San Antonio Water System

Energy Strategy Master Plan

San Antonio Water System

2023

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San Antonio Water System

I am pleased to present this Energy Strategy Master Plan, the first planning effort of its kind focused on energy consumption, efficiency, and master planning at San Antonio Water System (SAWS).

SAWS is committed to reducing its carbon footprint and supporting local climate goals. In addition to reducing carbon emissions, energy efficiency efforts help reduce the burden to SAWS customers which is critical in the midst of increasing energy costs. It is more important than ever that SAWS dedicates the efforts and resources necessary to reduce energy consumption and associated greenhouse gas emissions.

In support of these commitments, this Energy Strategy Master Plan lays out the framework to save energy, reduce utility costs, and memorialize SAWS' commitment to a goal of reducing energy intensity (kWh/unit) by 10 percent over the next five years (further reduction goal details are included in the plan). Developing this plan provides the opportunity to present this goal and establish strategies and commitments to achieve it. Success will require support of the SAWS Board of Trustees, executive team, and staff.

SAWS has long been a leader in conservation and is already implementing many of the steps required to achieve its energy goals. This document serves as SAWS' commitment to optimizing the water/energy nexus and supporting our mission of Sustainable, Affordable Water Services.

Thank you,

Robert R. Puente
President - CEO

1 Executive Summary

1.A SAWS Energy Strategy Master Plan

In 2022, San Antonio Water System (SAWS) spent approximately $45 million or 10 percent of its annual operating budget on energy, making it the fourth largest use of funds behind debt service, salaries and wages, and water procurement. Every year, SAWS' cost of energy is rising due to rate increases and changes in fuel adjustment charges. Strategically managing energy consumption will be key in reducing the impact of future energy cost increases.

In addition to reducing utility expenditures, this plan will be key in supporting the City of San Antonio's Climate Action goals. In October 2019, the city adopted the San Antonio Climate Action and Adaption Plan (CAAP). The plan set a goal for San Antonio to achieve carbon neutrality by 2050. Energy use is responsible for 48 percent of San Antonio's greenhouse gas emissions and since SAWS is one of the largest energy consumers in the city, this plan can have a real impact on San Antonio's carbon neutrality goal.

SAWS is a national leader in water conservation. Drawing on SAWS' history in water conservation, developing this Energy Strategy Master Plan (ESMP) can guide future energy conservation to achieve SAWS' operating cost, energy, and emissions reduction goals without compromising water quality or water conservation. This plan establishes **an initial commitment for SAWS to reduce its energy intensity (kWh/unit) by 10 percent by 2028**. Reaching this goal will require the support of SAWS' Board, executive team, and staff.

1.B Strategic Energy Management (SEM) Background

Key energy and water metrics were assessed for the period of 2020 to 2022 to establish baseline system performance. Consulting engineers developed 10 energy regression models for SAWS' systems to document baseline performance from which to measure future improvements in energy efficiency based on identified key variables for each system.

Site visits conducted with SAWS' staff during December 2021 and Spring 2023 identified over 100 potential energy efficiency projects. Of these 100+ potential projects, the most viable ones are listed in Section 5 and total approximately 71 million kWh in potential annual energy savings or 38,000 metric tons of CO2 equivalent (CO2e) in annual avoided emissions potential. These represent over $6 million in avoided costs each year or approximately 14 percent of SAWS' annual energy costs. Although the potential savings are significant, it is unlikely SAWS will be able to realize the entirety of the figures. However, they illustrate the magnitude of opportunities present within SAWS' operations.

These results can be achieved through operational changes in the water and wastewater systems that do not require significant capital investment and will not jeopardize system performance or regulatory compliance. Three of the top opportunities include prioritizing water sources within the portfolio based on energy intensity when and where possible; prioritizing pumps within each source based on energy efficiency; and reducing first-stage solids retention times at the Steven M. Clouse Water Recycling Center. As an example, developing sourcing strategies based on energy intensity means shifting water production to more energy efficient sources when conditions allow for it. These three opportunities alone could save SAWS approximately 47 million kWh per year in electricity use and $4.2 million per year in avoided electricity costs.

1.C Existing Energy Efficiency Efforts

Prior to the development of this plan, SAWS had already begun implementing energy related initiatives. Some of the most successful projects are highlighted below:

Demand Response: Participating in City Public Service Energy's (CPSE) Demand Response program to reduce peak (kW) demand during specified time periods. To date, SAWS has collected nearly $2.5M in demand response incentives.

Utility Energy Rebates: SAWS' Office of Energy Strategy (OES) consistently pursues CPSE rebates for energy efficiency upgrades. Since 2018, SAWS has collected about $1M in rebates.

Tariff Reviews: Performing monthly analysis to ensure SAWS electric accounts are in the most cost-effective tariff option. Since 2019, this effort has saved SAWS more than $1M in utility expenditures.

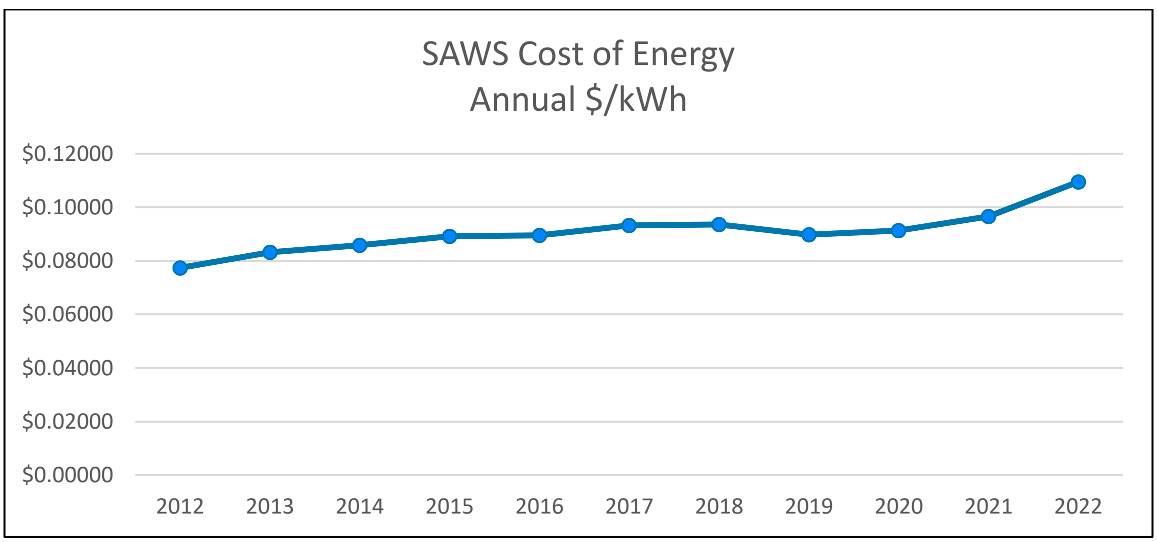
District Cooling Billing Demand Reduction Project: Implementing availability of real-time peak demand data to avoid peak and ratchet demand charges. This has resulted in savings of more than $100,000 annually.

Other notable projects include high-efficiency chillers, optimized Vista Ridge equipment, SCADA upgrades, variable frequency drives, and building management systems.

1.D Energy Rates and Providers

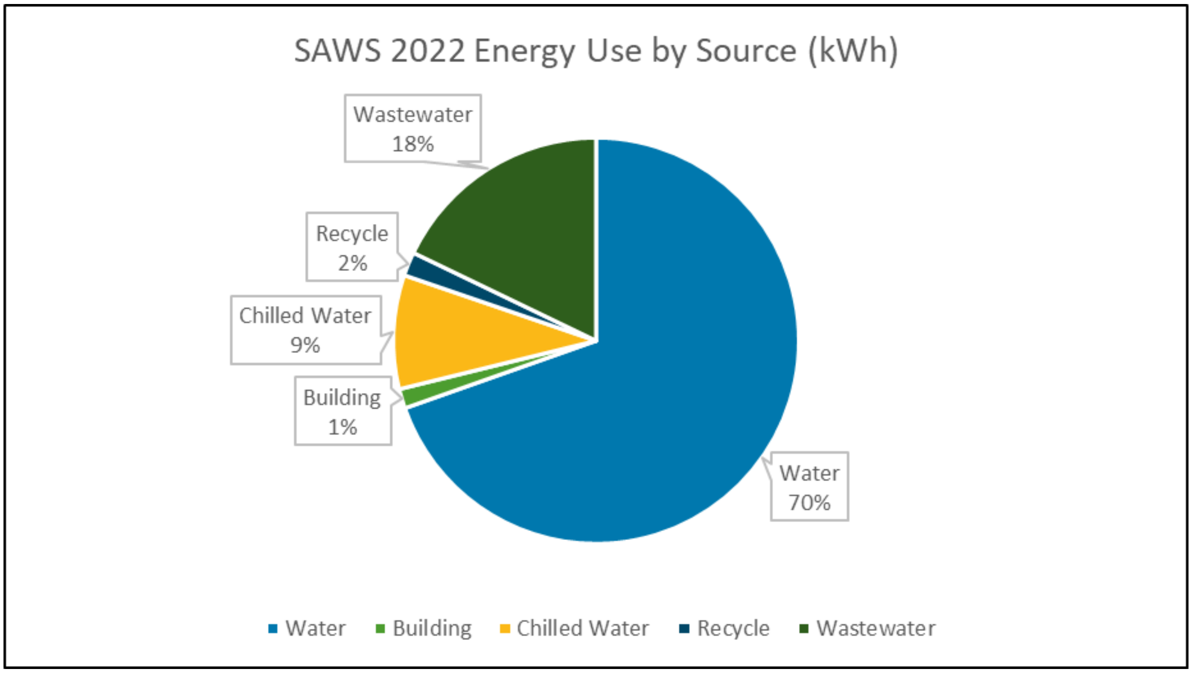
Understanding SAWS' energy costs and providers is an import part of planning efforts. SAWS gets its electricity from four electric utility providers covering multiple county lines: CPSE, Bluebonnet Electrical Cooperative, the Guadalupe Valley Electric Cooperative (GVEC), and New Braunfels Utility (NBU).

Regardless of future rate increases, SAWS can expect its energy costs to continue to rise for a variety of reasons, including increasing fuel adjustment costs, extreme temperatures and increasing population leading to more frequent peak-demand periods, and global energy volatility, among others. The graph below highlights how SAWS' energy costs (in $/kWh) have risen over the past 10 years.

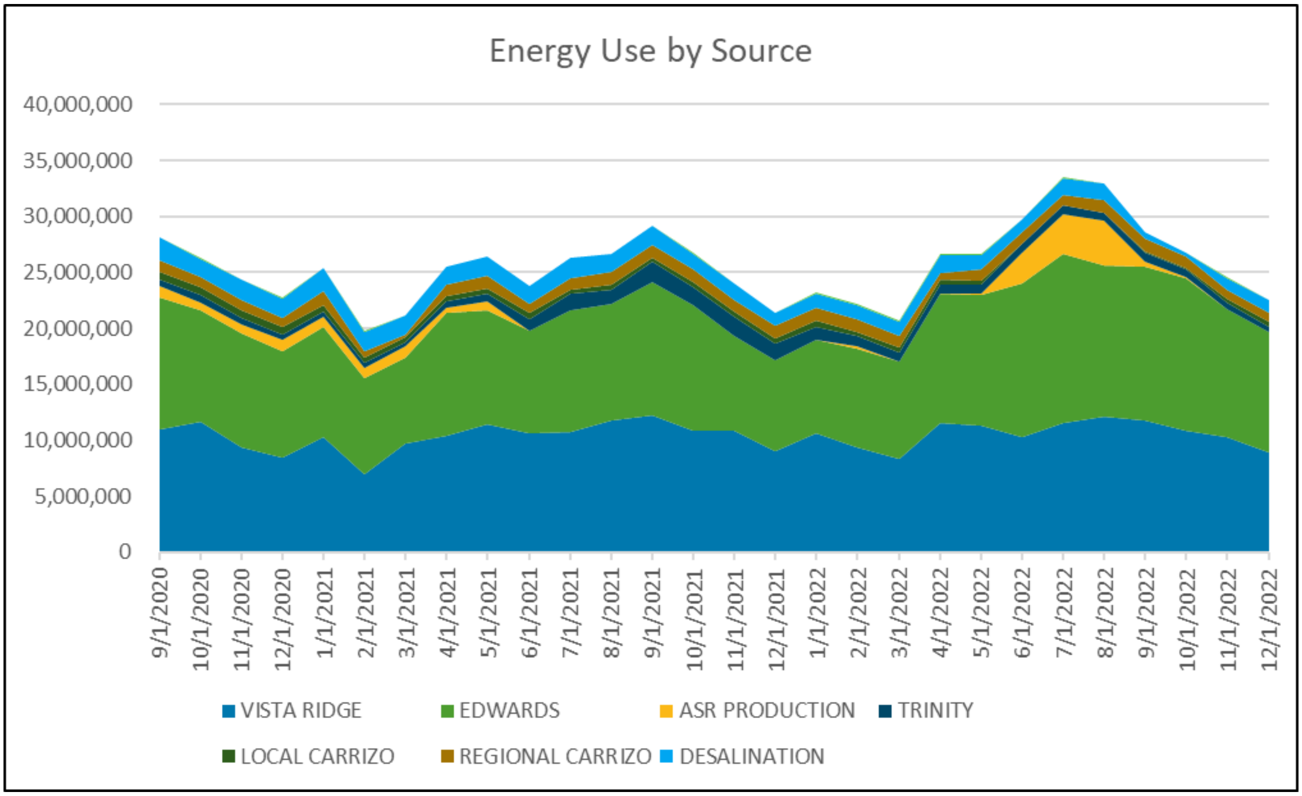


1.E Baseline Energy Assessment

The first and most important step of any energy strategy program is understanding how and where energy is consumed. Today, SAWS consumes about 475,000,000 kwh of electricity annually. For reference, this is enough electricity to power over 32,000 Texas homes for one year. SAWS consumes energy in five main areas: water production/distribution, water treatment, district cooling systems, recycled water, and auxiliary buildings. In 2022, water production/distribution accounted for 70% of SAWS' annual energy consumption and wastewater accounted for 18%. The chart below provides a breakdown of 2022 energy consumption.



