Addressing the Reliability, Financial, and Environmental Risks of Energy Management Strategies at Water Utilities

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ABSTRACT

This paper presents a framework and case studies developed to analyze the energy management options, their inherent risks, and risk mitigation strategies for suppliers of drinking water. Public health and safety, system reliability, and prudent cost management are all critically dependent on how well a water utility manages its energy demands and power supply options. Water often needs to be transported over long distances from source to tap, and when combined with the use of new treatment technologies, the embedded energy in every gallon of water delivered is increasing. Water utilities must manage their interface with the energy sector to manage the reliability risks associated with energy management options as energy costs increase.

The evaluation of energy management risks are formalized in this paper and a detailed case study presented to highlight the issues. For example, water utilities can shave costs and help manage energy costs by practicing demand management, but doing so may increase the probability that the water utility will incur some high costs and undesirable risks. The energy management options reviewed in this paper include: expanding the use of back up generation; use of solar power for peak energy production; improving pump efficiency and installing natural gas fired pumps; analysis of electric rate options; converting pressure reducing valves (PRV) to in-conduit turbines; optimizing the use of SCADA controls within the water distribution system; and developing additional water storage resources.

For each energy management strategy, the following risk analysis process was followed to identify risks associated with each strategy:

- *Risk Identification*. Identify what risks (reliability, environmental, and financial) are associated with each energy management strategy.
- *Risk Characterization*. Assess how large each risk might be, in terms of both the *probability* of occurrence and the types and levels of *consequences* associated with each risk.
- *Risk Assessment*. Evaluate options available to the utility for minimizing risks.
- *Risk Management*. Select a risk management option, based on the benefits and costs of the various options consistent with reliability priorities.
- *Implementation and Refinement*. Implement the risk management approaches selected, including monitoring and refinement of the strategies.
- *Risk Communication*. Communicate and defend the utility's risk management decisions to regulators, local political leaders, shareholders (if any), customers, and other stakeholders.

Introduction

The water-energy relationship is becoming increasingly better understood, but the means to achieve mutual efficiency in both the water and energy systems is less well understood. Water utilities face increasing energy demand due to more energy-intensive water treatment and increased demand for water (and thus energy) in growth areas. At the same time, energy utilities are faced with fuel price fluctuations and transmission constraint, along with load growth issues. Each system is affected by the decisions the other undertakes. Maintenance of reliability in the electrical system is crucial for water utilities. This is especially true in the arid West where water utilities often draw on their most expensive and energy intensive sources of water (e.g., those stores that are deepest, furthest away, or needing most treatment) at the very time when electricity is least reliable and most expensive – the summer months. Areas with apparently plentiful water also experience these same concerns, as water intensity generally increases in the summer months, at the time when grid stability is challenged by peak demand. The following summarizes some key factors that describe this relationship.

Energy costs are a large and growing fraction of operating expenses for water utilities. A recent American Water Works Association Research Foundation benchmarking study showed that energy costs require, on average, about 11% of operating budgets to be spent on energy (AwwaRF 2003). Energy costs tend to be a higher portion of operating costs in California, where average costs are 34% of total operating budgets (CEC 2005a). Given current trends, this energy demand is expected to double by 2015. In the U.S., water and wastewater utilities consume about 50,000 GWh, at a cost of over $4 billion annually (ACEEE 2005).

Typical energy use for drinking water supplies are shown in Table 1. Total electricity use is highly variable, depending on the location of supply, treatment methods required, and distribution geography.

Table 1. Typical Energy Use for Urban Drinking Water Supply

Use	Average energy use	Range of energy use
Conveyance	100 kWh/MG	0–10,000 kWh/MG
Treatment	250 kWh/MG	100–5,000 kWh/MG
Distribution	1,150 kWh/MG	0–1,200 kWh/MG
Sources: CEC 2005a, 2005d.		

