The Water-Energy Nexus: Analyzing Energy Savings from Water Efficiency Programs in Moulton Niguel Water District

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OBJECTIVES

The objective of this project is to identify and quantify the impacts of different water efficiency programs on energy use and greenhouse gas (GHG) emissions. The project would consist of:

- Quantifying energy use and carbon intensity of water pumping operations over multiple timescales.
- Investigating opportunities offered by water efficiency programs for water savings, energy savings, cost savings, and emissions reductions.
- Developing a framework that can be applied to other municipalities.

SIGNIFICANCE

Water requires significant energy to move, treat, and heat. Water-related activities comprise 19% of California's overall energy use[1] and generate 10% of the state's GHG emissions.[2] The Electric Power Research Institute estimates that the energy use of water and wastewater municipalities will increase by 23% in 2020 from 2000 levels and by 63% in 2050.[3] The Congressional Research Service published a report in 2017 exploring opportunities and barriers for energy efficiency in water and wastewater municipalities.[3] Its findings highlighted the need for more research, usable and complete energy data, advanced technology, policies on integrated resource management, and outreach to and opportunities for end water-users.

Because the water and energy sectors are usually siloed, traditional legislation has separately addressed water and energy issues, rarely integrating policy. However, California has made strides to make that policy connection, such as with Senate Bill (SB) 1425.[4] This bill requires the California EPA to oversee a repository for voluntary reporting of GHG emissions from water-energy activities. The repository will be developed and managed by The Climate Registry.

Although the introduction of integrated state policy has begun, California's past bills for energy and water have set strong statewide goals separately. In 2006, California legislators passed Assembly Bill (AB) 32, California Global Warming Solutions Act, to create the state's GHG reduction program, also known as the Cap-and-Trade program. AB 32 required 2020 emission levels to be set to 1990 levels.[5] In 2016, SB 32 enacted more stringent levels and directed the California State Air Resources Board to reduce 2030 emission levels to 40 percent below the limit set in 1990.[6] Further understanding the codependency and efficiency potential between energy and water municipalities can aid in reaching the 2030 emission goals.

MNWD has focused much of their efforts on water efficiency and conservation, aiming not only to reduce water usage, but GHG emissions as well. However, the electricity required to operate their pumps and systems costs MNWD an average of $2 million annually.[7] By analyzing energy savings, MNWD has the opportunity to shift their costs towards other operational and maintenance needs, such as infrastructure, which is another grand challenge in the water sector.

BACKGROUND

MNWD has been collecting water and energy data since 2010 and 2015, respectively.[8] Data is collected through MNWD's 105 electric meters and 55,000 end-use water meters.[8] In an effort to better use water data, MNWD co-founded the California Data Collaborative in 2016. This collaborative created a network of water professionals that are committed to creating an industry that makes data-driven decisions through applied research and the creation of tools.[9]

In 2015, MNWD partnered with UC Riverside to evaluate and report on the impacts of MNWD's water conservation programs.[10] The analysis was comprised of three phases. The first phase involved identifying the motivations behind residential customers' participation in MNWD water conservation programs and overall water saving. Additionally, this phase assessed the impacts on MNWD's revenue, water demand, and its customers' water bills. The second phase evaluated MNWD customer awareness. A survey on program participation was conducted and analyzed, and the feasibility of adding new conservation programs was assessed. The third phase further evaluated potential actions based on the results of phases one and two.

Currently, MNWD is participating in a case study with UC Davis to reduce supply and demand imbalances on the California energy grid by optimizing the timing of water pumping operations.[11] Additionally, MNWD is working on a report that looks at collaborations between gas, electric, and water utilities on resource-efficiency programs.[8] The report will investigate these programs' successful components, barriers to productive collaboration, and potential next steps.

EQUITY

A key component of this project would be how to use cost savings from MNWD's efficiency programs to provide higher incentives for participation, such as through collaborations with other utilities. Higher incentives would increase the overall accessibility of these programs by lowering the initial capital that low-income participants would need to participate.

Besides saving participants money, these types of conservation programs are also a way to give agency to marginalized communities. They empower individuals to help the environment by reducing their own water and energy use, and fight climate change by mitigating GHG emissions.

Involving community organizations in this process can further increase ownership and agency, exemplified by the work done by the Los Angeles Water Conservation Council for the Los Angeles Department of Water and Power's Ultra-Low Flush Toilet Distribution Program.[12] Furthermore, a repeatable framework would allow less-wealthy municipalities to conduct similar investigations, valuable when they might not have the resources for extensive studies.

