Energy Management Success in Five Utah Public Water Systems

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Abstract

As water utilities seek to improve their energy management practices, examples from successful cases are needed. Based on published documents and firsthand knowledge, this article summarizes energy management activities and results from five Utah water systems: Jordan Valley Water, Logan, Mountain Regional Water, North Salt Lake, and Riverton. The activities occurred from 2010 to 2018—a concentrated period of water-focused energy management efforts in the state—and the energy or cost savings ranged from 19% to 38% of each system’s annual baseline. The savings came from diverse operational and capital practices, including source selection, valve adjustments, time-of-use power rates, pressure zone reconfiguration, pump scheduling, and new facilities. Managerial practices like energy goals, policies, and teams were also influential. New case studies are welcomed as water utilities adjust to the ongoing energy transition.

Introduction

Public drinking water systems are major energy users, and energy is one of a water system’s top operating costs (EPA 2023; Jones and Sowby 2014; Sowby 2018a). Guidance on managing this energy use has come from federal governments, state governments, professional associations, non-profit organizations, and academia, especially in the last 25 years.

As more water systems seek to improve their energy management practices, examples from successful cases are in high demand. Unlike academic research and guidebooks, case studies “by practitioners, for practitioners” are far more impactful in advancing ideas into practice. Case studies are effective because they offer integrated insight into a real working situation rather than often theoretical and fragmented views that come from other types of research (Crowe et al. 2011; Rashid et al. 2019). However, case studies of successful energy management in the water industry seem to be sparse.

About 10 years ago in Utah there was a period of concentrated activity in this very field. The author was professionally involved in some of it. Many water systems participated in energy management programs sponsored by power companies, state agencies, or themselves, and some of the efforts were later documented. This is a rich subspace from which to gather case studies.

This article summarizes energy management activities and results from Utah water systems. The cases are presented below, followed by general discussion.

Case Studies

Five relevant cases were found: Jordan Valley Water, Logan, Mountain Regional Water, North Salt Lake, and Riverton. The systems are located in northern Utah, USA. Their energy management activities occurred between 2010 and 2018 and their documentation was published between 2016 and 2019. While many other Utah water utilities were doing similar things at the time, these are the few documented cases. Table 1 presents some highlights and each case is summarized below.
Table 1: Case Study Highlights

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*Jordan Valley Water*

One of the largest water suppliers in Utah, Jordan Valley Water Conservancy District serves the Salt Lake City area. Operating primarily as a wholesaler with significant surface water and groundwater resources, the district had been tracking energy for some time. In 2014 the district began a strategic energy management program with Rocky Mountain Power as documented by Sowby et al. (2017). Rocky Mountain Power provided financial incentives for energy savings and paid for consultants Cascade Energy and Hansen, Allen & Luce, who provided custom modeling tools and engineering support.

To start, the district formed a multidisciplinary in-house energy team and focused on developing a strong culture of energy management at all levels of the district. The cultural shift toward viewing energy management as part of the district’s mission to “provide a sustainable water supply” was instrumental in the program’s success.

Instead of asking, “How can we make this pump or building more energy efficient?” the team asked the deeper question, “How can we provide an energy-efficient water supply?” The team analyzed the district’s water source portfolio alongside each facility’s energy footprint and decided to prioritize surface water and low-energy-intensity wells. They also worked out favorable irrigation exchanges, adjusted pressure-reducing valves, and coordinated timing of water deliveries with their member agencies all to reduce energy demand. The effective practices were ultimately codified in an energy management guideline (Sowby 2018b).

Over two years, the district cut its energy use by 19%. “We’re saving over 18 million kilowatt-hours per year,” said former district general manager Richard Bay in a promotional video, also noting an $800,000 annual decrease in operating costs (RMP 2019). The changes from the program continue to help the district operate more sustainably today.
Logan City

At the time Jones et al. (2015) reported on the case, Logan City’s water system served about 50,000 people and its largest pressure zone had expanded and become unsustainable. Mainline breaks, customer complaints, and extreme pressures were plaguing water crews daily, and energy costs were running high.