Increasingly, energy utilities are investigating how to promote stability and resource efficiency in both the water and energy spheres. However to be successful in these programs, it is important to consider the fundamentally unique approach water utilities bring to the characterization and management of risks associated with energy management, both from a energy supply standpoint and how they manage its demand. This paper summarizes research that addresses this resource management question. The research was conducted in support of a recent major study for the American Water Works Association Research Foundation (AwwaRF): *Assessing the Risks and benefits of Energy Management Options for Drinking Water Utilities.*

Methodology

The AwwaRF approach brought together sponsoring water utilities from around the U.S. to help scope and provide input into the research. Each sponsoring water utility was then invited to review and critique the project approach and then meet to present their own energy management approach and information needs in planning an energy strategy for their organization. This working session was used to develop and frame the subsequent in depth case study research. By developing a line of inquiry that was initially based on the water utilities' business drivers, the investigators uncovered the choices and decision making strategies that led to the energy management approach the water utility has chosen.

Using this approach, the study team then investigated a variety of energy management strategies that might prove beneficial, and analyzed the risks associated with each strategy. The risks associated with energy management strategies can be categorized as:

- Reliability risks: in the case of water utilities, this refers to reliability of water supply (i.e., does the strategy impact the ability of the utility to deliver the quality and quantity of water to assure public health and safety?).
- Environmental risks: adverse impacts to the environment such as air pollution.
- Financial risk: incurring higher costs than necessary.

Tables 2 and 3 below outline the various strategies for which risks were analyzed during the course of the analysis. After conducting a literature review, and initial research on these strategies, and how they were being deployed (or not) at water utilities around the world, the study team met with two sponsoring utilities and explored the energy management approach strategies in-depth.

The study team met with operations managers at the chosen water utility to develop a case study on the energy management approaches they utiltize today, or would consider (Water U) and also identified additional opportunities from both the demand and supply side perspectives that could be appropriate for consideration by the case study water utility (Water U). Water U's actual strategies and those that are perceived as potentially worthwhile strategies are deconstructed through a systematic framework. Discussion on the framework and the Water U's strategy approach took place at the Water U over the period of several days. The six key steps utilized in this process were:

Table 2. Key Energy Demand-Reduction Options for Water Utilities

Options for reducing power demands	Benefits	Risks
Shift conveyance and distribution pumping to off-peak electric periods.	Significant electricity demand cost savings are possible.	Potential side effects on supply reliability and water quality.
Shift water treatment demands such as filter backwash to off-peak periods.	May provide significant savings in electric costs of treatment.	May have side effects on water quality reliability if backwash is overly deferred.
Optimize control strategies, upgrade pump motors, and employ variable speed drives or natural gas-driven pumps.	Reduces electric demand and consumption.	Cost of equipment, potential power quality issues, natural gas prices, and fuel storage.
Optimize the hydraulics of the water system to reduce pumping energy requirements.	Reduces pumping requirements, and thus energy needs and costs.	In and of itself does not increase reliability; may have water quality effects. Cost could also be an issue.
Develop additional water gravity-fed storage capabilities.	Independent of electric supply.	Capital cost, possible water quality implications.
Develop alternative treatment options.	May not reduce electric needs.	Cost and complexity of some systems.
Develop water conservation programs that reduce demand.	Reduces overall energy requirements.	May not reduce demand during critical peak periods.
Develop time-of-use (TOU) rates for water customers consistent with TOU cost of electricity supplies.	Brings water rates in alignment with true costs of supply, and reduces pumping during electric peak times.	Metering infrastructure and operating costs; may not break even in cost vs. demand reduction. TOU for water may not coincide with time of energy used in water delivered.

