

Can Alternative Water Supplies Effectively Support Power Generation?

Technical Brief — Environmental Sciences: Water and Ecosystems, Energy & Environment, Water Availability and Resource Risk Management

Electric power facilities are often impacted by water scarcity and water quality-related issues. Local conditions related to drought and increased competition contribute to water scarcity. Water quality challenges arise from basic problems with low quality source waters and concerns about receiving water impacts and environmental regulations. As they adapt to local conditions, many electric power facilities have identified and used alternative water supplies for decades, with alternative sources meeting primary or backup supply needs. Options for alternative source types are varied and include treated municipal wastewater effluent, industrial effluent, produced water from oil and gas production, mine pool water, agricultural runoff, stormwater, or brackish inland water. In some regions, interbasin transfers of water serve as an alternative to a local freshwater supply.

Electric power facilities have successfully used alternative water supplies for decades to meet primary or backup supply needs. A set of 17 case studies describe drivers for alternative water supply use, benefits, challenges, lessons learned and other site-specific findings.

EPRI investigated eight different alternative water supply types through development of 17 diverse case studies (EPRI, 2017). The compiled case studies highlight not only the drivers and benefits, but also costs, challenges and lessons learned to pave the way for other facilities considering an alternative supply. This study was developed as a resource for electric



power companies considering the use of an alternative water supply to address freshwater requirements. Results may also inform suppliers of alternative water sources by helping them understand the challenges and needs of electric facilities.

Study Approach

Case studies were developed by interviewing water management experts at each facility. Interview questions focused on risks, challenges and benefits of alternative water supplies, including:

- Drivers for implementation;
- Alternative supply reliability considerations;
- Requirements for the quality of the source water and treatment options;
- Infrastructure needed for implementation;
- Costs for fees to the water supplier, infrastructure, transportation, additional treatment, and O&M;
- Benefits to both the electric power facility and water supplier such as supply reliability, regulatory relief, or reputational risk reduction; and
- Technical, operational, economic, environmental, or political challenges.

High-level summaries of a selected of case studies are included in this brief.

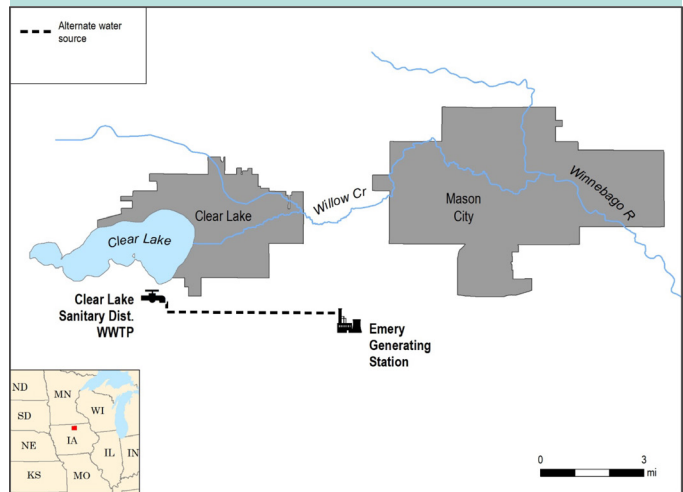
A literature review of past research identified and characterized alternative water supply types being used or considered for use by electric power facilities. The study provides a summary of relevant, past technical reports from EPRI, national laboratories, and other researchers focused on the topic of alternative water supply use in general as well as specific types of alternative supplies.

A list of electric power facilities using alternative water supplies was tabulated to characterize the prevalence of alternative water supply use and identify candidate case study facilities. The end result was a catalog of over 100 facilities located in 25 states using a diversity of alternative water sources (EPRI, 2017). The catalog captures a wide geography of facilities that currently use, previously used, or considered using alternative water supplies. Reclaimed municipal effluent was the most common alternative supply catalogued (68%), followed by brackish/saline inland water (8%) and mine pool water (8%). Sixty percent of the catalogued facilities using reclaimed municipal effluent are located in Florida, Texas and California. The catalog includes both successful examples and failed attempts to implement alternative water sources. The catalogued facilities were reviewed to identify a subset 17 facilities to target for more thorough case study development.