Since water production/distribution is the largest energy consumer at SAWS, it is also important to look at which water sources consume the most energy. This breakdown is shown in the graph below.



1.F Roadmap and Recommendations

This section outlines the actions that SAWS can take to reach its energy goals. A more detailed breakdown of specific energy conservation measures is included in section 5C.

The steps to achieving SAWS' goal include:

1. Start with pursuing low and no-cost energy conservation measures (ECMs) identified within SAWS' water, wastewater, and district cooling systems.
2. As part of its long-term energy strategy program, SAWS may consider pursuing the United States Department of Energy's 50001 Ready Certification described in more detail below.
3. As described in Section 5.A, SAWS established five energy teams during its Year 1 SEM engagement.
4. Funding for energy efficiency projects must follow a well-understood and agreed upon process. For example, Annual Capital and Expense Budgeting, Interim Funding, Financial Return, New Facility Capital Budgets, and Revolving Dedicated ECM funds.
5. In general, establishing a strong energy strategy program at SAWS means energy usage and cost will be considered in all aspects of the business.
6. After implementing low and no-cost projects, SAWS should consider conducting full ASHRAE Level 2 audits of certain facilities to pursue longer-term, capital energy efficiency projects.

7. Lastly, SAWS should regularly investigate and analyze potential renewable energy project opportunities, described further in Section 6.

1.G Best Practices

Organizations that are successful at energy strategy develop a culture that contains energy awareness and efficiency at every level. In addition to implementing energy projects and initiatives, SAWS should consider the following best practices.

Executive Commitment and Organizational Awareness: Executive support is one of the most important factors in determining the success or failure of an energy program. With support that is clear and constant, the energy strategy program creates a culture where energy efficiency is a normal part of doing business.

Organizational Goal Setting: In order to commit the proper time and resources towards energy initiatives, it is important to first establish goals. As referenced above, this plan includes an overarching goal of a 10% reduction in energy intensity by 2028.

Consistent Resource Commitment: The investment of the resources necessary to meet goals is critical to success. SAWS should commit human, financial, and educational resources towards this energy strategy master plan.

Engineering: Maintaining a long-term energy strategy program requires technical analysis to identify opportunities for energy and cost savings. Engineering analysis should be an ongoing practice, including use of SAWS' hydraulic model to assess the water and recycled water systems' energy efficiency opportunities.

Implementation Action Planning: Implementation action plans should be developed and reviewed annually to track progress. These plans should include prioritizing projects, assigning project leads and establishing timelines, incorporating new information as it becomes available, documenting successes throughout the year, and assessing key metrics against goals.

Tracking and Reporting: Tracking and reporting on an energy strategy program is important for quantifying program success. Four key steps include establishing goals, tracking performance metrics, verifying savings, and reporting out to energy teams and senior leadership.

1.H Special Considerations

This plan is intended to be a living document that can and will be refined over time. Not all of the recommendations and energy conservation measures will be fully implemented and there are other projects and/or measures that will be added over time. Energy efficiency is an important factor, but it is understood that water quality, permitting, and general operations are critical. Staff will do their best to incorporate energy measures as it is possible to do so.

The primary goal of this plan is to establish a balance between concrete energy conservation goals and water quality/system performance, and to lay out a strategic roadmap for achieving those goals.

2 San Antonio Water System (SAWS) Introduction

2.A Overview

San Antonio Water System (SAWS) serves approximately two million people in Bexar County and portions of Medina, Comal, and Atascosa counties. In 2022, this population included over 556,100 water customers and 497,300 wastewater customers. SAWS' mission, vision, and values are committed to providing sustainable and affordable water services today and for future generations.

SAWS is firmly committed to energy conservation, which aligns with its longstanding commitment to water conservation. If SAWS' facilities operate at optimal energy efficiency, the organization can measurably contribute to the success of the City of San Antonio's Climate Action and Adaptation Plan and other energy programs like CPSE's Sustainable Tomorrow Energy Plan (STEP) program. Additionally, it will help keep rates affordable for SAWS' customers. The term energy in this document refers to electrical energy consumption measured in kilowatt hours (kWh).

2.B The Need for an Energy Strategy Master Plan

SAWS is a national leader in water conservation. Drawing on SAWS' history in water conservation, developing an ESMP can guide future energy conservation to achieve SAWS' operating cost, energy, and emissions reduction goals without compromising water quality or water conservation. An optimized system can be operated to concurrently achieve energy efficiency, water quality, and hydraulic performance objectives.[1]

In September 2021, SAWS began a year-long SEM program, which laid the foundation for this ESMP. This is the first ESMP developed for SAWS. The primary goal of this plan is to establish concrete energy conservation goals that do not compromise customer expectations or system performance, and to lay out a strategic roadmap for achieving those goals.

Secondary goals for this ESMP include providing the framework and best practices for a successful, long-term energy strategy program, so these achievements can continue for the foreseeable future.

SAWS spent approximately $45 million for electricity in 2022. According to the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE), water and wastewater utilities that institute organization-wide energy efficiency programs save an average of 5-10 percent of their annual energy costs. For SAWS, such savings could amount to $2-4.5 million per year in avoided costs.

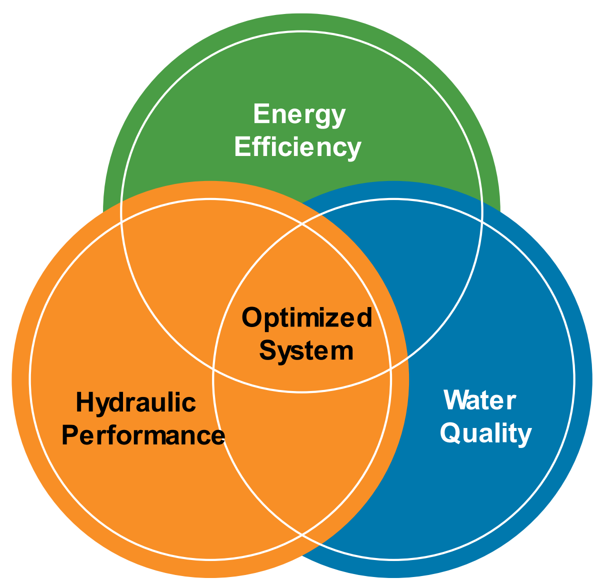


Figure 1. Jones and Sowby 2014

[1] Jones, S. C., & Sowby, R. B. (2014). Water System Optimization: Aligning Energy Efficiency, System Performance, and Water Quality. *Journal AWWA, 106*(6), 66-71.

Beyond achieving significant reductions in costs through reducing energy use, SAWS' energy strategy efforts will directly support the city of San Antonio's efforts to reduce greenhouse gas (GHG) emissions and adapt to a changing climate.

In June 2017, San Antonio City Council passed a resolution in support of the Paris Climate Agreement, directing the city to develop a plan for reaching the goals set in the agreement. In October 2019, the city adopted the San Antonio Climate Action and Adaption Plan (CAAP).[2] The plan set a goal for San Antonio to achieve carbon neutrality by 2050.

Based on the 2016 greenhouse gas inventory cited in the CAAP, energy use is responsible for 48 percent of San Antonio's GHG emissions. Often, municipal water and wastewater plants are the largest single energy consumers in a city, accounting for between 30 and 40 percent of the total energy consumed.[3] As such, SAWS' energy reduction achievements will have a significant impact on the city's carbon neutrality goals. In San Antonio, SAWS is CPSE's largest energy user.

Energy efficiency is a key strategy in achieving emissions reduction goals. It costs less money to save energy than to build new carbon neutral energy sources. A 2019 report from the American Council for an Energy Efficient Economy (ACEEE) found energy efficiency efforts alone could cut the United States' GHG emissions in half by 2050.[4]

Given SAWS' significant impact on San Antonio's overall energy use and associated GHG emissions, effective energy strategy within SAWS will be integral to the city achieving the goals laid out in the CAAP.

2.C Energy Strategy Master Plan Management

Management and implementation of this plan will be managed by SAWS' OES.

That said, successful implementation is only possible with the support of staff across multiple SAWS departments. To facilitate this collaborative effort, energy teams comprised of key staff members were developed. The energy teams are included in Table 1 below.

Table 1 SAWS Energy Teams

Energy Strategy

Name	Title	Department	Energy Team Role
Chris Wilcut	Director	District Cooling/OES	Management
Brandon Leister	Energy Manager	Office of Energy Strategy	Management
Stephen Turner	Resource Analyst Coord.	Office of Energy Strategy	Management

[2] SACRReportOctober2019.pdf (sanantonio.gov)
[3] Energy Efficiency for Water Utilities | US EPA
[4] Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050 | ACEEE

Alfred Rocha	Resource Analyst	Office of Energy Strategy	Management

Water Energy Team

Name	Title	Department	Energy Team Role
Jeff Haby	Senior Vice President	Prod. and Treatment	Executive Sponsor
Roger Placencia	Senior Director	Prod. and Treatment	Executive Sponsor
Matthew Digges	Manager	Prod. and Treatment	Energy Champion
Glenn Coates	Manager	Production Operations	Support
Rodrigo Morales	Supervisor	Production Control Ctr.	Team Member
Linda Bevis	Director	Water Resources	Support
Patrick Shriver	Manager	Water Resources	Team Member
Steven Siebert	Manager	Water Resources	Team Member
Pablo Martinez	Planner III	Water Resources	Support
Rob Escobar	Manager	ASR/Desalination	Energy Champion
Carl Krueger	Superintendent	ASR/Desalination	Support
Ben Arellano	O&M Technician	ASR/Desalination	Team Member
Bobby Johnson	Manager	Master Planning	Energy Champion
Timothy Ybarra	Project Engineer	Master Planning	Team Member
Dimas Camacho	Graduate Engineer II	Master Planning	Team Member
Liam Coffey	Graduate Engineer I	Master Planning	Team Member
Juan Gomez	Senior Director	Engineering	Support
Marty Jones	Director	Engineering	Support
Vicente Garza	Manager	Engineering	Support

James Gegenheimer	Project Engineer	Engineering	Support

Wastewater Energy Team

Name	Title	Department	Energy Team Role
Jeff Haby	Senior Vice President	Prod. and Treatment	Executive Sponsor
Alissa Lockett	Senior Director	Treatment	Executive Sponsor
Raymond Perez	Director	Treatment	Executive Sponsor
Tad Eaton	Manager	Treatment (Clouse)	Energy Champion
Kennith Wilkins	Manager	Treatment (Clouse)	Team Member
Michael Galindo	Manager	Treatment (Clouse)	Energy Champion
Jeremy Merz	Superintendent	Treatment (Clouse)	Team Member
Jorge Mejias	Superintendent	Treatment (Clouse)	Team Member
Juan Munoz	Superintendent	Treatment (Clouse)	Team Member
Marco Ramos	Superintendent	Treatment (Clouse)	Team Member
Jason Rozier	Superintendent	Treatment (Clouse)	Support
Tram Doan	Manager	Treatment (Leon)	Energy Champion
Ignacio Falcon	Superintendent	Treatment (Leon)	Team Member
Eduardo Lastra	Superintendent	Treatment (Leon)	Team Member
Juan Ramirez	Manager	Treatment (Medio)	Energy Champion
Kevin Hilldore	Superintendent	Treatment (Medio)	Team Member
Michael Rocha	Senior Wastewater Tech	Treatment (Medio)	Team Member
Juan Gomez	Senior Director	Engineering	Support

Marisa Palmer	Manager	Engineering	Support
Ila Drzymala	Senior Project Engineer	Engineering	Support

Note: Additional support is provided by Finance, Continuous Improvement and Innovation, and other SAWS departments as needed.

2.D Executive Commitment

This ESMP establishes SAWS' energy conservation goals have the support of the SAWS leadership team. Executive support that is understood throughout the organization is very important for successful energy strategy programs. Without support from leadership, cultural changes in operational behavior are difficult to normalize organization wide and sustain for the long term. Energy expenses can also be seen as separate from the core mission of an organization, but they can be an attractive opportunity for improving financial performance. SAWS is proud to have a leadership team that supports that connection.

Consistent and widespread support for energy strategy creates a culture where energy expense control is a normal part of doing business. Strategy, organization, and resource allocation are brought to bear in coordinated ways, and the financial and environmental dividends continue to pay out over the long term. This ESMP establishes the foundation for such success.

2.E The Planning Process

This ESMP is based on three key principles:

- The roadmap provided in the plan needs to lead to action.
- To maximize near term energy and cost savings, energy strategy will start with low-/no-cost opportunities and move to equipment replacement and upgrades second.
- Taking a systemwide perspective is vital, rather than pursuing or evaluating projects siloed between departments.

Development of this ESMP was led by SAWS OES staff members in collaboration with a consulting team. The foundation for this plan comes from the engineering analyses performed as part of Year 1 of the SEM engagement described in Section 2.B. Senior leadership and operations staff were interviewed in June of 2020 to document priorities and understanding of existing energy strategy activities within SAWS. Their input also provided a foundation for the development of this ESMP.

The goals established in this ESMP were developed by SAWS OES staff members in collaboration with members of the consulting team delivering SAWS' SEM program and endorsed by SAWS senior leadership. Baseline measurement work completed in the first year of the SEM program provided the foundation for SAWS to develop the goals set forth in this plan.

Just as SAWS publishes updates to its water conservation and management plans periodically, in response to significant changes or as needed to update goals, this plan is also meant to be a living document that gets updated and expanded regularly. SAWS will update this ESMP every three years, starting in 2026. The update will document progress made to implement the energy conservation measures (ECMs) recommended in Section 5, and it will document the next recommended ECMs SAWS will implement to continue progressing toward its overall energy conservation goal.

2.F 2022 Energy Strategy Master Plan Goals

This plan establishes that SAWS is setting an overall goal to reduce its energy intensity (kWh/unit) by 10 percent over the next five years. This reduction will be measured and verified by the energy regression models developed for SAWS' water and wastewater systems through the Year 1 SEM engagement. Achieving this goal represents approximately **24,865 metric tons of CO_2e in avoided carbon emissions per year**, equaling approximately **5,400 passenger vehicles taken off the road for a year**.