- Risk Identification: Identify what risks (reliability, environmental, and financial) are associated with each energy management strategy.
- Risk Characterization: Assess how large each risk might be, in terms of both the probability of occurrence and the types and levels of consequences associated with each risk.
- Risk Assessment: Evaluate options available to the utility for minimizing risks.
- Risk Management: Select a risk management option, based on the benefits and costs of the various options consistent with reliability priorities.
- Implementation and Refinement: Implement the risk management approaches selected, including monitoring and refinement of the strategies.
- Risk Communication: Communicate and defend the utility's risk management decisions to regulators, local political leaders, shareholders (if any), customers, and other stakeholders.

Results were then prepared and provided to the Water U to critique, and then included in the draft AwwaRF report cited above.

Table 3. Supply-Side Energy Management Options

Options for increasing power supply reliability and/or reducing power costs	Benefits	Risks
Install or expand backup **diesel** power generation on-site.	Relatively inexpensive. Can be sized to operate critical treatment and pumping systems during emergencies.	Air quality issues limit the run-time of diesel engines. Blackouts could last longer. No option for economic dispatch.
Install **natural gas** fired backup generation on-site.	Cleaner burning options include natural gas reciprocating engines, microturbines, and combustion turbines. Can be used for "peak shaving" during times of high electric demand, taking advantage of electric DR incentives offered.	Higher capital cost than diesel engines. On-site staff may not be familiar with technology. Potential fuel price volatility.
Install **renewable** generation on-site.	Tax credits and other incentives available. No air pollution.	High capital cost. Wind or sun may not be available when needed (requires detailed analysis of system sizing and storage options).
Contract with electric provider for *guaranteed power,* where third party owns and operates backup systems for an annual fee, or electric utility provides a second feeder line to ensure power supply except during widespread blackouts.	Outsourcing provides expertise that is generally not a core competency at water utilities. Provides known annual cost for budgeting.	Added cost [the energy services company must make money, too]. Little or no internal capacity building.
Participate in electric utility DR programs (along with one or more of the options above), and consider all rate options available from local electric provider.	May offset the cost of some supply-side solutions, by securing payment or rate advantages from electric utility.	May require on-site operator for generation equipment, and active participation in electric utility program logistics.

Findings

A brief overview of the Water U's context and operational parameters is provided as context to understand the strategy discussion which follows. Then, three of the strategies are discussed in detail below.

Water U Background

The Water U studied services a population of 170,000 customers with water production from multiple sources (wells, imports, surface and recycled water) running approximately 56 thousand acre feet. The maximum daily production capacity is about 84 MGD, and the annual minimum, which occurs in the spring, is about 17 MGD. By 2020 the Water U expects to need about 95 thousand AF. Some of this need will be met through conservation programs, and a significant portion is expected to come from increasing use of recycled water. Total electric usage (average of last two years) is 37 million kWh/year at a cost of $3.6 million/year average which is approximately 11-12 % of the total operating budget of Water U. Electric usage is primarily for pumping from purchased water connections, wells, and water treatment plants to finished water reservoirs (96%) and the remaining 4% of electricity is for treatment. Treatment plants are either gravity feed to distribution, or pumped to storage for gravity feed to distribution.

During the summer at Water U there is less than one day of finished water storage capacity. As a result, pumps are run around the clock during the summer –making avoidance of peak demand charges difficult and driving Water U to import water. Water U also faces considerable likelihood that water will be needed in the summer for brush fires when water supply and electricity constraints are greatest.

The following strategies were considered at Water U:

Strategy 1:	Expand the use of back up generation
Strategy 2:	Use of solar power for peaking and earning Renewable Energy Credits
Strategy 3:	Improve pump efficiency
Strategy 3a:	Install natural gas fired pumps
Strategy 4:	Rate analysis
Strategy 5:	Convert Pressure reducing valves (PRV) to turbines to generate electricity using available head and rate of flow
Strategy 6:	Optimize the use of SCADA within distribution system.
Strategy 7:	Develop additional storage
Strategy 7a:	Aquifer Storage and Recovery
Strategy 8:	Installation of Variable Frequency Drives (VFD)s

Each of these strategies was assessed during the case study development. The risk identification, characterization, and management for three of the strategies are summarized below.