MUNICIPAL EFFLUENT

Emery Generating Station, Iowa

Emery (602 MW NGCC) has used ~1 MGD of municipal effluent from a nearby sanitation district for cooling tower makeup water since it began operation in 2004. The use of municipal effluent was driven by restrictions on groundwater in the area and a lack of other viable surface water supplies. Municipal effluent comprises 40% of Emery's water needs and is blended with groundwater before use. Reputational benefits have been noted from the water use, with only minor challenges occurring from the quality of the water.



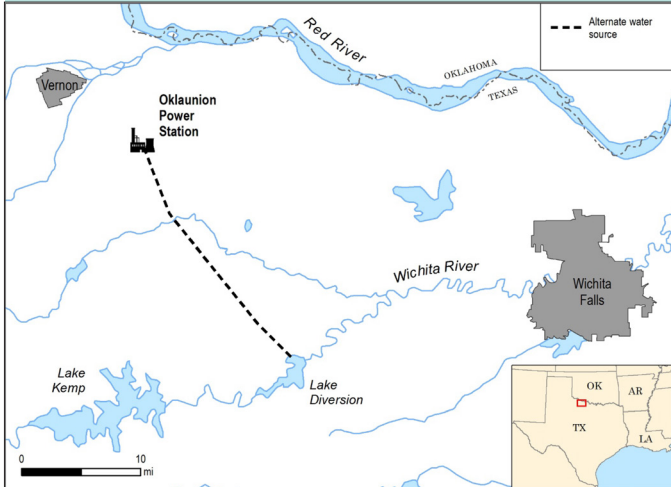
Key Findings from Case Studies

The case studies illustrated that a variety of alternative water supply types can provide a reliable source of sufficient quality water to facilities, reducing water-related risks, and in some cases providing regulatory and reputational benefits. Key findings include:

BRACKISH INLAND WATER

Oklauion Power Station, Texas

Oklauion (692 MW Coal) has used brackish surface water as its primary water source for 30 years without significant challenges. Some challenges have occurred with low cycles of concentration from poor water quality during droughts. Still, this source has been reliable and cost-effective in a region where traditional freshwater sources are not readily available and water rights can be an issue during times of drought.



Some alternative supplies are more promising than others. Treated municipal effluent was the most common supply type identified and is the most promising due to quantity and quality reliability. Brackish inland water, stormwater, mine pool water, agricultural runoff, and inter-basin transfer are also being successfully used. Stormwater and agricultural runoff have challenges related to variable quantity and quality, but may be viable alternatives when there is a water quality-related driver (e.g., regulatory, financial or reputational incentives to reuse of degraded rather than discharge to vulnerable receiving waters). Mine pool water, brackish water and industrial effluent have variable water quality and require treatment; however careful planning, well-defined agreements, and a backup source can support successful use of these sources. Interbasin transfers and produced water appear to be the least promising supplies for the future.

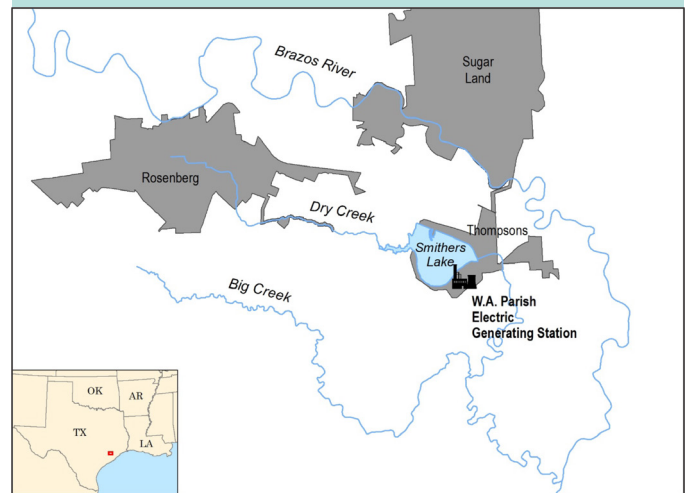
Electric power facilities have used alternative water supplies for decades. Case studies demonstrated that alternative supplies can be a reliable and cost-effective option, supporting a range of uses. Neither poor source water quality nor the need for long range pipeline transport precludes successful implementation. Alternative water supplies are successfully being used to meet a variety of plant needs (e.g., cooling, process water) and may provide 100% of the facility's supply needs or be blended with other water sources prior to use.

