The future of American hydropower

American Municipal Power has been powering up existing hydro facilities on the Ohio River.

Smithland project.

Cannelton project.

In 2007, American Municipal Power (AMP), a nonprofit energy provider in the US, began initial investigations into further diversification of its energy portfolio. Understanding the changing energy and environmental regulations across the country, AMP sought to ensure its energy grid could balance their various forms of power while being nimble enough to adjust to future forces. Its leadership turned to hydropower, the most prevalent, long-term renewable energy option.

Taking advantage of existing infrastructure

The Ohio River starts in the northeast of the US in Pennsylvania and flows southwest feeding into the Mississippi River, the largest of tributaries. It is the second busiest river, responsible for a great deal of trade and transportation throughout the region. Built along the river is a series of dams and locks operated by the US Army Corps of Engineers. These were created to help navigation along the river and attenuate flooding of the waterway.

Modelled after the Belleville hydroelectric project on the Ohio River, the four hydropower projects that would be built by AMP would take advantage of this existing infrastructure and locate the powerhouses at existing dam sites to add 309MW of renewable, clean power to the region – enough to power 150,000 homes annually and representing 72% of the current hydropower construction in the US. The US Department of Energy has recognised this concept of hydroelectric development as the greatest potential for future hydropower but sadly, only 3% of the dams in the US are currently power producing dams. Over 300 sites, largely located across the Midwest region, have been identified as locations that could contribute a combined 8GW of new hydropower.

Major Features of the Cannelton, Meldahl, Smithland, and Willow Island Hydroelectric Projects

Project	State	USACE District/ Division	FERC Regional Office	Number of units	Max. Head, ft.	Power, MW	Average Annual Energy, GWh
Willow Island	West Virginia	Huntington/Ohio River	New York	Two	20	35	195
Meldahl	Kentucky	Huntington/Ohio River	Chicago	Three	30	105	522
Cannelton	Kentucky	Louisville/Ohio River	Chicago	Three	25	84	390
Smithland	Kentucky	Louisville/Ohio River	Chicago	Three	22	72	350

Meldahl project.

Four powerhouses at once

AMP's decision to build all four projects at once was made for a series of reasons but was primarily driven by the need for clean reliable power and the potential cost savings of simultaneous development. The ambitious endeavor was made possible through the implementation of standardised designs, which enabled cost savings throughout the project and maximised efforts among more than 50 contractors and suppliers. The result was both minimised risks and costs as well as the implantation of robust and proven designs for one of the country's largest new hydroelectric developments.

The hydroelectric projects are similar in many ways. The new reinforced concrete powerhouses will be constructed in the abutments of the locks and dam structures on the opposite side of the river from the locks. Water will be supplied to the powerhouses through open headrace channels excavated through the existing river banks in the upstream pools and will be discharged back to the downstream pools through excavated tailrace channels in the existing river banks. The projects will use the head differential created by the locks and dams along with the flows in the river to produce power and are all designed to:

- Minimise impacts on navigation.
- Minimise impacts of flooding.
- Minimise maintenance requirements.
- Maximise energy output.
- Generate power for many years.

The major features of each project are discussed below and are summarised in the table above for easy comparison. All projects are located on the left bank of the existing locks and dam and will utilise horizontal bulb type units with 7.7m diameter runners.

Addressing the licensing issues

MWH was brought in early in the process to deal with the complex licensing requirements that exist within the US. New hydropower construction involves licensing from both the state and federal governments, which, if not done correctly, can hold up a project for years. To deal with the complex issues at stake, AMP and MWH developed a strong relationship with leadership at the Federal Energy Regulatory Commission (FERC) and the US Army Corps of Engineers (USACE). This relationship, coupled with AMP's proactive and engaging licensing approach, was instrumental in moving the projects forward.

Adding to the complexity of the licensing process was the need for achieving USACE Section 408 approval. While this process was not new within the USACE, the approval had

Views of the Willow Island project.

never been required on new hydropower developments before. This created a complex and often unclear regulatory path, even to the regulators, but the team's knowledge, relationships, and perseverance were up to the challenge. With MWH's support, AMP successfully navigated the very difficult and challenging permitting and licensing process, helping to highlight the need for regulatory reform and improved processes for future hydropower development.

The projects

While each of the projects is similar and AMP is able to capitalise on the savings resulting from simultaneous development of the four projects, each site has specific technical challenges. Geotechnical conditions vary greatly from site to site as do hydrologic conditions and site constraints leading to unique design solutions being implemented at each site.

The Willow Island hydroelectric project is located on the West Virginia shore of the Ohio River adjacent to the existing Willow Island Locks and Dam, about 161.7 river miles below Point Bridge, Pittsburgh, PA and consists of a landside closure structure constructed out of hardfill (roller compacted soil-cement) capped with reinforced concrete and a riverside closure structure constructed out of conventional concrete. The powerhouses and closure structures are founded on rock.

The Meldahl hydroelectric project is located on the Kentucky shore of the Ohio River adjacent to the existing Captain Anthony Meldahl Locks and Dam, approximately 275 river miles downstream of Willow Island plant. The powerhouse and closure structures for the Meldahl project are similar to the Willow Island project though they are much larger structures due to the head at the site and plant size.

The Cannelton hydroelectric project is located in Hawesville, Kentucky adjacent to the existing Cannelton Locks and Dam on the Ohio River. Smithland hydroelectric project is located downstream of Cannelton adjacent to the existing Smithland Locks and Dam on the Kentucky side, about 62.5 river miles upstream of the confluence of the Ohio and Mississippi Rivers. The powerhouses and closure structures for these two projects are founded on alluvial deposits, and consist of both landside and a riverside closure structures constructed out of hardfill.

Future of hydropower

Hydropower is increasing in importance as a major clean energy solution and is a requisite part of long-term, sustainable energy infrastructure. In fact, the largest source of renewable energy in the US is hydropower. It accounts for 17% of the total power yet new construction has been limited in large part because of regulatory and financial issues. AMP's success however, has become a symbol of the future of hydropower in the US. Built to last, the Ohio River hydropower plants will help AMP and its participating member communities enjoy low-cost, reliable power for generations to come thanks to a renewed river resource.

Author information

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