The city had suggested a multimillion-dollar pipeline to bring in more water, but hydraulic modeling by Hansen, Allen & Luce showed that it would not solve the problem. Instead, the city decided to divide the pressure zone in two. The upper zone would continue to be served by a spring from above, and the lower zone would be served by two existing wells that would be retrofitted with lower-head pumps. Pressures in the lower zone would be moderated and leaks would be less severe.

The team soon realized that lowering the head on the wells would cause immediate and permanent energy savings—a possible way to fund the project since the city had its own power utility. Logan self-funded the well improvements and paid itself back with the energy savings.

From 2013 to 2014, mainline breaks declined from 212 to 128 (a 40% reduction), water production declined from 13.2 MGD to 11.0 MGD (even though end use remained about the same), and energy cost declined from $428,000 to $291,000, a 32% reduction. Customer complaints fell with better pressure management and crews shifted to preventive instead of reactive repairs.

The progress continued in subsequent years. “After installing several PRVs [pressure-reducing valves], rebuilding two culinary wells, and creating a new pressure zone in 2013, the City of Logan experienced significant water and energy savings along with an almost 50% reduction in mainline breaks,” Paul Lindhardt, Logan’s water division manager, said (HAL 2017). “The savings and operational efficiency have continued each year since 2013. If the current savings continue, the payback period for this project will be shorter than projected.”

Mountain Regional Water

Mountain Regional Water Special Service District serves portions of Summit County. The district has been tracking energy use in 2007 (DEQ 2016; Evans 2018). Recognizing energy as a significant and rising operating cost, in 2010 the district began deliberately managing its operations with energy in mind and later involved partners and Rocky Mountain Power.

According to Doug Evans, the district’s energy manager, key strategies were to pump water during off-peak times when power is cheaper (using equalization storage to buffer water supply and demand) and to pump “long and low” with variable-frequency drives and jockey pumps to avoid demand charges for high power use. Because Rocky Mountain Power offers a few different rate schedules depending on electric load and time of day, the district tested some options and selected the ones that best matched how each facility could operate and save money. The default rate was not always the best option.

The district also implemented a regular water audit and leak repair program. Because water loss is energy loss when it has been pumped, controlling leaks is a clear strategy to save energy. Likewise, the district ensured that PRVs were not allowing pumped water to recirculate back to lower pressure zones.

The result was a considerable decrease in energy costs in the following years. By 2012, the district had saved $300,000 per year even when Rock Mountain Power had increased its rates; by 2015, the savings increased to $392,000 per year, mostly attributed to the power schedules (DEQ 2016a), and in 2018, the savings reached $443,000 per year. A longer trend from 2007 to 2018 shows increasing water production but decreasing energy cost per unit volume (Evans 2018). The efforts have saved about $2.8 million from 2010 to 2018.
City of North Salt Lake

A city of about 21,000 people situated on a mountainside with 18 pressure zones, 38 PRVs, and 1,300 ft of elevation difference, North Salt Lake was struggling to pump water efficiently and racking up expensive power bills, especially in the summer. The city ultimately completed an energy management program with Rocky Mountain Power, Cascade Energy, and Hansen, Allen & Luce from 2014 to 2016 (Sowby et al. 2019).

During the program, the team identified PRVs as a major opportunity. The city’s water sources were at low elevation, and all water had to be pumped uphill. But the existing PRV setpoints were allowing pumped water to fall back down the mountain, sometimes through multiple pressure zones, even returning to the same pump station where it started. Hydraulic modeling helped identify proper setpoints that would keep pumped water in the intended zones and eliminate pumping in circles. The operators adjusted the valves accordingly and made a plan to monitor them going forward. The city also found opportunities to use off-peak electricity and prioritize wells according to energy footprints.

The results amounted to 3.7 million kWh of avoided energy, which constitutes 25% of the water system’s baseline energy use over a three-year period. The cost savings are similar, amounting to 22% of the baseline cost. The city also observed improved pressures and fewer customer complaints.

