Water Treatment Energy Management

In this case study we examine how a large water treatment facility implemented a monitoring and control system using cost-effective cloud-based tools to measure, analyze and manage their energy consumption.

Summary

Water pumping, treatment and conveyance are among the largest energy and cost outlays for many local and regional municipalities. Electricity time-of-use rates and peak pricing tariffs are driving those costs even higher. This paper describes how Monterey Regional Water Pollution Control Agency (MRWPCA) implemented a process data monitoring and control solution in order to analyze and optimize energy use, reduce deployment costs and save operational expenses.

The Water - Energy Nexus

Water and wastewater industries rely heavily on grid-supplied electrical energy to power equipment for conveyance and treatment of water. Large pumps and motorized processes handling millions of gallons of
water per day are among the largest energy expenses for many municipalities. The energy demands of water and wastewater treatment facilities comprise over 30% of many municipalities’ energy budgets.¹

These facilities can offer unique opportunities to improve efficiency, manage loads and lower costs by fine-tuning timing of operations relative to each other and to the time of day. However, most operators lack the tools to monitor, analyze and adjust plant processes’ energy usage with sufficient granularity to reduce energy-related costs. Traditional building energy management systems are often relatively complex and expensive to deploy to provide sub-metered data for plant processes.

The advent of cloud-based energy monitoring and control systems, like the one prepared for the Monterey Regional Water Pollution Control Agency (MRWPCA), allows plant operators to leverage web-based technology to quickly gather and analyze extensive real-time operating data at a relatively low cost, enabling reduced energy costs by effectively monitoring and managing critical loads often in conjunction with pre-existing plant-wide supervisory control and data acquisition (SCADA) systems.

The MRWPCA Facility

The Monterey Regional Water Pollution Control Agency (MRWPCA) operates a regional wastewater treatment plant that is the world’s largest water recycling facility designed for raw food crop irrigation. MRWPCA operates 25 pumping stations and a main plant that together treat 20 million gallons of wastewater per day².

MRWPCA’s tertiary treatment plant, consisting of sand filters and related pumps and equipment, draws its power from Pacific Gas and Electric (PG&E). In 2011 Solar City installed a 1.12 Megawatt solar system to augment the plant’s PG&E power source. One of the largest solar power installations in Monterey County, it significantly reduced MRWPCA’s carbon footprint.³

² MRWPCA web site, http://www.mrwpca.org
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**Project Approach**

Engineers determined that MRWPCA has the potential for additional peak power reductions by monitoring and controlling “time of use” (TOU) power requirements at the plant. Savings would come in part from qualifying for alternative PG&E rate structures, leveraging the use of the solar installation and carefully controlling monthly peak power demand. The plant set a goal to maintain peak loads below 500 kW to qualify for a lower electricity tariff that would minimize monthly costs.

These energy management goals required the ability to closely monitor and analyze a massive amount of new real-time data from twenty individual pumps and plant processes, with the ability to control discretionary lighting loads. In order to facilitate these goals, MRWPCA chose and installed a new energy and demand monitoring system.

The MRWPCA energy monitoring and demand management system was developed through a cooperative effort with MC Engineering, Inc., a California-based engineering consulting firm, and Candi Controls, which provides a cloud-based platform for machine-to-machine (M2M) data monitoring and control. MC Engineering specializes in identifying efficiency gains for water and wastewater utilities by leveraging technology and real-time data to develop projects that are funded from resulting efficiency gains and related savings. Candi Controls specializes in cross-platform, device- and protocol-agnostic communications. The company also has a suite of “PowerTools” user-interface templates which leverage its M2M platform, one of which was used to cost-effectively create a unique MRWPCA mobile and browser app.

Water treatment systems analysts began the project by obtaining in-depth knowledge of plant operations, conducting a facility audit and targeting strategic loads for monitoring. Low-cost energy monitors were then installed at strategic locations throughout the plant to meter instantaneous power usage. The data is encrypted and streamed via a local network to a hosted cloud service for archiving and processing. Additional network-based control switches were installed to manage industrial lighting during high-use periods if required to help keep peak load below the threshold goal.

By monitoring large loads that have some degree of operator discretionary control, an optimal time-of-use strategy and target usage peak was to be maintained. The data and controls are managed through a software Application Programmer Interface (API) and presented to operators through a secure web-based graphical interface on laptops, computer screens and portable Apple iPad tablets. The app includes a Facility Overview page to provide staff with at-a-glance real time power data (below).