Supply Side Strategy 2. Use of On-Site Solar Power for Peaking and Earning Renewable Energy Credits

WATER U recently completed installation of a solar power array for peak shaving at one site. Could this program be replicated or expanded? WATER U may have additional sites that have the room for PV panels, and the return on investment (with current incentives being offered through state renewable energy programs) might allow for additional sites to be developed. Renewable energy credits (RECs) may be earned based on kWh produced. Renewable energy credits are typically traded in the form of certificates that bear the contractual right to claim the environmental benefit of electricity generated from a renewable energy source (including any green-house gas (GHG) credits generated). Recent estimates for the value of RECs are approximately 1.5-2.0 cents per kWh in private markets.

Risk identification. Risks with respect to solar power are: *cloudy days* and *lack of economic viability*. Also one current problem with solar investments in California is that incentives per installed kW are dropping. In the past, when WATER U installed its first large array, rebates were fairly high ($4.50 per watt installed) but have now fallen to $2.50 per Watt and are expected to fall further as incentives are based on a downward ratchet that correlates to the total amount of installed solar in California. Some on-site solar PV arrays are eligible for net metering as opposed to the more complex interconnection requirements for some distributed generation in California governed by Rule 21. Under net metering, a customer does not sell their excess energy to the utility but rather receives a credit on their bill, essentially running the meter backwards when generating more power than consuming on-site. Net metering is available for solar, wind, biogas, or fuel cell technologies or other hybrid generating system, and must not exceed 1 MW in total nameplate rated capacity. There is also currently a cap of 0.5% of peak load for power generated by net metering customers that both SCE and PG&E are close to reaching. PG&E has indicated they support Senate Bill 1, which would lift this cap to 2.5% of their peak load.[1]

Risk characterization. Cloudy day risk could result in low reservoir levels if pumping were dependent on solar arrays. In reality, locations where current and planned solar arrays would be installed have access to power from the distribution grid, thus cloudy days pose little reliability risk.

Financial viability is affected by the process required to verify the REC, issues concerning ownership of RECs when utility funds have subsidized solar installation (this was recently resolved, with ownership of the RECs with the system owner), and shelf life of the RECs. It may also be that the solar contractor has contracted for the RECs in the fine print of the installation contract. All of these factors could reduce the value of the solar generated RECs and affect project payback.

In addition to REC value, there is financial risk associated with certain electricity demand charges, if system failure or poor performance occurs during a defined peak period of noon- 6PM for summer months. A new peak may be set for one 15-minute period, and a ratchet clause would charge Water U for that higher peak for up to 12 months.

What are the failure risks with solar technology? Are there human factors in operations and maintenance that influence performance? (E.g., washing off dusty array.) Would reliance on solar prompt additional back up power investment for rainy days, though rainy day water usage is typically lower?

Risk assessment. Additional specific research is required to evaluate and assess these risks, such as system performance, and the current processes for REC verification, ownership and sales. Moreover there is some regulatory risk, e.g., in the state of California, and the unbundled trading of RECs may be impacted by the implementation of the Governor's recent Greenhouse Gas Initiative.

Risk management. Based on ownership and shelf life inputs- RECs could be held or sold to better manage financial risk based on market dynamics. Also, managing reservoir levels or cloudy days will be required.