As described above, this goal is based in part on the engineering measurements, calculations, and evaluation completed between September 2021 and October 2022 through SAWS' Year 1 SEM engagement as well as prior consulting and internal OES work. The findings from this work provided SAWS the understanding and confidence to set this goal and the pathway to achieving it, which is outlined in Section 5 of this ESMP.

Using the energy regression models to track savings allows SAWS to consider the metrics most applicable to each water and wastewater system and sub-system, tracking variables that have the greatest effect on energy use and providing the most accurate picture of usage and savings over time.

2.G History of SAWS Conservation Efforts

SAWS has a long history of successful resource management programs, including water conservation achievements realized over the last 35 years and more recent energy efficiency achievements.

In 2001, SAWS established the Office of Energy Management (OEM) to manage SAWS energy consumption and expenditures. Additionally, OEM consolidated the billing process associated with all SAWS utilities, making energy data accessible for analysis.

Due to rising energy costs and growing awareness around the connection between operational efficiency and energy use, SAWS' OES has started taking a more strategic approach to reducing energy expenditures over the last three years. This work involves reviewing tariffs, monitoring utility issues, advocating for energy efficiency efforts, and implementing energy projects to contribute to the goals set in this ESMP. The office is now referred to as the Office of Energy Strategy.

Currently, OES consists of four staff members, including an Energy Manager, Senior Resource Analyst, Resource Analyst, and Administrative Assistant.

The following sections outline the water conservation, wastewater reuse, and energy efficiency steps SAWS has taken to date.

Water Conservation

SAWS is nationally recognized for sustainable and responsible water management. SAWS recognizes the effort to promote conservation is a cost-efficient approach to minimizing the increase in demand for water caused by population growth. Beginning in 1994, SAWS implemented progressive water conservation programs aimed at reducing the total amount of water used. These programs target both indoor and outdoor residential, commercial, and industrial uses through a combination of education and outreach, reasonable regulation, and financial incentives.

San Antonio's long-standing commitment and investment in water conservation and infrastructure improvements has yielded its largest water supply. SAWS has successfully reduced the gallons per capita per day (GPCD) used by SAWS customers by approximately 50 percent over the past 35 years. Water conservation continues to be a strategy for long-term water supply.[5] SAWS' 2019 Water Conservation Plan establishes the goal of reducing total GPCD to 88 from an average of 120 in 2019.[6] Figure 2 shows SAWS' water consumption in gallons per capita per day for the last 22 years – falling from 146 GPCD in 2000 to 122 GPCD in 2022.[7]

SAWS' Conservation Department is currently in the process of developing it's 2024 Five-Year Water Conservation Plan. Once complete, the water demand reduction strategies in the Conservation Plan will be included in this ESMP as a means of reducing energy consumption.

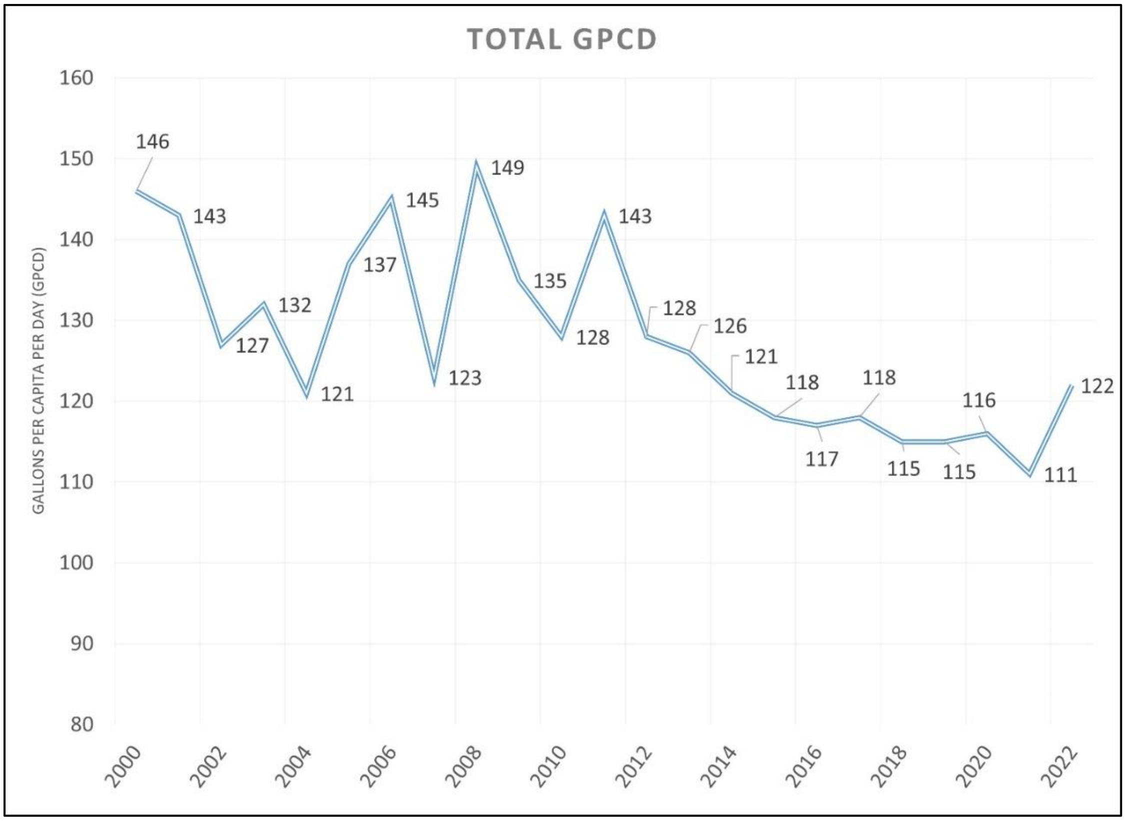


Figure 2. SAWS Water Consumption in Gallons per Capita per Day (GPCD) since 2000.

SAWS' water conservation and management programs and goals have been consistently documented and tracked through planning documents, starting in 1998. Since then, SAWS has published updates in 2005, 2009, 2012, 2017, and 2019 to incorporate changes in population, water demand patterns, regulations, and water supply options and to provide a clear direction for implementation. The most recent conservation plan, published in 2019, provides an update on current water use in SAWS' service area, new opportunities and strategies to achieve even more water conservation, and updates on a drought mitigation plan.

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[5] 20171107_SAWS-2017-Water-Management-Plan.pdf

[6] 2019SAWSConservationPlan.pdf

[7] In 2022, GPCD increased 5.9% above the predicted normal year GPCD from the 2017 WMP due to extreme drought (increased temperatures and decreased rainfall), especially during the summer months when irrigation is used.

Many initiatives have contributed to SAWS' progress in extending water supplies through conservation, moving toward achieving its long-term goals. In the last five years:

- Conservation initiatives saved over 1 billion gallons of water annually by working with residential and commercial customers through education, incentives, and regulation.
- Over 2 million square feet of water-intensive grass has been replaced with low water-use plants or permeable patios through WaterSaver Landscape Coupon programs.
- The GardenStyleSA.com website and e-newsletter provide timely regional low water use landscape information to reduce outdoor watering.

Wastewater Reuse

In 1996, SAWS committed to building one of the nation's largest direct recycled water systems. The recycled water produced from the SAWS Water Recycling Centers has proven important to SAWS' diversification and conservation efforts. Today, more than 130 miles of pipelines deliver highly treated recycled water to over 85 customers, including industrial and commercial users, golf courses, municipal parks, universities, military facilities, and healthcare facilities. For private customers, the system can provide up to 25,000 acre-feet (ACFT)[8], conserving large amounts of potable water. In 2022, 12,300 acre-feet per year (AFY) had been contracted to private customers and for SAWS' use.

The system was also designed to supplement base flows in the San Antonio River and Salado Creek. Annually, approximately 6,590 AFY is used to ensure flow during low flow periods or in the event of a drought. The result has been significant and lasting environmental improvements for the aquatic ecosystems in these streams. In addition to supplying base flow to the San Antonio River and serving our recycled water customers, SAWS also supplied CPSE over 42,000 ACFT of recycled water for use in their electrical generation. In 2022, distributed recycled water accounted for about 18% of SAWS' total water demand (potable and non-potable).

Ameresco

In 2010, SAWS partnered with Ameresco – a cleantech and renewable energy asset developer – under a Power Purchase Agreement where Ameresco captures, cleans, and sells wastewater digester biogas at the Steven M. Clouse Water Recycling Center. SAWS receives a portion of the proceeds.

This project is environmentally friendly, reduces SAWS' carbon dioxide emissions, and provides a renewable energy source.

SAWS has collected nearly a million dollars in royalties through this project since 2010.

Energy Efficiency

Recently, SAWS' Office of Energy Management has transitioned to the Office of Energy Strategy in order to better focus of strategic energy initiatives versus basic management of energy accounts. Over the last few years, SAWS' OES team has implemented multiple energy efficiency and cost reduction measures outside of the recently developed SEM project. A summary highlighting some of these projects is included below:

Demand Response Program. CPSE's Demand Response program is a voluntary load curtailment program for its commercial and industrial customers. The program is designed to reduce CPSE's peak load growth

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[8] 1 Acre-foot (ACFT) = 325,851 gallons.

by incentivizing customers to shed electrical loads as needed. Participation in CPSE's Demand Response Program reduces their need for generating capacity during peak afternoon hours.

SAWS volunteers three types of facilities to participate in the program: Pump Stations, Water Recycle Centers, and District Cooling Plants. In 12 years of participation, SAWS has consistently been able to reduce energy demand by 2-7MW annually, which has resulted in almost $2.5 million in incentive payments from CPSE.

Energy Rebates. OES consistently works with CPSE to collect rebates for infrastructure projects that save energy. Project examples include LED lighting, adding variable frequency drives (VFDs), and high efficiency chillers, among others. Since 2018, SAWS has collected roughly $1M in rebates.

Tariff Reviews. CPSE offers four different electrical tariffs, which SAWS can utilize at its discretion. To ensure SAWS is utilizing the most cost-effective tariffs, monthly calculations are performed to compare the actual costs vs the calculated costs under different tariffs. If particular accounts have lower bills in a different tariff versus the actual tariff, SAWS staff works with CPSE to switch to the more cost-effective tariff. Since 2019, this effort has saved SAWS more than $1M total in utility bills.

District Cooling Billing Demand Reduction Project. In an effort to help reduce peak demand and ratchet charges (base demand charges applied throughout the year based on summer peak), OES worked with Information Services on a project to give district cooling operators the ability to view the plant's energy demand in real time. This real time access to energy data gives operators the ability to make operational changes to avoid demand peaks. Since implementing this project in 2021, SAWS district cooling has been able to avoid ratchet charges completely and cost savings are in excess of $100,000 annually.

High Efficiency Chillers. Several existing chillers at SAWS' district cooling plants are past their useful lives (over 25 years old). In an effort to ensure service reliability and reduce energy consumption, these chillers are being replaced with high efficiency variable speed centrifugal chillers.

Vista Ridge. The Vista Ridge Project was designed and built with energy efficient equipment. Operational energy efficiency standards are also part of the contractual obligation for this project.

Supervisory Control and Data Acquisition (SCADA) System Upgrades. Following 2019-2020 initiatives, SCADA systems are in place throughout the SAWS water system and in wastewater system lift stations. SCADA can provide granular visibility into these systems, which in turn can allow operators to optimize energy usage.

Variable Frequency Drives (VFDs) and/or VFD Controllers. SAWS uses VFDs in some wastewater applications, the district cooling pumps, H2Oaks – which includes both the Desalination and ASR plants – some pump stations, and at Agua Vista. VFDs allow the energy consumption of motors to vary to meet demands instead of running at their maximum speed constantly.

Building Management System (BMS). A BMS has been installed at SAWS headquarters, which provides the visibility to optimize HVAC energy consumption throughout the year, including at zero occupancy. This BMS also controls SAWS' service centers' HVAC systems.

3 Energy Service Providers, Rates, and Costs

In order to develop goals and strategies to manage the cost associated with its energy use, it's important to first understand where these costs come from and what they are today. In general, SAWS energy costs are increasing, even without any formal utility rate increases. Regardless of future rate increases, SAWS can expect its energy costs to continue to rise for a variety of reasons including increasing fuel adjustment costs, extreme temperatures and increasing population leading to more frequent peak-demand periods, and global energy volatility, among others.[9]

SAWS gets its electricity from four electric utility providers covering multiple county lines: City Public Service Energy (CPSE), Bluebonnet Utility, the Guadalupe Valley Electric Cooperative (GVEC), and New Braunfels Utility (NBU). Seventy percent of SAWS' energy comes from CPSE as shown in Figure 3. The following sections provide more detail on each of these organizations as it relates to SAWS' energy costs.

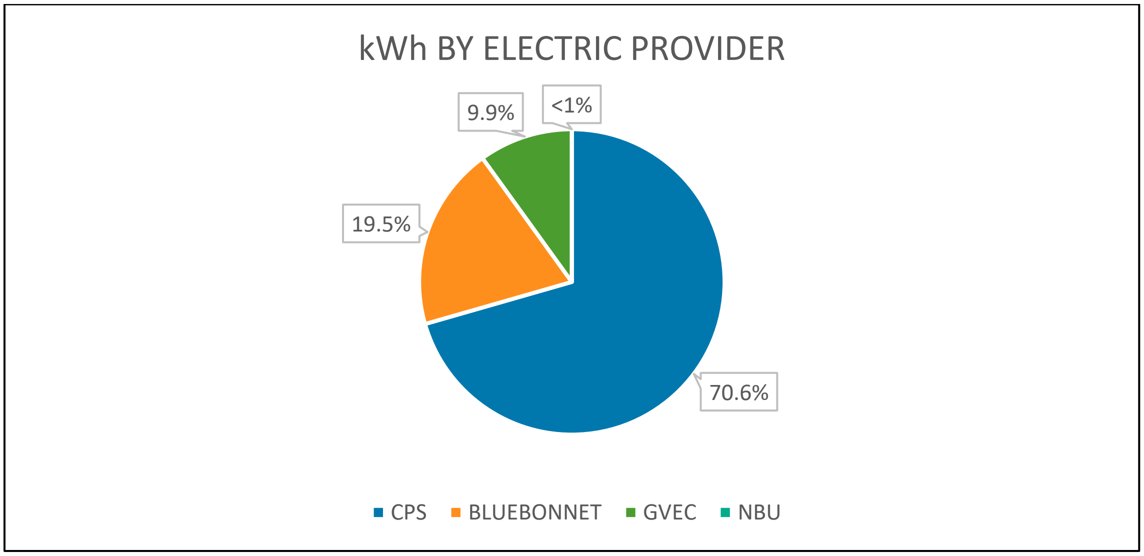

Figure 3. 2022 October YTD Energy Use by Utility.