“We were able to educate our staff about energy usage and how to save energy within our water system,” Sam Christiansen, the city’s public works operations manager at the time, told the consultants (HAL 2018). “We went from not only thinking about meeting the water demand, but to how we can meet the demand in the most efficient manner.” The changes implemented in the program will continue to save energy and money every year.

Riverton City

In Salt Lake County, Riverton City serves both drinking water and secondary (irrigation) water to its customers. At the time of reporting (DEQ 2016b) the city had 9,700 secondary connections. The separate systems allow higher-quality groundwater sources to be dedicated to drinking water rather than being overdrawn for irrigation. Canals and other lower-quality and less-reliable sources serve the secondary system, which conserves better water for the drinking water system.

The same conservation mindset applies to energy and which water facilities the city uses to serve customers efficiently. Riverton City constructed a new irrigation pump station and pond to provide a more direct route from source to demand in one area of the city. The previous route was a higher lift from a lower canal and passed through several PRVs, making it hydraulically longer. The new route took water from a higher canal reduced the energy cost by 70% or $42,000 per year for the same water volume.

Besides the new pump station, Riverton also reduced leaks, leveraged storage ponds to reduce peak pumping, monitored PRVs to avoid repumping, and ran pumps slower and longer to avoid demand charges. Later, the city used hydraulic modeling to avoid further capital and energy expenses in solving a water quality issue (Shurtz et al. 2017).

Discussion and Conclusion

The years in which these cases occurred, roughly 2010 to 2018, constitute a turning point for water system energy management in the state. Up until then, water systems were not particularly motivated to save energy, and even if they wanted to, they were largely on their own: Utah power companies did not understand how water utilities used energy and did not offer custom incentives for them; engineers had received little training on energy management; and water regulators were unsure of
their role in how to mandate or encourage energy efficiency. But then at this time and place, water system interest, power company incentives, engineering expertise, and regulatory support (DEQ 2014) all converged as a natural result of market needs. Dozens of other Utah water utilities tried their first deliberate energy management activities during this period (although their cases are not formally documented) and the topic continues to be addressed today. The level of initial engagement, concentrated during those few years, seems to have elevated the importance of energy management for Utah’s water industry.

In the five cases reviewed here, there was no single path to energy savings. Rather, the results came from practices as diverse as the systems themselves. Some were capital, requiring a significant investment to reconfigure pressure zones and install new pump equipment as Logan did. But most were operational: selecting water sources, adjusting valves, choosing when to operate pumps, and changing time-of-use power rates. Sometimes money is needed to secure new assets in order for the system to run more efficiently, but sometimes little or no money is needed to optimize existing assets to the same effect. Still others showed success with less technical and more managerial practices: those focused on building organizational capacity for energy management, including forming teams, establishing policies, and setting goals around energy management. Even the small sample of five cases shows the potential of capital, operational, and managerial approaches and implies a multitude of opportunities for almost any water system.

While the case studies are insightful, the target is moving. Water systems are facing new energy management hurdles today: renewable energy, dynamic pricing, flexible loads, and micro-grids, all of which are features of the ongoing energy transition (Patel et al. 2022; Sowby 2023). The industry especially needs case studies from water utilities who are navigating these challenges. As AWWA (2016) said, a water utility “should publish articles in water industry journals or give presentations at water association events …. The lessons learned may help other utilities. Additionally, sharing energy performance information [lets others know about the utility’s] ongoing commitment to energy efficiency and sustainability.” With such work, a body of practical knowledge will eventually build up that will help everyone in the water industry better manage energy for the benefit of their utilities, their customers, and the environment.

References


Evans, D. “2018 water and energy report.” Mountain Regional Water Special Service District. 


https://doi.org/10.1002/awwa.1939.


https://doi.org/10.5991/OPF.2017.43.0038.


https://doi.org/10.1061/(ASCE)WR.1943-5452.0001006.