Alternative supply use requires a strong driver. In the case studies, the most common drivers were a lack of a traditional freshwater supply and/or water quality-related constraints. Reputational reasons were not identified as a strong driver in any of the case studies. In some cases, the lack of a driver and high costs for conveyance and treatment prohibited implementation of an alternative water supply in place of a traditional freshwater source.

STORMWATER

Parish Electric Generating Station, Texas

Parish (3,724 MW Natural Gas & Coal) uses a mix of surface water, stormwater runoff, coal pile runoff, and reclaimed sanitary effluent as makeup water for the plant's man-made cooling lake and cooling tower makeup water. Stormwater provides supplemental flow into the cooling lake and accounts for approximately 10-12% of the water entering the lake. Alternative water use at Parish has provided cost savings, improved cycles of concentration, and upstream and downstream benefits.



Benefits of alternative water supply use are varied. Alternative water supply use in water scarce areas has allowed plants to be sited in a preferred location. Alternative supply use has also provided regulatory, quality-related benefits to the water supplier, and quantity and quality benefits to the electric power facility. In many examples, facilities realized additional benefits beyond those directly related to the primary driver. Additional benefits were most commonly related to reputation and water quality, although cost and regulatory benefits were also noted.

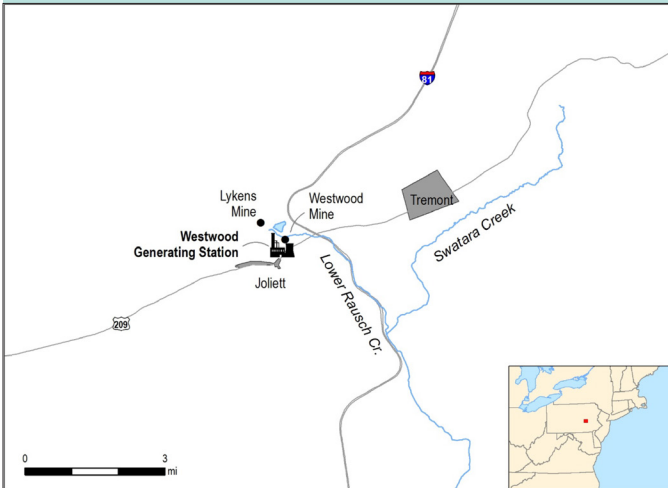
Successful implementation requires good planning, defined conditions, and backup supplies. Common factors for successful use of alternative supplies were good planning, establishment of well-defined conditions with the water supplier, and the availability of backup supplies. Facilities that rushed the process of using an alternative supply experienced greater challenges and costs.

Quality is the biggest challenge but can be overcome. Water quality-related issues were the most commonly identified challenge of alternative supply use, but case studies demonstrated that these challenges are manageable. Additional treatment is typically needed, regardless of the water source.

MINE POOL WATER

Westwood Generating Station, Pennsylvania

Westwood (30 MW Coal Refuse) uses mine pool water as a primary water source (cooling tower makeup, boiler makeup, and fire protection). Westwood was constructed on the site of a closed coal mine in 1988 to assist in the reclamation process and use the coal mining refuse as a fuel source. Mine pool water provides the plant with a reliable, low cost water source of adequate quality. External benefits include reducing the potential for acidic mine pool water to contaminate nearby surface and groundwater sources. Potential quantity issues arise during dry periods, when the rate of recharge of the mine pool is slower, which is why a second mine pool, which has poorer water quality and requires more treatment, is reserved as a backup source.



Looking Forward

Although treated municipal effluent is the most commonly used alternative supply type for electric power facilities, only between 1 and 10% of U.S. wastewater is currently being recycled. In spite of a general trend of decreasing wastewater effluent flows resulting from water conservation activities, there is little competition for this supply type. Looking forward, wastewater treatment plants are increasingly becoming water resource recovery facilities, which can provide “the right water for the right use.” The abundance of supply and the evolution of wastewater treatment plants into water resource recovery facilities may make municipal effluent an increasingly viable alternative source for electric power facilities and others in the future. The case studies highlighted in this study demonstrate several successful examples of effluent reuse at electric power facilities. This study may serve as a useful resource to educate electric power facilities and alternative water supply entities to help them better understand the benefits, address the challenges and effectively implement use of an alternative water supply.

EPRI, 2017. *Alternative Water Supplies for Power Generation*. EPRI Report 3002012045

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