3.A City Public Service Energy (CPSE)

CPSE is the largest utility from which SAWS receives electricity, with over 500 active SAWS accounts. The City of San Antonio owns CPSE, and it is the nation's largest municipally owned electric utility serving close to 900,000 electric customers. While CPSE provides both natural gas and electricity, most SAWS accounts are electric with only a few natural gas accounts.

Tariffs (Rates)

SAWS utilized four CPSE commercial electrical tariffs: General Service (PL), Large Light Power (LLP), Extra Large Power (ELP), and Super Light Power (SLP). Rate components include a service availability charge, energy charge (per/kWh), peak capacity charge, demand charge (per/ kW), fuel adjustment charge, and the TCEQ regulatory charge.

[9] Short-Term Energy Outlook Supplement: Sources of Price Volatility in the ERCOT Market (eia.gov)

The following figures provide a breakdown of each of these electrical tariffs, using data provided by OES in May 2023.

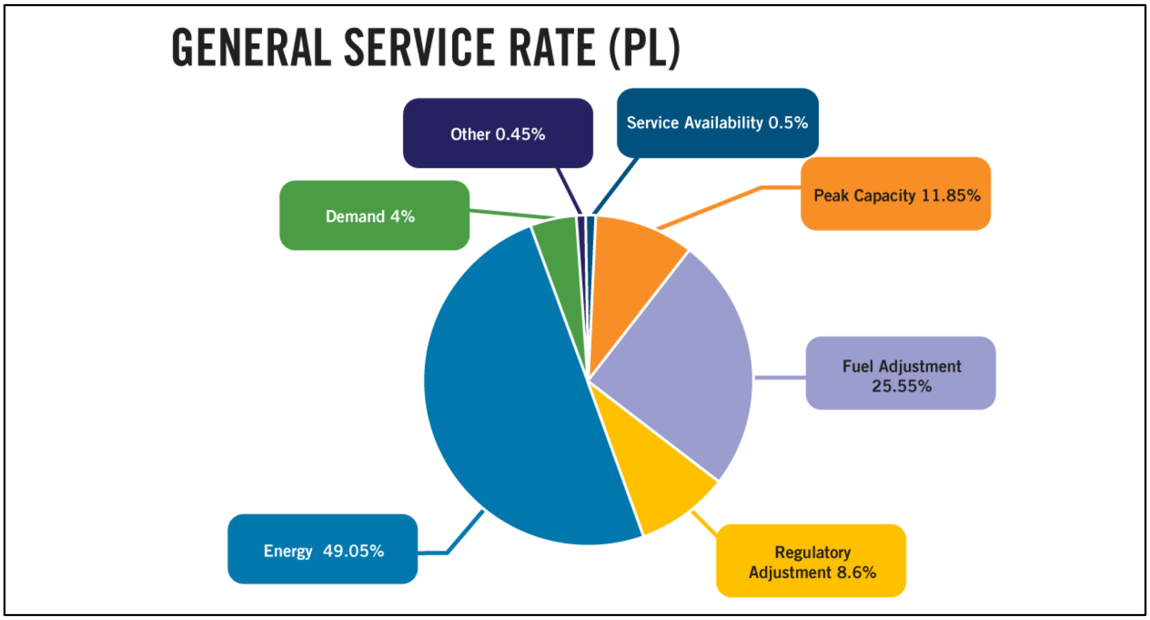

Figure 4. Twenty seven percent of SAWS electric expense occurs on the PL tariff rate. From this breakdown of the PL rate cost elements, the 65% that comprise Energy, Demand, and Peak Capacity charges are the ones that SAWS can most readily control.

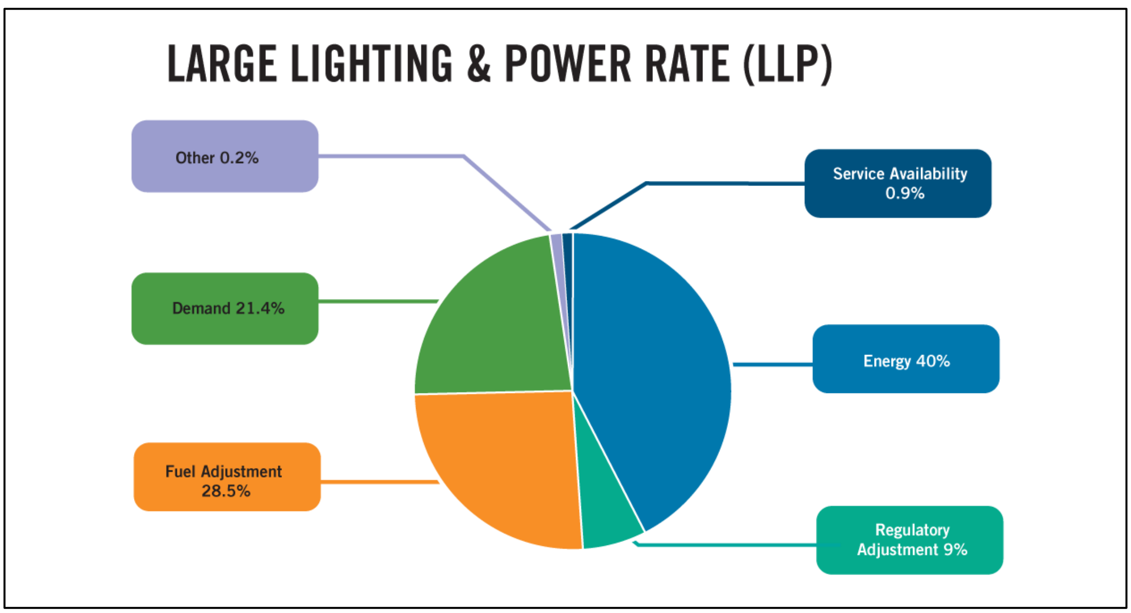

Figure 5. Seventeen percent of SAWS electric expense occurs on the LLP tariff rate. From this breakdown of the LLP rate cost elements, the 61% that comprise Energy and Demand charges are the ones that SAWS can most readily control.

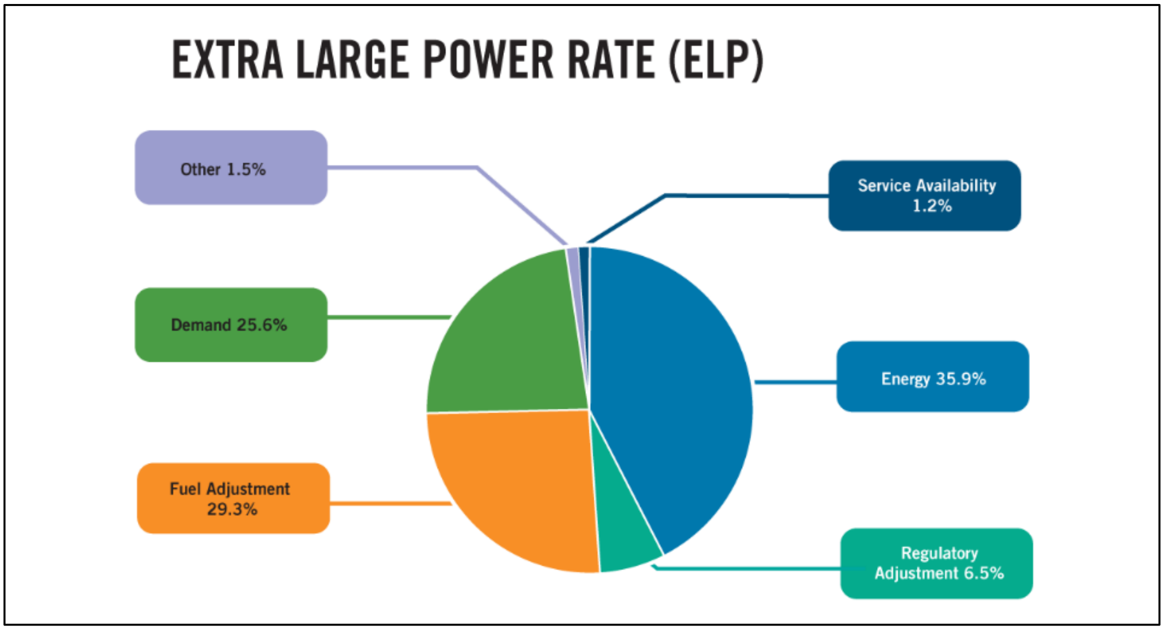

Figure 6. Thirty-eight and a half percent of SAWS electric expense occurs on the ELP tariff rate. From this breakdown of the ELP rate cost elements, the 61.5% that comprise Energy and Demand charges are the ones that SAWS can most readily control.

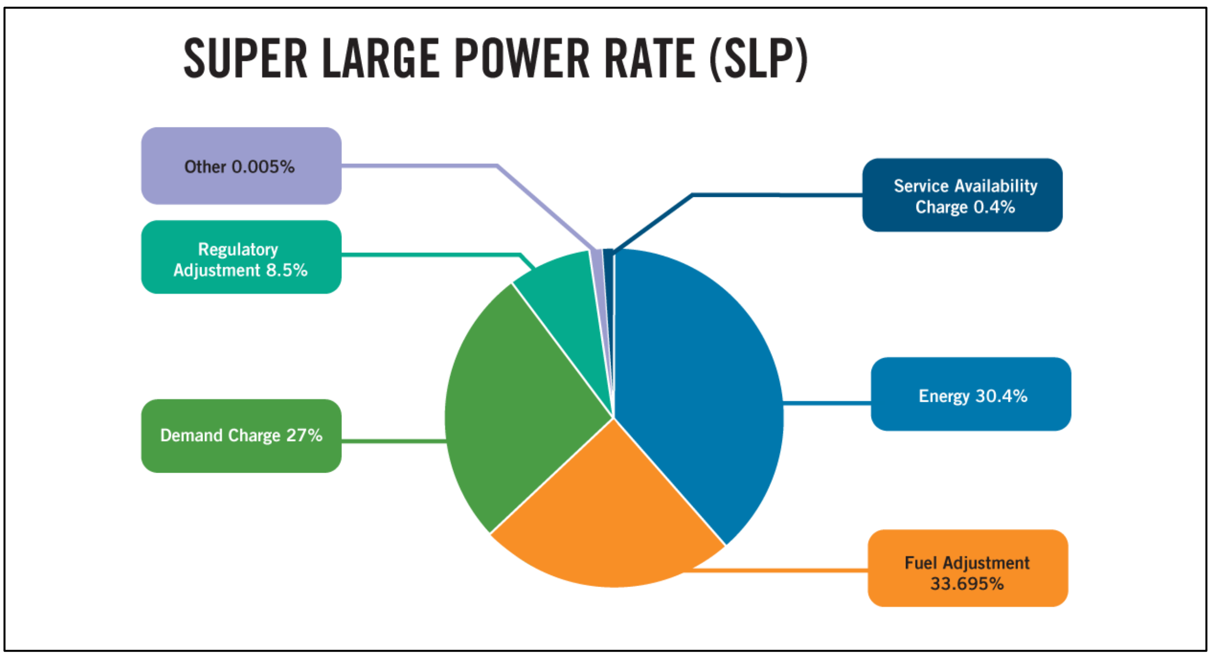

Figure 7. Seventeen and a half percent of SAWS electric expense occurs on the SLP tariff rate. From this breakdown of the SLP rate cost elements, the 57.4% that comprise Energy and Demand charges are the ones that SAWS can most readily control.

The figures above demonstrate SAWS' energy expense exposure comes from two sources: energy usage in general and peak energy demand. Overall energy usage can be reduced through efficiency projects and some operational changes, while peak demand charges can be reduced through operational changes, including 4CP awareness[10] and increased participation in Demand Response programs.

Tariff Increases

In 2022, CPSE implemented its first tariff increase since 2014. The 3.8% increase affected all four tariffs SAWS uses. One percentage point of the 3.8% tariff increase is dedicated to increased fuel costs due to a major 2021 winter and ice storm named Winter Storm Uri, explained in further detail in Section 3.C below. This one percentage point increase will be passed through the fuel-adjustment charge portion of each tariff category.

3.B Other Utilities

Bluebonnet Electric Cooperative

Bluebonnet provides energy for the Vista Ridge Project. Currently, SAWS has two accounts that use Bluebonnet energy and at pump stations, wellfields, and rectifiers.

Rates
SAWS uses the Commercial Single Phase and Distribution Primary Service rates. The bill components include wholesale power cost (including energy and power factor recovery factor) and distribution cost (including service availability, billed demand, and excess demand).

Guadalupe Valley Electric Cooperative (GVEC)

GVEC is an electric wholesaler providing energy for two SAWS projects: the Regional Carrizo Project and the Vista Ridge Project.

Rates
SAWS currently uses four types of GVEC commercial rates: Commercial Retail, G3, G4, and G5. The bill components include a service availability charge, delivery charge, demand charge, generation charge, and transmission charge.

New Braunfels Utility (NBU)

NBU provides service for two rectifiers for the Vista Ridge Project. These bills average less than 200 kWh per month.

Rates
The electric rate includes a Delivery Charge and Cost of Power Charge.

[10] All businesses, including SAWS, are charged the 4 Coincident Peak (4CP) charge. This fee is calculated based on the electricity consumed by that business in the previous year during June, July, August, and September – the four months during which the Electric Reliability Council of Texas' (ERCOT's) energy demand is highest, resulting in the highest energy costs.