Implementation and refinement. Research could discover additional strategies being undertaken by others with RECs to identify possible refinements to WATER U's strategies. For example, a local bottling plant that is expanding in the WATER U area, may be interested in purchasing the RECs as a good will gesture that could generate positive publicity for both parties. While the bottling company hasn't announced a renewable energy strategy per se, it does

[1] http://www.pge.com/suppliers_purchasing/new_generator/solar_wind_generators/nem_enrollment_cap.html

list climate protection as one of its top 3 environmental issues.[2] California does not yet have a public trading process for *renewable energy certificates,* but is expected to develop one.[3]

California recently passed ground-breaking greenhouse gas legislation. The *California Global Warming Solutions Act of 2006* (AB32, passed August 31, 2006). This law adopts the goals established by the Governor's executive order in 2005 that set a GHG reduction target for the year 2020 at 1990 levels. With California's population growth, this goal will be difficult to meet, and load serving entities in the state (i.e., utilities) will need to find reductions wherever they can. It is expected that some kind of market-based compliance mechanism will be put in place that values GHG reduction credits. Thus, while current Self-Generation Incentive Program (SGIP) incentives per kW of solar power are on a sliding scale, California Solar Initiative (CSI) funding has not yet fully ramped up, and GHG credits (and federal tax credits) can make investments in PV systems more attractive.

Risk communication. Good-will publicity could be gained within the community by communicating this investment decision and the resulting return. This often forms part of the decision to participate in such a decision, and, like a number of other strategies discussed, should be adequately communicated to local constituents.

Demand Management Strategy 6: Coordinate – Optimize Use of SCADA Within Distribution System

Risk identification. Manually each season, the refill triggers for water reservoirs are set, at season start. Because imported water is such a large operational cost, this has been a successful strategy. The refill criteria are in part determined by water quality issues, which are always foremost. Currently, three of five reservoirs can gravity flow to system, and the other two have to be pumped. Each well pump in the system is staged to be run from least expensive to most expensive and similarly with other (distribution) pumps. Now that additional wells are being added, it is possible to more aggressively manage pumping on a daily basis, especially as additional storage is added and reservoir refill criteria are reevaluated.

Risk characterization. One concern with the current control system is that it has, by necessity, been focused on surviving imbalances in water supply and demand in the summer months. As the system develops additional wells and storage facilities, it may be possible to manage water resource selection on a daily or hourly basis. In this manner, the least-cost water resource that is chosen is designed to include the cost of peak power.

Additional storage or a change in pumping strategy could increase water residence time in the distribution system. Potential impacts on water quality from the addition of storage include the following:

a. Reduction in disinfectant residual
b. Increased biogrowth
c. Increased risk of nitrification

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[2] http://www2.coca-cola.com/citizenship/environmental_report2005.pdf
[3] http://www.resource-solutions.org/policy/webcasts/9.7.05/Wingate_RECs_RPS_webcast_9-7-05.ppt#481,13, How RECs Are Used To Show Compliance

d. Taste and odor
e. Impact on consumer confidence

Additional concerns are: a) Do the additional wells' water quality differ from existing wells? b) Will water from new wells taste or smell different, i.e., will consumers notice a difference? c) Will new wells' water quality require additional or new treatment?

Risk assessment. Some other water utilities have programmed the hourly tariffs of their utilities into their SCADA systems, including night, weekends, holidays, so that they always know where the next least cost gallon of water can be had. However, to do this in a way that is maximally effective for WATER U would require consideration of safe yield limitations and the cost and timing of imported water from a regional water wholesale provider. Modeling may suggest that it might make sense to pump and store water at off-peak electric times, e.g., at night. Water U would then use imported water during peak power periods.

Imported water is more expensive, but a necessary resource in the WATER U. If possible it could help electric load profiles to take wholesale water deliveries at the times when producing well water is most expensive.

Risk management. Managing this risk may be a considerable management investment and drain on already scarce time resources. A rough analysis of the potential savings should be considered prior to a full scale modeling effort to ensure that such efforts would net attractive financial returns.

Implementation and refinement. A number of home grown and elegant water modeling systems exist to increase the utility of SCADA systems to water districts. There are also a number of optimization software products on the market today.[4] However a feasibility analysis should be considered to prioritize this strategy relative to other options.

