Exploring Advanced Treatment Options for California Water Security

A Management Plan for Three Sites Across California

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CALIFORNIA'S WATER CRISIS

PROJECT BACKGROUND

California faces immense challenges as climate change and rising water demand continue to strain the state's available resources. Extended periods of drought, increased evaporation from rising temperatures, groundwater depletion—particularly severe throughout the Central Valley—and a shrinking Colorado River further contribute to water shortages throughout the state. With worsening water quality issues, aging infrastructure, and reservoirs at critical lows, California communities must employ supply-side and demand-side solutions to ensure an affordable, safe, and secure water supply in future years. The following technologies will be pertinent to California's future water security: water recycling technologies (Direct and Indirect Potable Reuse) and desalination processes for seawater and groundwater.

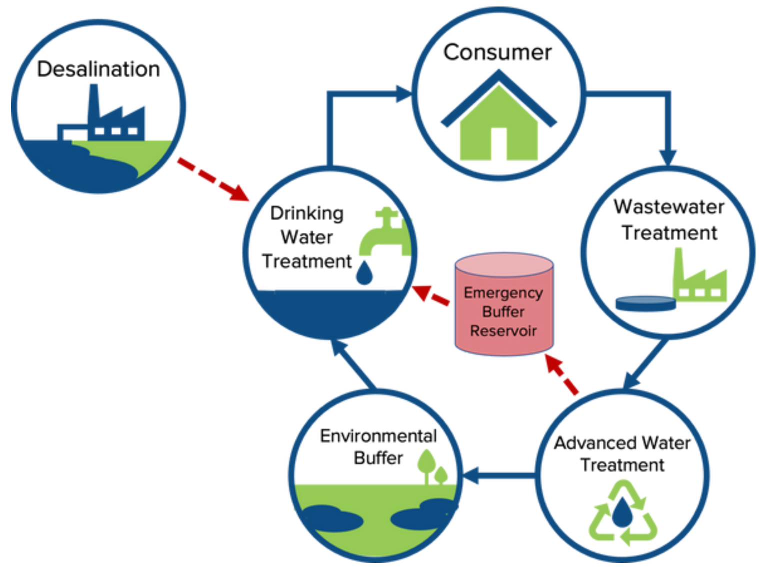

Figure 1. Potable reuse treats wastewater to advanced water treatment levels before the water enters drinking water supply. Desalination separates salt from saline water, converting it into fresh drinking water.

APPROACH & RECOMMENDATIONS

1

We developed a model in R to calculate the energy requirements, capital costs, and operation & maintenance costs for different water treatment technologies.

We applied this model to three water agencies across California: the cities of Bakersfield, Fresno, and Oxnard.

2

Indirect potable reuse is the most cost-effective and climate resilient technology for all three sites.

Groundwater desalination is the most affordable option among these technologies; however, it relies on a consistent supply of groundwater, making it unreliable long-term as supplies dwindle.

3

Our water risk assessment determined more work needs to be done.

We assessed socioeconomic, environmental, and water risk for each site. Risk scores were not evenly distributed within site boundaries, showing the need for additional research to equitably implement these technologies.

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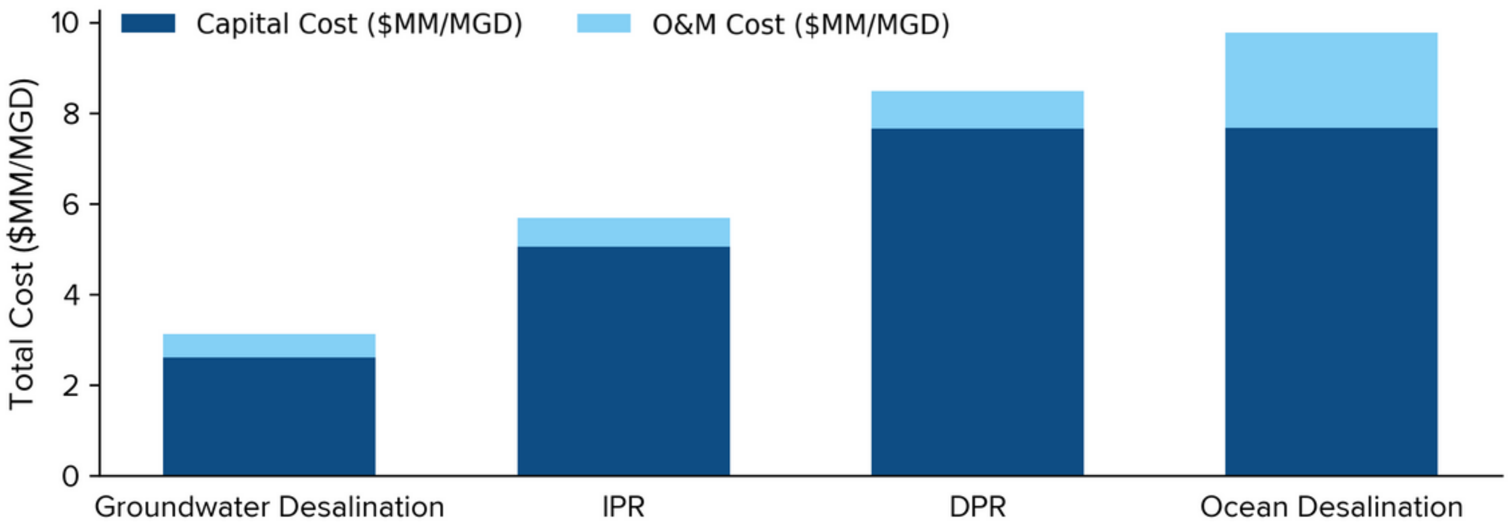

Figure 2. Approximate costs for each technology for the City of Oxnard at a calculated flow rate of ~6.3 MGD. Groundwater desalination is the most cost-effective, but relies on a consistent supply of groundwater, which is not guaranteed. IPR is the most cost-effective technology that is resilient to local water supply changes.

PROJECT IMPACT

The California water crisis impacts certain areas differently, and regions of California have diversified their water supplies in response; however, only some California municipalities have the luxury of diversifying their water supply portfolios beyond surface and groundwater sources, typically in wealthier, more populous areas like Los Angeles, Orange County, Santa Barbara, and San Diego.This project focuses on water districts that (1) have the need for advanced water treatment technology, but haven't yet developed it, (2) have the resources to support this technology, and (3) include communities that are disproportionately burdened by multiple sources of pollution. Our model and preliminary environmental justice analysis provide a baseline for water districts in the early stages of planning to safeguard their water supply while meeting future demand.

FUTURE WORK

Acquire comprehensive cost & energy data sets
Due to the novelty of potable reuse, there are currently limited operational facilities to compare cost and energy requirements.

Capture extraneous processes
Required processes that potentially pose high energy requirements or costs such as pumping, storage, recharge, ocean outfalls, or basin spreading are not included in this version of the model.

Integrate environmental & social risk into model
Our initial analysis showed differences in water risk, but due to time constraints it was not incorporated into the model.