3.C Costs Summary

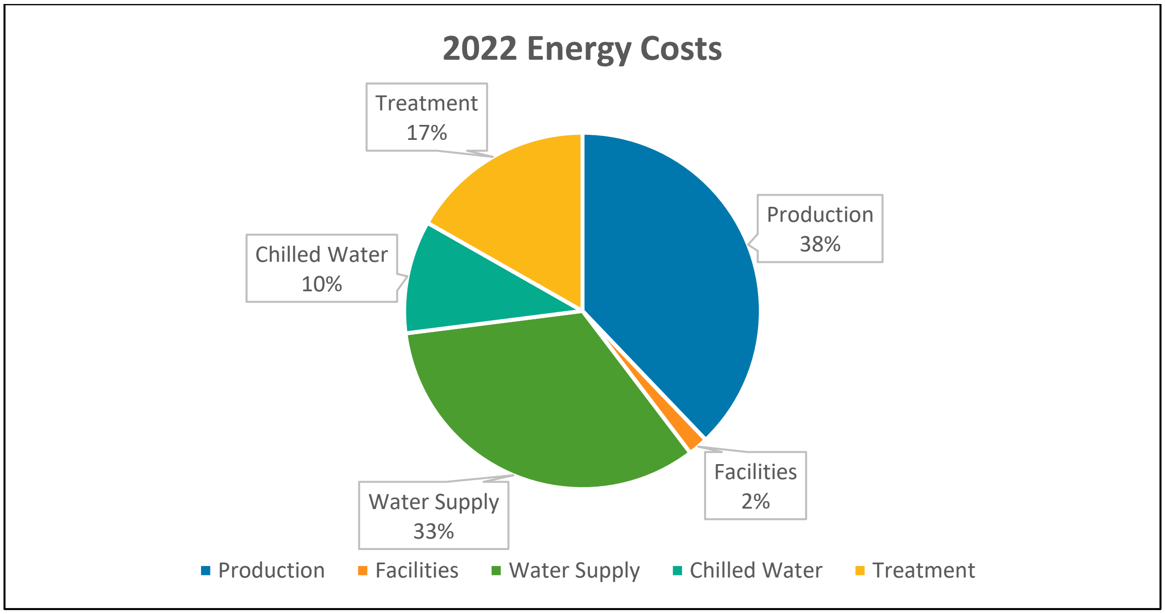

Figure 8. SAWS 2022 Energy Expenditures by Source

In 2022, SAWS paid approximately $45 million for energy.

Prior to the Vista Ridge Project's completion, roughly 95 percent of SAWS' power came from CPSE, and SAWS spent about $600,000 per year with GVEC. The majority of the power used to bring water to SAWS via Vista Ridge is provided by Bluebonnet (over $5.7 million per year), Guadalupe Valley (over $2.5 million per year for Vista Ridge), and New Braunfels Utility (about $1,000 per year). Today, roughly 70 percent of SAWS' power comes from CPSE.

All of these providers are "Non-Opt-In Entities (NOIEs)," meaning they operate in areas of Texas that are not subject to retail electric competition. Power pricing is only subject to tariffed rate structures of each NOIE.

Regardless of future tariff/rate increases imposed by each of these four utilities, SAWS expects its energy costs to increase year over year. Since 2012, SAWS' annual energy costs from CPSE have increased by an average of one percent each year. CPS only instituted a formal rate increase in 2014 and again in 2022. This trend is expected to continue.

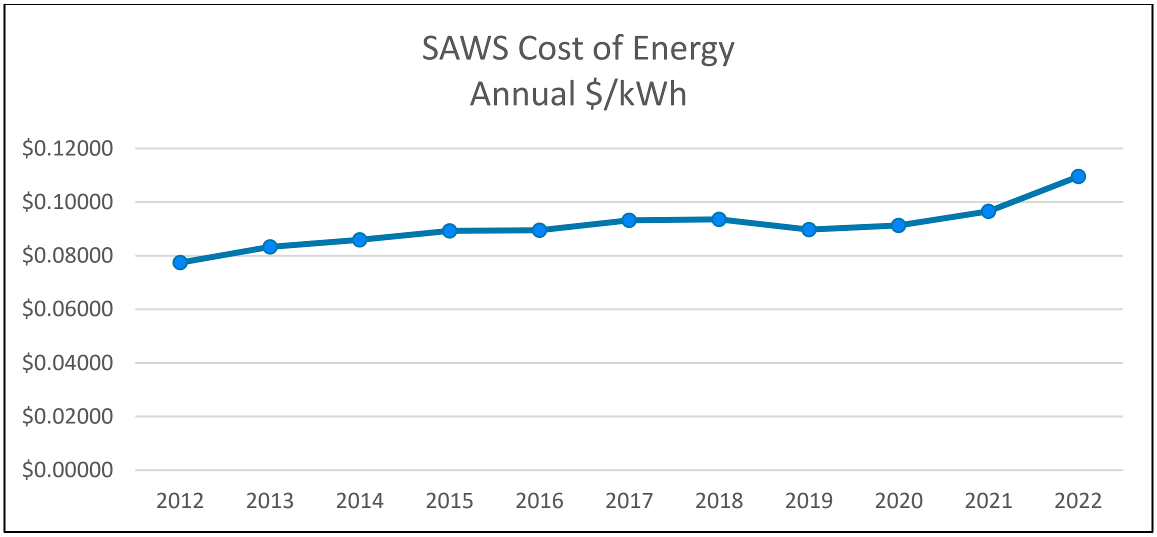

Figure 9. SAWS Historical Cost of Energy.

Additionally, in mid-February 2021, a major winter and ice storm, known as Winter Storm Uri, struck much of North America. The electrical grid within the borders of the ERCOT and the natural gas pipeline industry suffered massive failures. In addition to the loss of hundreds of lives and roughly $2 billion in property damage, there were enormous financial consequences to the Texas electric market participants. Massive wealth transfers occurred during the storm, related to the prices of natural gas, which fuels most of Texas' power generation. Since the storm, there have been bankruptcies, lawsuits, legislative changes, organizational changes at ERCOT and the Public Utilities Commission, and ongoing attempts to restructure the ERCOT market design. Ultimately, the costs from the storm will be borne by large energy consumers such as SAWS, and it will take years for cost impacts to subside.[11]

As mentioned in Section 3.A above, one percentage point of CPSE's 2022 tariff increase was directly dedicated to paying for fuel cost increases that resulted from Winter Storm Uri, which equates to approximately $300,000 a year to SAWS. GVEC charged SAWS a one-time recovery fee of $394,000 based on its energy use during Winter Storm Uri. Bluebonnet increased the power cost recovery factor portion of their energy charge by 15% which resulted in about a 10% overall bill increase. NBU's small commercial accounts appear to be unaffected thus far.

San Antonio is one of the fastest growing cities in America. Between 2010 and 2020, San Antonio's population increased approximately eight percent. Between April 2020 and July 2022, it increased another 2.7 percent.[12] Providing water services to an increasing population will increase SAWS' energy costs as well.

Increasing energy costs and future population growth mean that even if SAWS maintains its current energy consumption patterns, it will cost more moving forward. These costs make a comprehensive energy efficiency program important – energy efficiency will allow SAWS to cost-effectively manage its costs without compromising service to its customers.

[11] Short-Term Energy Outlook Supplement: Sources of Price Volatility in the ERCOT Market (eia.gov)
[12] U.S. Census Bureau QuickFacts: San Antonio city, Texas; United States

4 Baseline Assessment

4.A Overview

In order to develop goals and strategies to improve energy management, it is necessary to first understand how energy is being used. An energy baseline assessment provides that understanding and defines the key metrics that will be used to track future progress against established goals. During the first six months of SAWS' Year 1 SEM engagement (September 2021-February 2022), the consulting team conducted baseline assessments as part of developing energy regression models for the following 10 water and wastewater systems and subsystems:

Water:

- Holistic Potable Water System (all water supplies and distribution infrastructure)
- Edwards Water Supply
- Artesia, Seale, Randolph (ASR Recharge/Supply)
- H2Oaks Campus
  - Brackish Groundwater Desalination
  - ASR Treatment Plant
-
- **Wastewater:**
- Steven M Clouse WRC
- Leon Creek WRC
- Medio Creek WRC
- Recycled Water Distribution

These baseline assessments were based on the most recent available data for a period of at least two consecutive years. Therefore, for most of the systems and subsystems listed above, the baseline period was 2019-2021 or 2020-2021. The Holistic Potable Water System model was updated in June 2023 from a baseline period of 2018-2020 to a new baseline period of September 2020-October 2022 in order to accurately account for the Vista Ridge Project coming online in 2020. Specific baseline periods for each of the other water and wastewater systems and subsystems are included in the following sections.

The following sections provide summaries of SAWS' water portfolio, three water recycling centers, district cooling system, and auxiliary buildings. In 2022, SAWS' water system accounts for over two thirds of SAWS' total electricity use and wastewater accounts for approximately 17.5% as shown in Figure 10.

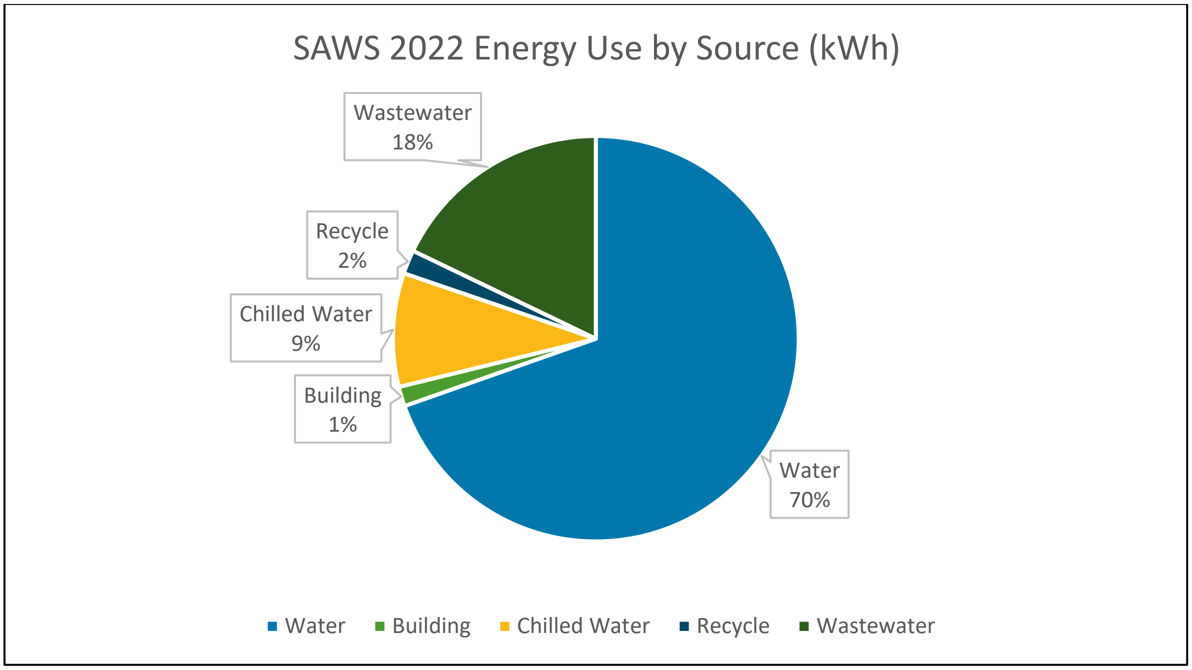

Figure 10. 2022 Energy Use by Source.

4.B Water

SAWS' water portfolio includes eight sources with 14 associated projects. This section describes each of those sources and projects and provides energy use data where applicable. All water production is included in the holistic model, and to provide additional clarity, some sources have individual models as well. SAWS water system production by source and the energy use by source are shown in Figures 11 and 12 below. Table 2 shows the SAWS water system **total energy use** in kWh for 2019-2022.

Table 2. SAWS Water System Energy Use

Year	Energy Use (kWh)
2019	172,841,778
2020	226,879,129*
2021	306,727,385
2022	337,968,172

**The large jump from 2019 to 2020 is a result of the Vista Ridge project coming online. 2020 only includes 8 months of Vista Ridge as project came online in May.*

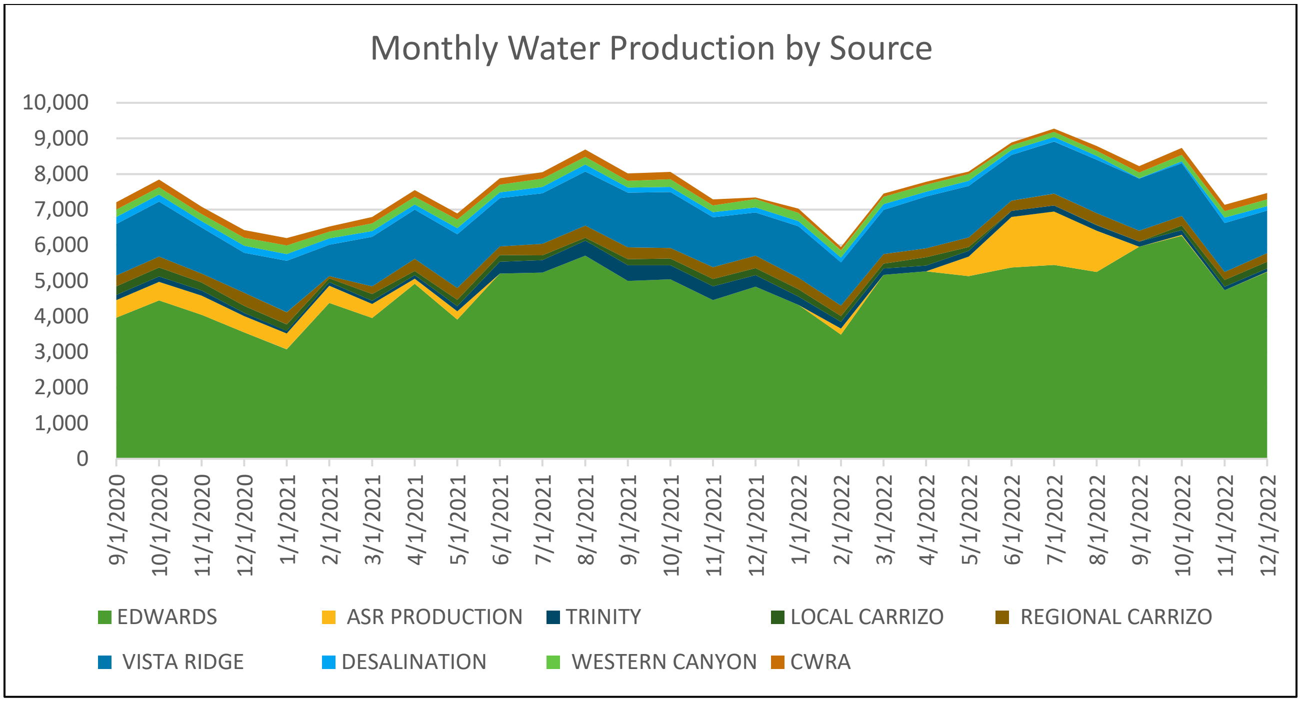

Figure 11. Monthly water production (in millions of gallons) by SAWS water source for the baseline period September 2020-December 2022.