Demand Management Strategy 7: Develop Additional Storage

Background. One of the major challenges faced by WATER U is having less than one day of water supply in storage during summer peak demand. As a result WATER U has recently added several storage facilities.

During summer months in particular, when demand exceeds local supply, the imbalances are not able to be buffered through additional pumping off-peak due to safety margins currently applied to storage levels. In some locations, pumping is already operating at the maximum safe yield for the aquifer. As much as possible, booster pumps are used to move water to fixed elevations to provide higher efficiencies than the dynamic environment of a well head pump.

It's possible that with increasing storage coming on line (as much as a 10% increase in the next year) that storage refill criteria could be reevaluated against the risk of not being able to meet required water pressure for fire safety. Also, during the emergency curtailment by the water wholesaler discussed in Strategy 6 above, WATER U learned that it can go without imported water for longer periods than expected. As a result of that emergency shut-down, WATER U was

[4] One optimization software product often cited by water utilities is summarized at http://www.derceto.com/derceto-water.html

able to avoid reaching the higher Tier 2 supply rate from the wholesaler. In total, about one million dollars was saved. Though the bulk of the savings came from learning about the ability to 'harden the system' in January and February and not during peak water and energy consumption periods, it did fuel an interest in reducing reliance on imports from the wholesaler.

The WATER U system currently has storage set-point goals that are conservative and automated, but firm. That is, once the levels are set – it requires a manual intervention to change them. As a result, operational impacts on storage levels are minimal. For example, a reservoir or storage facility fill goal might be near 100% in summer, but in winter – it may drop to about 75%.

Though storage development is not on its face an energy management issue, it does have substantial implications for energy consumption patterns, and thus the time-related demand charges for electricity.

Table 3. WATER U Planned Storage Capacity Additions

0Reservoir Name	Capacity	Comments
4B tank 2	2.5 MG	This reservoir will be built this year to operate with the existing 2.5 MG tank.
1C	9 MG	2 tanks 3.5 MG & 5.5 MG
4D	3 MG	1 tank
5D	0.25 MG	1 tank
6C	1 MG	1 tank

Risk identification. In general, adding water storage does not have an appreciable downside. There are financial concerns with building storage that is not utilized or is inappropriately sized to growth. Addition of storage also requires modifications to usage strategies. It is not just a simple matter of adding storage. Storage buffering brings its own concerns such as: Total Organic Carbon (TOC) from imported water, which is a precursor to trihalomethanes (THMs).[5] Increased residence times may lead to THM risk. Regulated disinfection byproducts (DBPs), primarily THMs and haloacetic acids (HAAs) are formed when chlorine reacts with natural organic matter in the water. This is why reservoirs are dropped down in winter when reduced demand creates less water turnover.

Storage is also susceptible to earthquakes.

Risk characterization. *Earthquake (reliability) risk* can result in pipe joint failure or cracks in storage. This is already being mitigated by WATER U by building earthquake-proof joints into all new piping to and from storage. In addition, a sensor (accelerometer) detects earthquake motion, trips a switch, and closes valves automatically. WATER U staff then must physically inspect the pipes before re-opening the valves. There is also a plan to install flex joints at all pipe fittings.

System redesign work might be called for to take better advantage of storage, considering load factor issues. This might include the cost of a controls programmer and the opportunity cost for the management and direction of such an individual. Additional risks include financial risk of the capital required for expansion. Analysis is required to determine whether storage provides the best return on investment. Cost of storage is mostly in the resources that go to acquiring a

[5] The research team did not have access to data indicating MET water was specifically more susceptible to DBPs.

suitable location and construction. To maintain gravity feed to the distribution system, high ground is required. Of course, this same high ground typically has higher real estate value.