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3 Solar City – MRWPCA Press Release, 2/15/2011
Site overview page, operator app for iPad and browser

Operators can also view real-time and historical loads as peak demand or as the net power from the grid from within their app. The following screen shot presents a typical historical usage interface that shows all plant processes, or individual processes as selected, for plant staff and analysts to monitor in real time.
Data Management and Reports

The system archives real-time energy usage and instantaneous demand data at user-defined intervals and stores it on a remote server via an encrypted connection. Over 100,000 data records per day are currently streamed from MRWPCA’s on-site devices to Candi Controls’ Cloud Service, requiring up to 300 Gigabytes of data records management per year for the site. Password-protected reporting tools are available to authorized users for retrieving detailed historical data. Various reports can be generated at the click of a mouse, including instantaneous, fifteen minute, and hourly average demands for a selected interval, and for one or more monitored processes.

For large and multi-site utilities like MRWPCA, this enterprise-wide solution allows energy managers to collect data from a number of facilities through one centralized interface. Used in conjunction with interval billing data typically available from the electric utility, the load data can be used to shift loads, set load targets, provide a baseline from which energy savings can be determined for each load center, and a variety of other uses that once required extensive efforts to collect and analyze data. Data can be downloaded from the Cloud Services Reports tool, and is available in several formats, including CSV for Excel spreadsheets, for use in additional analysis.
Process Control

One of the unique features of the system is its ability to control loads in a facility through a variety of different device protocols. Where traditional energy management systems may be limited to specific architectures and require custom programming, the cloud-based platform provides flexibility by automatically assigning the required protocol drivers to an on-site server to enable control of strategic loads. The process of adding a new control point and protocol to an existing operator user interface (UI) takes about 60 seconds. Real-time control signal latency is typically less than 200 milliseconds.

Controllable loads may include lighting, HVAC, and large process-related devices that are traditionally managed by supervisory control and data acquisition (SCADA). End-users are afforded the ability to quickly add and edit devices using an on-line tool-box of features in the web-based administrator interface. This includes a library of drivers for control and monitoring of hundreds of different off-the-shelf products, with tools designed to easily accommodate modular expansion of device count and features. The following image presents some of the basic lighting controls that were added to the MRWPCA system with a drag-and-drop web-based interface, allowing plant staff to utilize this unique interface capability.

Direct load control from within operator interface, via iPad and browser
Industry Trends and Opportunities

As the smart grid evolves, data-driven cloud-based solutions will become increasingly important for improving utility operations. As major investor-owned utilities in California investigate demand-side power management as an alternative to investing in construction of new power generation assets, the potential energy impact is huge: California water and wastewater facilities spend more than $500 million each year on energy costs, which constitutes approximately 5 percent of all energy usage in California.¹⁴

Electricity providers are transitioning now to peak day pricing, and the associated high hourly rates during peak day events will result in higher energy bills for many water utilities operating under time-of-use tariffs. By relying on real-time data and leveraging low cost power monitors and cloud-based monitoring and control, water and wastewater utilities are uniquely positioned to control their energy use and develop a synergistic partnership with their electricity provider. Many electric utilities offer incentives that will fund both energy audits and the installation of technologies that are proven to reduce peak demands and energy usage. While new smart meters are providing end-users with more information on historical usage, they often lack the granularity needed to gather and analyze system-wide data, or manage multiple loads on a real-time basis. The integrated solution provided to MRWPCA by MC Engineering and Candi Controls is expected to have significant positive impact on the utility's bottom-line operating costs.

By Steve Raschke
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¹⁴ California Energy Commission report on Energy and Water/Wastewater Efficiency
About MRWPCA:

MRWPCA was formed as a joint powers public entity in 1972 to provide regional wastewater collection, treatment and recycling for Pacific Grove, Monterey, Del Rey Oaks, Seaside, Sand City, the former Fort Ord, Castroville, Moss Landing, Boronda, Salinas, Marina and unincorporated areas of northern Monterey County. The recycled water is used for food crop irrigation in the northern Salinas Valley. Reducing the need to pump water from wells is part of the regional effort to slow seawater intrusion. MRWPCA serves approximately 250,000 people. Visit [www.mrwPCA.org](http://www.mrwPCA.org).

About MCE Engineering:

MCE Engineering leverages over 20 years’ experience serving the municipal water and wastewater industry, with related expertise in a variety of disciplines including energy, architecture, and transportation related design and construction. On the web at [www.mcarey-eng.com](http://www.mcarey-eng.com).

About Candi Controls:

Candi Controls, Inc. enables cloud-based M2M integration for telecoms, utilities and manufacturers to the widest range of products and services for control, monitoring and data acquisition. Candi’s software platform connects enterprise data systems with hundreds of off-the-shelf devices, regardless of brand, price or protocol, and to mobile apps on any platform. Candi is used today for energy management, customer engagement and systems control by telcos, utilities, systems integrators and manufacturers in North America, Asia and Europe. For more information see [www.candicontrols.com](http://www.candicontrols.com).