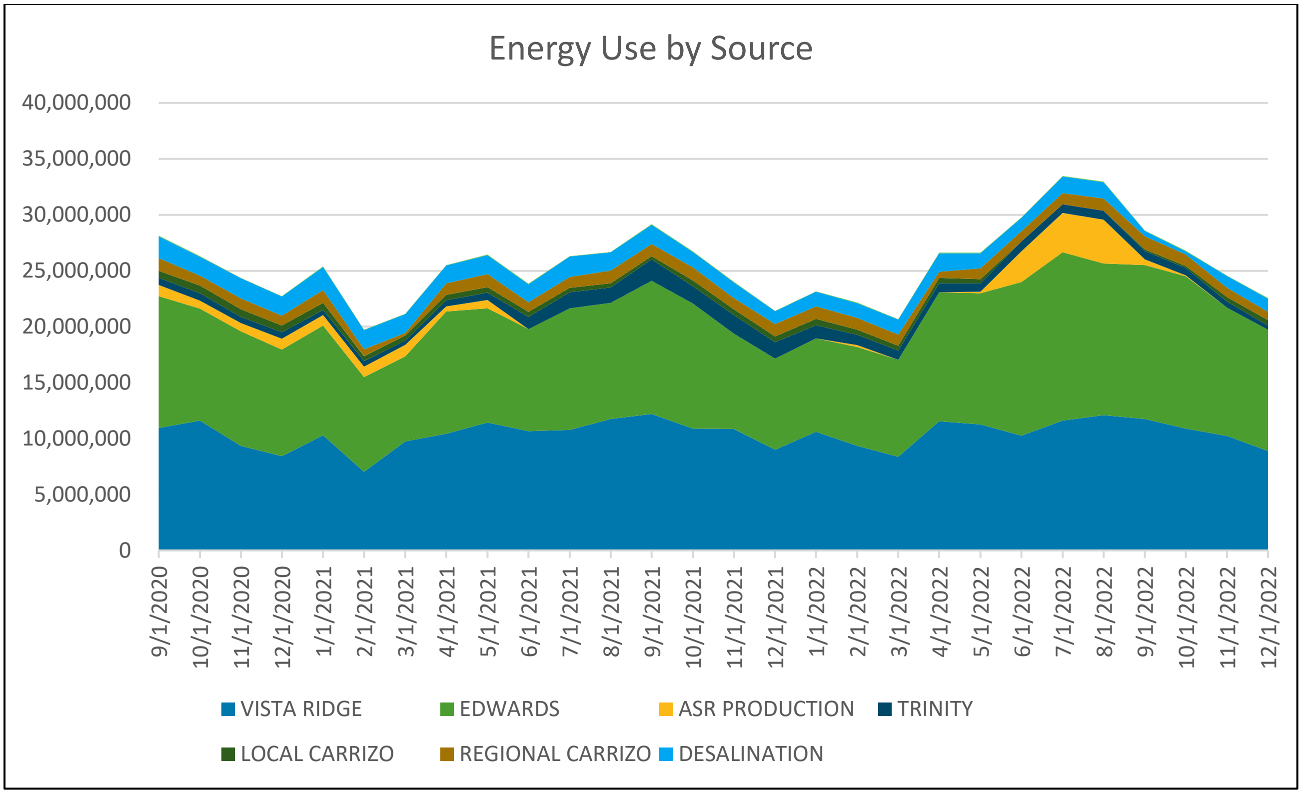

Figure 12. SAWS monthly energy use (in kWh) by water source for the baseline period September 2020-December 2022. This data does not include energy data for Western Canyon or CRWA, because energy use is not known. SAWS pays a lump sum per AFY through those contracts.

Water Portfolio

Aquifer Storage and Recovery (ASR) Project

Today, the ASR Recharge/Supply system takes water from three primary pump stations in the Edwards Water Supply – Artesia, Randolph, and Seale – and supplies it to the ASR injection wells at the H2Oaks facility, allowing SAWS to store Edwards water. In 2022, 5.1 percent of the water SAWS distributed came from the ASR Project.

The ASR treatment plant adjusts the hardness of the water to match the water conditions of the Edwards water supply. Because the ASR storage water originated in the Edwards aquifer, some of it does not require treatment through the ASR plant (depending on demand requirements).

The energy use associated with the production of stored water from the ASR Recharge/Supply project for 2018 – 2022 is 5,676,753 kWh per year.

This water is treated at the ASR Treatment plant, located on the H2Oaks campus. The treatment plant adjusts the hardness for water from the Local Carrizo wellfield, described below, and some of the ASR injection wells. The energy use associated with producing and treating Local Carrizo water in the ASR Treatment Plant during the baseline period is 5,547,219 kWh per year.

Carrizo Aquifer / Local and Regional Carrizo Projects

The Carrizo Aquifer stretches from the Rio Grande to parts of Arkansas and Louisiana, supplying water to over 60 Texas counties. The Local Carrizo project is a SAWS-owned supply located on H2Oaks property. SAWS can access up to 9,900 AFY. The Regional Carrizo project includes water purchased from Schertz-Seguin Local Government Corporation (SSLGC) and the SAWS Buckhorn wellfield. These projects began in 2013 and 2014 respectively. Lastly, SAWS also has an agreement with the Canyon Regional Water Authority to purchase up to 2,800 AFY from the Carrizo Aquifer in Gonzales and Guadalupe counties.

In 2022, Carrizo Aquifer water contributed 4.3 percent of the total volume of water SAWS distributed.

A baseline assessment was conducted for the H2Oaks property, which includes the Local Carrizo project. The energy use associated with the Regional Carrizo Project was assessed as part of a holistic assessment of SAWS' water distribution system.

Edwards Aquifer

The Edwards Aquifer is among the oldest water source for the City of San Antonio. Edwards water is produced by numerous wells and booster stations scattered throughout the entire system and a broad range of pressure zones. Edwards still provides the most water utilized by the system annually. In 2022, approximately 57 percent of the water used by SAWS customers came from the Edwards Aquifer. Today, SAWS has permits to access approximately 259,000 acre-feet (AF) for the year. However, due to regulatory cutbacks and in order to benefit the Edwards Aquifer Habitat Conservation Plan, the volume SAWS is actually able to use this year from Edwards may drop to 169,000 AF if the current drought conditions persist. In a worst-case scenario during the Drought of Record, Edward's availability could be as low as 105,000 AF with a 44% cutback and additional Edwards Aquifer Authority forbearance reduction. These Edwards Aquifer cutbacks necessitate the usage and management of the other non-Edwards water sources, including the associated increase in energy use.

The baseline assessment for the Edwards Aquifer was established using a baseline period of May 1, 2019 through July 31, 2021. The energy use associated with the Edwards Aquifer during the baseline period was 125,085,043 kWh per year.

Simsboro Aquifer / Vista Ridge Project

Starting in April 2020, SAWS customers began receiving treated water from the Vista Ridge Project, which consists of a 142-mile pipeline that delivers water from Burleson County wells to supply over 200,000 households in San Antonio with water. SAWS' contract allows it to purchase 50,000 AFY of Simsboro and Carrizo aquifer groundwater, plus limited make-up units in certain years when applicable. Besides the pipeline, SAWS constructed the infrastructure so the Aqua Vista site could condition and treat approximately 48 million gallons per day (MGD) of water to match Edwards Aquifer water quality.

The Vista Ridge Project was ramping up during the baseline period, and energy use was 71,551,990 kWh per year at that time. On average, energy use associated with the Vista Ridge Project is approximately 130M kWh per year.

Trinity Aquifer / Texas Water Supply Company, Oliver Ranch, and Timberwood Projects

The Trinity Aquifer and its three associated projects: Texas Water Supply Co., Oliver Ranch, and Timberwood provided approximately 2.0 percent of SAWS' total distribution in 2022. Texas Water Supply Co. is the largest of these projects, and it is contractually allowed to produce up to 17,000 AFY. However, practically this would only be possible during very sustained, wet periods of time. SAWS purchases water from the Trinity Aquifer through an agreement with the Texas Water Supply Co., which expires in 2027.

The Oliver Ranch Project is an agreement with the Massah Development Corporation to purchase water from the Trinity Aquifer, delivering 2,000 ACFT.

The Timberwood Project is the smallest Trinity Aquifer project, delivering up to 1,000 AFY of Trinity water from four wells in Northern Bexar County.

The energy use associated with these three projects was included in the holistic assessment of SAWS' distribution systems, shown in Figure 12.

Wilcox Aquifer / Brackish Groundwater Desalination (BGD) Project

Starting in 2016, SAWS began pumping brackish (salty) water from the Wilcox Aquifer and treating it to produce potable water. The treatment plant is located at the SAWS H2Oaks Center. The desalination plant can produce up to 11,200 AFY of finished water today, but it was designed to allow for expansion in order to produce over 33,000 AFY. Finished water from this plant is blended with the finished water from the ASR and Local Carrizo treatment plant and directly from some of the ASR wells before it is boosted into the distribution system. In 2022, 4,300 AFY was distributed to customers from the desalination plant, totaling 1.5 percent of the total distributed water that year.

The energy use associated with the BGD Project during the baseline period was of 16,666,252 kWh per year.

Water Purchase Contracts

Canyon Lake

This surface water project was established in April of 2006 and delivers treated water from Canyon Lake to SAWS customers. SAWS has an agreement with the Guadalupe-Blanco River Authority and water purveyors in Comal, Kendall, and Bexar counties to receive a minimum of 4,000 AFY. Additionally, SAWS takes any water unable to be used by other entities. This amount fluctuates from year to year depending on demand in those other utilities. The additional amount has been steadily reducing due to population growth and increased customer demands.

SAWS pays per AF for this water and is not directly responsible for associated energy use through this contract.

Lake Dunlap

Through an agreement with Canyon Regional Water Authority, SAWS can receive up to 4,000 AFY of treated surface water through the end of 2023. At that time, the water volume is returned in basin and CRWA replaces this 4,000 AFY to SAWS with groundwater supplies. Starting January 1, 2024, the full water volume from CRWA (6,800 AF) will be produced from the Wells Ranch Carrizo groundwater source.

SAWS pays per AF for this water and is not directly responsible for associated energy use through this contract.

Table 3. SAWS Water Portfolio Contract Summary

Source	Project	Principle Contract Expiration Date	Permit/Contract Availability (AFY)	Firm Yield (AFY)*	Cost/AF**	Notes
Simsboro Aquifer	Vista Ridge	2080	50,000	50,000	$1,954.00	Vista Ridge is blended with Carrizo Aquifer water at 20%-30%. At end of the P3 contract term in 2050, the project reverts to SAWS ownership.
Trinity Aquifer	Texas Water Supply Co	2027	17,000	2,000	$1,299.00	
	Oliver Ranch	2035	2,000	2,000	$806.00	Minimum take of 100 AF/month. If actual take is <100 AF in a month, cost is = $/AF*100. Unused volume has 12-month roll over.
	Timberwood***		1,000	1,000	N/A	Cost analysis unavailable.
	Western Canyon	2037	4,000	4,000	$1,072.00	SAWS base supply is 4,000 AF, however, SAWS is required to take what other entities are not able to take. This amount fluctuates.
CRWA	Lake Dunlap	2023	4,000	4,000	$1,165.00	At end of contract, water volume will be transferred to Wells Ranch groundwater through 2047.
	Wells Ranch	2047	2,800	2,800		Additional 4,000 AF will be added beginning in 2024.
Regional Carrizo	SSLGC	2080	500	11,533	$1,526.00	Contract with SSLGC to allow an optional purchase 0-75% of SSLGC surplus water. Planned annual take is 500 AF.
	Buckhorn***	2080	11,688			

*Firm Yield is the volume of water which can be produced from a defined source during a repeat of the drought of record under existing regulatory, legal, contractual, hydrological or infrastructure constraints.

**Cost is gathered from the 2017 Water Management Plan data, most recent approved cost analysis.

***SAWS owned or permitted, not contracted.

Water Portfolio Energy Intensity

Where a baseline assessment provides the total energy used over a period of time, to further understand how energy is used within SAWS and to understand the associated costs, OES calculated the energy intensity of the SAWS water portfolio. To establish energy intensities, the energy use during the baseline period was compared with each projects' production volume (in million gallons), energy cost, and cost of purchasing the water in the cases where SAWS does not own the water rights. It is important to understand the associated energy intensity of SAWS' water portfolio, because it has both energy and cost implications that can affect how SAWS prioritizes action and makes progress against the goals established in this ESMP.