Hydrogeology in the area is managed well so that knowledge of where to drill is low risk. Creating a site opportunity for storage is more difficult. In the case of one major industrial water customer served by WATER U, they were willing to facilitate storage development on-site to ensure resources for their bottling plant. In the case of one golf course, storage for recycled water was perceived to be a win-win. The golf course uses lower cost recycled water, and the WATER U is still making money on the sale of water. Other financial risks are largely sunk costs, such as management of potential terrorism and vandalism, as WATER U has video monitoring of facilities to limit intrusions. There is also some environmental risk with respect to disruption of indigenous species during pipeline construction.

Risk assessment. Most available locations for potential storage are remote from current treatment facilities, in areas where groundwater is sometimes under the influence of surface water, e.g., from losing streams that recharge upper aquifer zones. As a result, these locations are not suitable for additional storage because water stored there would need to be treated as if it were surface water.

The benefits of utilizing water storage to participate in electrical demand response programs are dependent on utility service territory and tariff structure. Water District B figured they could save as much as $50,000 the first year by participating in the California Critical Peak Pricing (CPP) or other incentive programs, and using system gravity-feed storage to avoid pumping during peak electricity periods. Rate analysis was used to derive a rough estimate of the value of water storage. The amount of savings available to Water District B can be used to offset water storage construction costs and provide a long-term revenue source in addition to the added system reliability resulting from increased storage capacity. In the case of Water District B, approximately 40% of the storage capacity was available for demand response participation or about 7.5MGal. The incentive payments from the electric utility are estimated to contribute $120,000 per year to Water District B's operating budget. Over the life of the storage facility, the net present value of the participation payments could exceed $2.3 million – or over $300,000 per MGal in storage capacity.

This example refers to a larger system than WATER U, but the analysis clearly demonstrates that it would be a worthwhile aspect to consider when planning for additional storage. This analysis does not include the additional savings that could be gained by shifting some operations off-peak permanently or the value of operational relief in not pumping around the clock.

Risk management. All new water storage has earthquake valves and appropriate engineering. Battery operated valve closures are triggered by an accelerometer so that in the event of an earthquake there are automatic closures. Retrofit of old valves is also occurring. Above ground this is easy access for welding, but flexible coupling is a more involved process requiring excavation and replacement. Some financial risks are also managed because home developers can be required to pay for pump stations and reservoirs to provide supply to their developments.

Implementation and refinement. WATER U might consider conducting a feasibility analysis to evaluate other storage sites and possibilities. The study recommended that WATER U experiment with one storage facility, systematically varying water storage levels during both off-peak and on-peak periods, to determine whether the potential exists to turn pumps off during the noon-6PM electrical peak period without loss of system pressure. The question is essentially, what is a safe reservoir level, and what margin of safety is actually required in order to refill storage during off-peak. An additional analysis that might refine this strategy further would look at slightly over-sizing booster pumps (during normal replacement cycle), in order to allow for faster reservoir filling during off peak periods.

Risk communication. Environmental risks associated with siting of new storage facilities have special communication requirements. There are communication protocols for nearby Indian groups when work is conducted in areas where white sage is traditionally collected (in the hills above the city where Water U is). There are additional communications within Fish and Game, Forestry, and other agencies if new facility development is considered in upper basins in the hills.

Strategy 7a. Aquifer Storage and Recovery

A related strategy is to store WATER U water underground in winter, and use the credits gained to off-set replenishment fees imposed for withdraws from the aquifer. Stormwater collection for recharge could enhance this strategy. There are some issues with this that could include salt balance. This strategy was not fleshed out in detail.

Conclusions

Water U is like many of its brethren water utilities in its need to supply ever greater amounts of clean water, keeping public health and safety as the highest priority. Management of energy demand and supply side resources almost always require a review of risk tolerance as it relates to this water supply reliability. Energy management decisions must also weigh the financial and environmental risks associated with any energy management strategy. There are numerous strategies available for managing these risks, and the intersecting demands between water and electric infrastructure are forcing the creation of incentive programs that benefit both sectors. Water utilities that adequately identify and manage these energy management risks can better assure their reliability and financial health.

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