AVAILABLE DATA

Moulton Niguel is able to provide the following data through non-disclosure agreements:

- Residential monthly and hourly metered water use[a]
- Metered energy use by pump station
- Spatial and temporal data about pumping infrastructure and energy requirements
- Rebate participation data for residential and commercial customers
- Water conservation programs participation data for residential and commercial customers
- Existing Southern California Edison and San Diego Gas & Electric energy rate structure and information on potential future energy rate structures.

APPROACH

- With water and energy usage data, evaluate existing energy savings from water efficiency programs
- Review past studies of water efficiency programs and electric usage
- Based off of existing operations, determine inefficiencies in the water system for water and energy use savings
- Determine water pumping energy use relative to minimum operational needs and how energy use is distributed in time and space
- Analyze the amount of energy that could be reallocated to take advantage of better time of use rates and reduce carbon emissions
- Assess the potential for augmenting this reallocation by expanding MNWD's water efficiency programs
- Fit the above approaches into a repeatable framework

DELIVERABLES

Beyond the required deliverables, a software tool and/or an additional section in the final report will be provided for the repeatable framework.

INTERNSHIP

MNWD is able to sponsor two, part-time (maximum 27 hours per week) paid internships over the summer for a duration of 10-12 weeks. The start and end date of the internship would be June/July and August/September, respectively. The pay range for interns is currently $13-16 per hour.

[a] Currently, 20 percent of water meters monitor usage hourly. Over the next two years, MNWD plans to expand to monitor 100 percent of meters.

REFERENCES

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4. S.B. 1425, 2016 Pavley, 2016 Reg. Sess. (CA 2016).
5. A.B. 32, 2006 Nunez and Pavley, 2006 Reg. Sess. (CA 2006).
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7. “Moulton Niguel Tests New Ways to Save Money, Cut Energy Use.” (2017). Moulton Niguel Water District.
8. Atwater, Drew. (2020). [Personal Communication].
9. “The Future of Water Management.” (2020). California Data Collaborative.
10. Schwabe, Kurt et.al. “Analysis of Water Conservation Drivers for Effective Water Management.” (2015) University of California, Riverside- School of Public Policy.
11. Good, Robert. (2014). “Reducing Electricity Grid Imbalance through Energy Demand Management of Water Delivery Infrastructure.” University of California, Davis.
12. “Ultra-Low Flush Toilet Distribution Program.” (2020). Mono Lake Committee.

BUDGET

No additional funding is anticipated to complete the project. However, if beyond $1,300 is needed, Moulton Niguel Water District will consider the request and review the need for more funding.

CLIENT LETTER OF SUPPORT

(Please see attached)

moulton niguel water district

January 24, 2020

To: Bren School Group Project Committee

Subject: Client letter of support: "The Water-Energy Nexus: Analyzing Energy Savings from Water Efficiency Programs in Moulton Niguel Water District" (Proposal for a 2020-2021 Bren School Group Project)

The Moulton Niguel Water District is pleased to provide this letter of support for "The Water-Energy Nexus: Analyzing Energy Savings from Water Efficiency Programs in Moulton Niguel Water District" project. We are excited to have the opportunity to host up to two part-time interns as part of the project.

The internship will center on the objectives of the Group Project but will also provide the intern with an opportunity to develop professional skills, work on-site with District staff, understand the District's internal operations and water distribution systems in general. The Director of Finance & Water Resources will mentor the students on the embedded energy in the water system and a wide variety of other real-world skills. I have personally corresponded with Claudia Flores in developing the proposal and her knowledge of water systems and enthusiasm for the use of data to help solve key natural resources issues inspired my interest in the project.

The District has substantial experience in supporting academic and professional interns. The following are examples of two key intern positions:

- Data Science Interns- supports analysis of AMI hourly metered water usage data and collaborates with the District's data analytics group to learn real-world statistical and modeling skills at a water agency while interacting with top-water analytics talent through the California Data Collaborative
- Water Efficiency Interns- supports District water efficiency programs through engaging and educating customers as well as evaluating internal District sites' water use efficiency.

The District is eager to sponsor up to two half time Bren student summer interns who we would be happy to accommodate in our Aliso Viejo office. It will be our pleasure to provide data as needed, and/or to provide any other resources for the project that may be needed, to the best of our ability. Data that is in the District's possession will be made readily available to the team with a non-disclosure agreement due to the personally identifiable information required for the project. Data types include metered water usage, billing, meter information, energy usage data and information on water efficiency participation.

Much of the data required for the Group Project is protected but the District has experience working with research institutions and has a standard non-disclosure agreement that should suffice to engage in the work.

The District will consider additional funding on a case-by-case basis based on the project value added.

Sincerely,

Drew Atwater, Director of Finance & Water Resources