The energy intensity assessments were developed using at least one year of data within the last three years for which monthly energy and production data were available. Key metrics included:

- Production volumes
- Energy Consumption (kWh)
- Electricity cost
- Contracted cost of water rights

Energy Intensity Methodology

As described above in Section 4.B, SAWS produces or purchases water from eight different sources. One significant efficiency opportunity for the system is to prioritize the use of the water sources that require less energy over the sources that use more energy. The methodology for calculating these energy intensities can be complex. For our analysis we used the following rationale:

1. Production data and energy use data were used for calendar years 2019 to 2021 for all water supplies.
2. To calculate the energy intensity, in kWh per million gallons produced, we totaled the energy used during the measurement period and divided by the millions of gallons produced during the same period.
3. The ASR Plant total energy includes energy for the Local Carrizo wells and the ASR wells.
4. The Desalination Plant total energy includes energy for the Desalination wells but excludes energy for the West High-Service Pumps.
5. Both the Canyon Regional and the Western Canyon Project include energy use in the cost of the water; for those supplied we could not calculate an energy intensity, only a cost per million gallons ($/MG).
6. Any depreciation of assets and O&M costs were excluded from the cost per million gallons calculations for assets owned by SAWS.
7. Figure 13 below shows the energy intensity of SAWS' various water sources based on analysis conducted by the OES team. These values are not yet considered final by SAWS. The chart shows the energy required to produce one million gallons from each of the water sources in the SAWS system. These energy intensity numbers are represented as kilowatt-hours per million gallons (kWh/MG). Because some of the water sources are purchased water, there is also a column that indicates the purchase cost and energy cost to produce water from each source in dollars per million gallons ($/MG). For the $/MG column, only variable costs are included. It excludes construction costs,

depreciation, and O&M costs for these sources. The columns have been color coded from green to red with green being the lowest kWh/MG or $/MG and red being the highest.

Water Sources	Energy Intensity (kWh/MG)	Overall $/MG (energy and purchase cost)
Edwards	1,791	$ 143
ASR Plant	2,887	$ 231
Regional Carrizo	3,113	$ 1,811
Timberwood (Trinity)	3,638	$ 291
Oliver Ranch (Trinity/Massah)	4,177	$ 2,285
TX Water Supply (Trinity)	4,893	$ 3,814
Vista Ridge	7,492	$ 6,245
Desalination	9,323	$ 746
Canyon Regional Water Authority (CRWA)	N/A	$ 4,982
Western Canyon/GBRA	N/A	$ 2,783

Figure 13. Energy Intensity of SAWS' Water Sources.

Today, non-energy criteria are used for water sourcing decisions. Moving forward, these energy intensity calculations can help ensure that energy is one of the decision-making factors alongside take or pay obligations, permitting, and others.

4.C Wastewater

SAWS operates three water recycling centers (WRCs). The following sections provide information on each and the energy baseline assessments for 2020-2022.

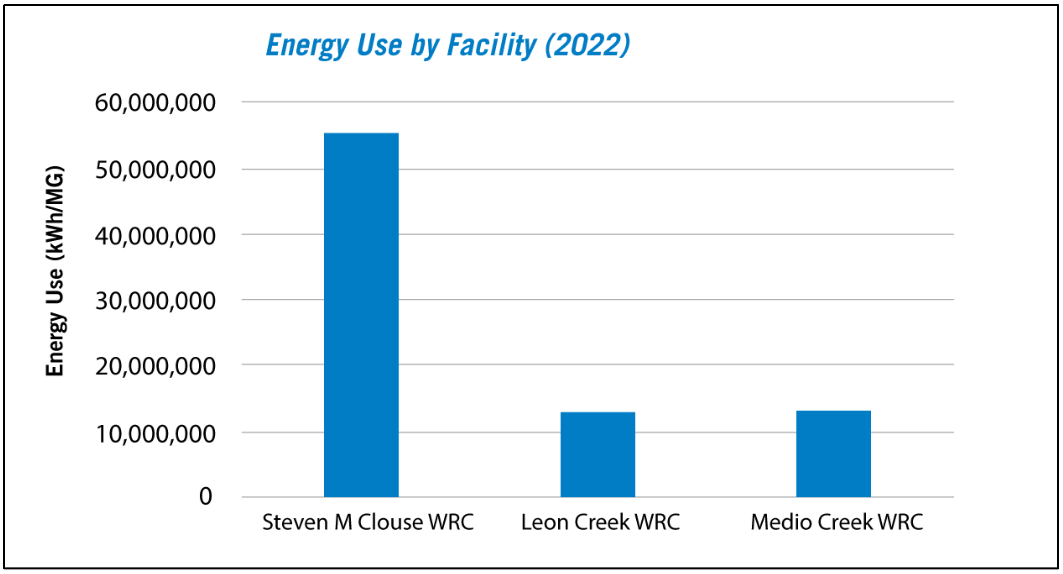

Figure 14. 2022 Energy Use (in kWh/MG) by SAWS WRC Facility.

Steven M. Clouse WRC

The Steven M. Clouse wastewater plant is an activated sludge plant that treats waste from the Central, East, Far West, and South Sewersheds plus some raw sewage from the Leon Creek WRC. Clouse also serves as the central biosolids processing facility for SAWS. The plant has a first- and second stage-aeration process. Some of the treated wastewater from this plant is used as reclaimed water. The plant also has a renewable energy lease agreement with a third party for beneficial use of the plant's biogas.

The baseline period of July 1, 2020, through June 30, 2021, was used to establish the energy model. Multiple variables were tested to determine the most statistically significant model possible, ultimately three were chosen for the model, they are:

1. Total Flow (MG)
2. Outfall 800 Type 1 Reuse (MG)
3. March 2021 Change Indicator (0,1)

The following table shows total energy use (in kWh) at the Clouse WRC in 2020, 2021, and 2022.

Year	Energy Use (kWh)
2020	50,102,565
2021	55,377,349
2022	55,649,801

Leon Creek WRC

The Leon Creek wastewater plant treats waste from the Western Sewershed. The plant is an activated sludge plant, however the solids from this plant along with some raw sewage are sent to the Clouse treatment plant. Some of the treated wastewater from this plant is used as reclaimed water.

The baseline period of June 1, 2020, through May 31, 2021, was used to establish the energy model. Multiple variables were tested to determine the most statistically significant model possible, ultimately three were chosen for the model, they are:

1. Outfall 001 Flow (MG)
2. Outfall 002 Flow (MG)
3. Outfall 800 Type I Reuse Flow (MG)

The following table shows total energy use (in kWh) at the Leon Creek WRC in 2020, 2021, and 2022.

Year	Energy Use (kWh)
2020	12,516,863
2021	13,645,659
2022	13,953,837

Medio Creek WRC

The wastewater plant treats waste from the surrounding area in two distinct plants that share a common lift station. Both plants are extended aeration sludge plants with aerated carousels. The solids from this plant are pumped to the collection system for the Leon Creek plant. Disinfection is provided with UV treatment.

The baseline period of June 1, 2020, through May 31, 2021, was used to establish the energy model. Multiple variables were tested to determine the most statistically significant model possible, ultimately two were chosen for the model, they are:

1. Total Flow (MG)
2. Pre-March 2021 Indicator (0,1)

The following table shows total energy use (in kWh) at the Medio Creek WRC in 2020, 2021, and 2022.

Year	Energy Use (kWh)
2020	12,963,270
2021	13,225,590
2022	13,017,810

Recycled Water Supply

Over 130 miles of pipelines deliver highly treated non-potable recycled water to over 85 customers, including golf courses, municipal parks, universities, military, healthcare, and to supplement base flows in the San Antonio River and Salado Creek. Altogether, the recycled water system accounted for approximately 18 percent of SAWS' total water demand (potable and non-potable) in 2022.

The baseline period of April 1, 2019 to March 31, 2021 was used to establish the energy model and understand average energy use. SAWS' recycled water system used an average of 8,349,486 kWh per year during the baseline period.

4.D District Cooling

SAWS has owned and operated district energy infrastructure in downtown San Antonio since 1968. The original district cooling and steam plant provided five 2,000-ton chillers and two 40,000-pound per hour boilers. SAWS delivered both district cooling and steam to the convention center, federal buildings, and several hotels in the downtown area until 2014, when SAWS terminated the steam business. In 2000, SAWS built a second district cooling plant downtown. In 1999, the City of San Antonio created the Greater Kelly Development Association (GKDA) to control and manage an industrial development area created from a former Air Force base known as the Port of San Antonio (Port SA). In 2000, SAWS assumed ownership of the district cooling and steam assets at Port SA. In 2014, SAWS terminated the steam business and transferred the steam assets back to GKDA.

The SAWS downtown district cooling customer profile currently includes 21 total customers. City of San Antonio accounts are 69 percent of the load, hotels are 23 percent of the load, federal accounts are five percent, and five small miscellaneous accounts are three percent of the system load. At full capacity the downtown district cooling system can produce up to 20,000 tons of district cooling.

The Port SA district cooling customer profile includes five total customers: three aviation accounts that are 75 percent of the system load as well as Port SA and the Air Force, which account for 25 percent of the system load at that location. At full capacity the Port SA district cooling system can produce up to 6,000 tons of district cooling.

Today SAWS' district cooling system uses roughly 45,000,000 kWh of electricity annually.

4.E Buildings / Auxiliary

SAWS' auxiliary buildings not associated with water or wastewater treatment processes, including its headquarters office building and service centers, only account for 1.6 percent of SAWS' total energy use. The following table shows total annual energy use (in kWh) from SAWS' buildings and auxiliary facilities in 2021 and 2022.

Year	Energy Use (kWh)
2021	6,707,015
2022	7,599,552

5 Pathway to Achieving Energy and Cost Saving Goals

5.A Approach

In September 2021, SAWS began a year-long SEM engagement. This effort was led by Chris Wilcut, SAWS' Director of District cooling & Energy Strategy, and his energy strategy team, who were instrumental in the progress made over the course of the engagement. In the first six months, SAWS formed five energy teams to lead energy strategy activities in different areas of SAWS operations. These teams each participated in a treasure hunt in December 2021, involving specific discussions about energy uses within the water and wastewater systems, site tours (or virtual tours for the distribution system), free exchange of information between the SEM delivery team and SAWS energy teams, and a brainstorming session where the energy teams created a list of ideas for saving energy within their process. Each of the WRC energy teams participated in a second treasure hunt in the spring of 2023.

The SEM implementers held an initial kick-off meeting on September 10, 2021, that was presided over by members of the SAWS executive team, introduced the SEM program, and laid out expectations for participants. Along with monthly follow-up calls after the treasure hunts, the following activities occurred through Years 1 and 2 of the SEM engagement:

Training

- Executive Kickoff Meeting: September 10, 2021
- Leadership Workshop: September 21, 2021
- Wastewater Kickoff Meeting: September 22, 2021
- Water Kickoff Meeting: September 23, 2021
- Wastewater Energy Team Meeting: October 4, 2021
- Water Energy Team Meeting: October 5, 2021
- Workshop 1 Water: October 14, 2021
- Workshop 1 Wastewater: October 28, 2021
- Workshop 2 Water: November 30, 2021
- Workshop 2 Wastewater: December 1, 2021
- Wastewater Process Optimization Training I: March 3, 2022
- Wastewater Process Optimization Training II: March 10, 2022
- Wastewater Process Optimization Training III: March 17, 2022
- Energy Sensei Training: March 24, 2022
- Workshop 3: May 31, 2022
- Workshop 4: October 5, 2022

Treasure Hunts

SAWS Energy Teams and consulting staff toured the sites listed below to find and document all potential ECMs within each site. Treasure hunts typically last the full day. Consulting staff provide energy savings and cost of implementation estimates for each identified project. Energy Teams implement the projects identified during the Treasure Hunt throughout the SEM program to support energy conservation goals.

Water

- H2Oaks Campus: December 8, 2021

- Water Distribution System: December 9, 2021

Wastewater

- Steven M Clouse WRC: December 6, 2021 and June 2023
- Leon Creek WRC: December 7, 2021 and June 2023
- Medio Creek WRC: December 7, 2021 and May 2023

These treasure hunts, the subsequent brainstorming sessions, opportunity registers, and energy regression model development all form the basis of understanding how SAWS can achieve the goals established in this plan.

5.B Results

Overall, SAWS has significant potential to save energy and costs through improving the energy efficiency of its operations.

To date, the energy teams have documented more than 100 energy efficiency projects. The most viable ECMs total approximately 75 million kWh in potential energy savings and over $6 million in avoided costs or approximately 14 percent of SAWS' annual energy expenditure. These opportunities also represent over 40,000 metric tons of CO_2e in avoided emissions potential, which equates to taking approximately 8,695 passenger cars off the road for a year.

Specific projects and recommendations from the different treasure hunts are outlined in the next section.

During Workshop 4, held on October 5, 2022, energy team members filled out an Energy Management Assessment (EMA) Self Evaluation to prompt discussion on their progress in the SEM program so far. The full EMA is included as Appendix C. This survey had energy team members rank SAWS' current energy strategy activities in the categories of commitment, planning and implementation, and measuring and reporting. Table 3 shows the overall results of the self-assessment. The scores are out of five total possible points with five representing the highest level of engagement or strongest procedure in place for each category. SAWS energy team members will participate in this same EMA at the end of Year 2 of the SEM engagement in 2023.

Table 4. 2022 EMA Results (scores are out of five total possible points)

Program Element	Primary Assessment Point	Score
Commitment	Policy & Goals	0.5
	Resources	2.5
	Communication	1.0
Planning and Implementation	Project Management	2.5
	Employee Engagement	2.25
	Reassessment	1.5

Measuring and Reporting	Data Collection & Availability	3.0
	Analysis	4.0
	Reporting	3.0

5.C Roadmap and Recommendations

This section provides recommendations on potential projects and processes SAWS may consider implementing in order to achieve its commitment of 10 percent reduction in energy intensity (kWh/unit) over five years. The energy (in kWh) and cost savings included in this section are estimates and should not be taken to represent exact quantities of energy or dollars savings SAWS will see by implementing each project. Additional calculations by OES or consulting staff would be required to establish more exact predictions.

It is important to note that the energy conservation measures detailed in this section are only for consideration. Some of these may only be partially implemented based on the priority needs of the specific department. Since this plan is intended to be a living document, this is not an exhaustive list of projects. It is expected that projects can and will be changed, added, or even deleted.

The steps to achieving SAWS' goal include:

1. Start with pursuing low- and no-cost energy conservation measures (ECMs) identified within SAWS' water, wastewater, and district cooling systems. The priority projects for SAWS' water and wastewater systems are summarized in this section and full opportunity registers are included as Appendix B. SAWS should focus on the projects identified in this section between now and the first update to this ESMP in 2026.
2. As part of its long-term energy strategy program, SAWS may consider pursuing the United States Department of Energy's 50001 Ready Certification described in more detail below.
3. As described in Section 5.A, SAWS established five energy teams during its Year 1 SEM engagement. These operations team members and managers can play an integral role in maintaining an energy strategy program within SAWS. It is important that cross-functional teams maintain communication and understand the importance of their role in continuing to advance energy efficiency efforts at SAWS. Current energy teams (as of December 2022) are included as Appendix A.
4. Funding for energy efficiency projects must follow a well-understood and agreed upon process. This section outlines some recommendations.
5. In general, establishing a strong energy strategy program at SAWS means energy usage and cost will be considered in all aspects of the business. Going forward, energy efficiency should be incorporated into the procurement and design phases of new programs and projects at SAWS. Section 6 outlines energy strategy program best practices in more detail.
6. After implementing low- and no-cost projects, SAWS should consider conducting full ASHRAE Level 2 audits of certain facilities in order to pursue longer-term, capital energy efficiency projects.
7. Lastly, SAWS should regularly investigate and analyze potential renewable energy project opportunities, described further in Section 6.

Water System Energy Conservation Measures

The top four projects identified within SAWS' **holistic water system** are outlined below. Together, these projects represent approximately **51.7 million kWh per year** in savings or **27,665 Metric Tons CO2e per year** in potential avoided emissions. As stated above, these values are estimates and do not represent exact savings quantities. For the water and wastewater measures summarized in this section, avoided emissions data is calculated by converting energy data to metric tons of carbon dioxide-equivalent emissions (CO2e) using the factors associated with the site's eGRID subregion.[13] eGRID is a US Environmental Protection Agency database that aggregates the energy mix of the electrical power grid in 27 subregions throughout the United States. SAWS is associated with the ERCT subregion.

Opportunity 1: Calculate the Energy Intensity of Different Water Sources and Develop Sourcing Strategies that also Account for Energy Costs

Background: SAWS has eight different water sources for their water system. These water sources include traditional groundwater wells, brackish groundwater desalination, aquifer storage and recovery (ASR), and multiple wholesale water purchase agreements with neighboring water sources.

Each of these water supplies has a different energy intensity (kWh/MG) to produce the water and transport it to the SAWS water system. The most energy intensive sources require over five times the energy to supply water than the least energy intensive sources.

Over the years, in a concerted effort to diversify water supply, the system has shifted production from the Edwards Aquifer to more distant sources. In 2022, the Edwards Aquifer water supplied approximately 57 percent of potable water distributed to SAWS customers. The remaining water production was split between the other eight water sources.

BY THE NUMBERS

Estimated Annual Savings: 29,179,000 kWh

Estimated Annual Avoided Costs: $2,626,000

Estimated Annual Avoided Emissions: 15,638 Metric Tons CO2e

Timeline: Mid-Term

ECM: The energy cost to produce water should be included as an element of the water sourcing strategy, so the system can consider reducing overall energy use. When possible, the system should consider options throughout the year that meet diversification, contractual, and demand goals while also reducing production in sources that require more energy.

It is unreasonable to expect the system would be able to completely discontinue the use of any of these water sources, but even a 5% to 10% shift of water from more energy intensive sources to lower energy intensive sources when appropriate will yield significant savings. An example might include shifting H2Oaks production from Desalination to ASR when possible.

[13] Power Profiler | US EPA

Opportunity 2: Consider Energy Intensity within Production Infrastructure

Background: Among the SAWS water sources that produce groundwater, operators can choose between similar wells. Operators make these choices based on several operational parameters. They do not factor in the energy implications of their choices, because they don't know the relative energy intensities (kWh/MG) of their various wells.

There are several factors that can impact the energy intensity of a water source. They include: the amount of lift required by the well to produce water from the ground, the discharge pressure of the well and/or booster pump, the age and condition of the equipment at the site, the starting efficiency of the pumps and motors, and any throttling of the pump discharges that may be in place to adjust the pumps' performances on their curves.

BY THE NUMBERS

Estimated Annual Savings: 14,600,000 kWh

Estimated Annual Avoided Costs: $1,313,000

Estimated Annual Avoided Emissions: 7,819 Metric Tons CO2e

Timeline: Mid-Term

ECM: SAWS can calculate the energy intensities of the primary and secondary pump stations in the Edwards Aquifer, the brackish wells, local and regional Carrizo wells, ASR wells, and the Oliver Ranch and Timberwood wellfields and provide it to their system operators. This will allow the operators to favor the wells and pumps stations within each water source with the lowest energy intensities. This will require a solid asset management review and a robust preventive maintenance regimen to ensure infrastructure is not overtaxed in its use.

The measurements and calculations for this measure should be periodically updated to account for changes in the aquifer levels, adjustments to operating pressures, and wear on the pumps.

Opportunity 3: Determine the Most Efficient Wells Pumps and Booster Pumps and Prioritize Their Use

Background: At many of the SAWS primary and secondary pump stations, as well as booster stations, there are an array of pumps that can be selected for service. When choosing pumps to start or stop, prioritization is typically based on a desire to balance runtime hours – the pump with the least number of hours is chosen so pump wear is consistent.

While this may be the best approach as an asset management strategy, there are energy implications to the order in which pumps are prioritized. Pumps in an array will almost never have identical energy intensities. It is common to find as much as a 10% difference between the most efficient pumps and the least efficient pumps at a station.

BY THE NUMBERS

Estimated Annual Savings: 6,700,000 kWh

Estimated Annual Avoided Costs: $505,000

Estimated Annual Avoided Emissions: 3,578 Metric Tons CO2e

Timeline: Mid-Term

ECM: SAWS should calculate the relative energy intensity of the pumps in each pump station and booster station. Then operators should prioritize the use of the pumps with the lowest energy intensity.

The measurements and calculations for this measure should be periodically updated to account for changes due to wear on the pumps.

The priority project identified at SAWS' **H2Oaks Campus** is summarized below. As stated above, the savings values are estimates and do not represent exact savings quantities.

Opportunity 4: Occasionally Reduce Water from Desal

Background: There are two treatment plants on the H2Oaks campus: ASR/Local Carrizo treatment and desalination. The desalination plant can treat up to 10 MGD on four trains that treat 2.5 MGD each. In theory, the plant can operate as low as 2.5 MGD. In practice, however, the plant doesn't operate as well below 5 MGD.

The energy intensity for the desalination plant is three times higher than the energy intensity for the ASR treatment plant. During the summer months the desalination plant is producing at 7.5 MGD or 10 MGD. There are periods within the year when the water resources and the production groups know that customer demand will be able to be met through other less energy intensive sources and a shift in desal production will not interfere with customer demands or goals to store additional water into the ASR.

BY THE NUMBERS

Estimated Annual Savings: 300,000 kWh

Estimated Annual Avoided Costs: $26,500

Estimated Annual Avoided Emissions: 158 Metric Tons CO2e

Timeline: Near-Term

ECM: In identified time periods H2Oaks operators and water resources planners should coordinate limitations on the production from the desalination plant to 5 MGD and make up the additional water for customer demand from other sources. This will dramatically reduce the overall energy use for the H2Oaks facility while keeping the desalination plant operational in case higher production is needed.

The full opportunity registers documented through the Year 1 SEM engagement for SAWS' water system is included in Appendix B.

Wastewater System Energy Conservation Measures

The top seven priority projects identified within SAWS' three WRCs, Steven M. Clouse, Leon Creek, and Medio Creek, are outlined below. Together, these projects represent approximately **10.8 million kWh per year** in savings and **5,766 Metric Tons CO2e per year** in avoided emissions. As stated above, these values are estimates and do not represent exact savings quantities.

Steven M. Clouse WRC

Opportunity 1: Reduce First Stage Solids Retention Times

Background: The Clouse plant has two stage aeration. In the first stage of aeration, the plant was wasting activated sludge in a manner that led to inconsistent or lengthy solids retention times (SRT). This led to wide swings in sludge age and may have contributed to higher bacterial biomass, unnecessary partial nitrification, and growth of filamentous bacteria.

ECM: The plant can improve its sludge quality and reduce the Dissolved Oxygen requirement by basing their activated sludge wasting a lower SRT. This strategy requires that the plant adjust its return activated sludge (RAS) to waste activated sludge (WAS) ratio to maintain a consistent solids retention time. Doing so will stabilize sludge age and sludge quality.

BY THE NUMBERS

Estimated Annual Savings: 3,240,000 kWh

Estimated Annual Avoided Costs: $292,000

Estimated Annual Avoided Emissions: 1,736 Metric Tons CO2e

Timeline: Near-Term

Opportunity 2: Reduce Sludge Blanket in Primary Clarifiers

Background: The primary clarifiers at the Clouse plant had accumulated sludge blankets that were 10 feet deep. This excessive blanket depth, coupled with high water temperatures, allows settled BOD to dissolve into the liquid phase, increasing the BOD load on the aeration basins.

ECM: The plant should increase sludge pumping and thickening to reduce the sludge blankets from 10 feet to a target of one foot. Doing so will reduce the oxygen load required in the aeration basins and should have an added benefit of increasing the gas production of the anaerobic digesters.

BY THE NUMBERS

This project has no direct savings, but directly supports the savings associated with Projects 19 and 21-23 in the Clouse Opportunity Register in Appendix B.

Timeline: **Near-Term**

Leon Creek WRC

Opportunity 3: Manually Clean the Diamond Filters to Increase the Time Between Backwashes

Background: The diamond filters have automatic backwash sequencing that is triggered by pressure drop across the filters. The automatic backwashes were not sufficiently cleaning the filter media, so backwashes were triggered prematurely, sending excessive water back to the head of the treatment plant.

ECM: Plant personnel manually cleaned the diamond filters so that the media was more effective at filtering plant effluent and the time between backwashes increased. This reduced the amount of backwash water returned to the head of the plant and reduced the energy required to retreat the extra recycled water.

BY THE NUMBERS

Estimated Annual Savings: 75,000 kWh

Estimated Annual Avoided Costs: $6,750

Estimated Annual Avoided Emissions: 40 Metric Tons CO2e

Timeline: **Near-Term**

Opportunity 4: Reduce Aeration when NH3 is Low

Background: The plant has targeted a plant effluent ammonia level of 0.1 mg/l, well below the permitted effluent ammonia limit of 2 mg/l. In addition, plant operations maintained two blowers in operation throughout the day, which resulted in periods of the day when more aeration was provided than needed to treat nitrification demand.

ECM: The plant has increased their ammonia effluent target to 1.0 mg/l. This increase has reduced the dissolved oxygen (DO) required in the aeration basins. In addition, they have been able to operate on one blower between 7 am and noon each day.

BY THE NUMBERS

Estimated Annual Savings: 1,130,000 kWh

Estimated Annual Avoided Costs: $102,000

Estimated Annual Avoided Emissions: 605 Metric Tons CO2e

Timeline: **Near-Term**

Medio Creek WRC

Opportunity 5: Reduce Aeration in Plant #2 Carousels

Background: The Medio Creek plant uses activated-sludge carousels in both their old plant (Plant 1) and their new plant (Plant 2). The Plant 1 carousels each have two surface aerators that operate on two speeds while the Plant 2 carousels each have three surface aerators that are on variable frequency drives (VFDs).

The Plant 2 carousels have continuous DO monitoring and automated control. Plant 1 carousels have no continuous monitoring and must be operated manually.

Because the operators have little monitoring of the DO levels and no remote control of the aerator speeds for Plant 1, the plant tends to operate on a maximum speed. They also rarely adjust the speed at Plant 2. The result is the plant consistently over-aerates the carousels.

BY THE NUMBERS

Estimated Annual Savings: 1,630,000 kWh

Estimated Annual Avoided Costs: $147,000

Estimated Annual Avoided Emissions: 870 Metric Tons CO2e

Timeline: Near-Term

ECM: Reduce the speed of the aerators during low-flow times when there is less BOD. Implementing this measure will be significantly enhanced by installing continuous DO monitoring and giving operators a means to adjust surface aerator speeds remotely.

Opportunity 6: Replace UV Ballasts and Bulbs that are not Functional

Background: The Medio Creek plant uses UV treatment to disinfect plant effluent. During the plant tours, it was discovered that some of the ballasts and bulbs weren't operational, requiring the plant to run all banks off the UV system, regardless of disinfection needs and plant flows.

ECM: Replace the damaged ballasts and bulbs so the UV systems can function properly. This change will allow the site to turn off some of the treatment channels when the plant is at lower flows.

BY THE NUMBERS

Estimated Annual Savings: 750,000 kWh

Estimated Annual Avoided Costs: $68,000

Estimated Annual Avoided Emissions: 401 Metric Tons CO2e

Timeline: Near-Term

Opportunity 7: Reduce the Wasting Footprint and Reduce WAS Aeration

Background: The Medio Creek plant does not treat their waste activated sludge (WAS). Instead, their WAS is pumped into the collection system for the Leon Creek WRF. Before the WAS is pumped off the plant, however, it is stored in a largely decommissioned carousel. For odor control reasons, the WAS is aerated with surface aeration.

It does not appear that there are any process reasons for this large storage area, and the amount of surface aeration required could be reduced if the amount of WAS stored on site was reduced and the storage area was diminished.

ECM: Reduce the amount of WAS stored at the Medio Creek plant and significantly reduce the storage area for the WAS. This change will reduce the surface aeration requirements and lower the energy use.

The limiting factor for the WAS pumping off plant may be the capacity of the WAS discharge pumps. If that is the case, the plant should consider increasing the size and capacity of those pumps.

The full opportunity registers documented through the Year 1 SEM engagement for SAWS' wastewater system are included in Appendix B.

BY THE NUMBERS

Estimated Annual Savings: 500,000 kWh

Estimated Annual Avoided Costs: $45,000

Estimated Annual Avoided Emissions: 267 Metric Tons CO2e

Timeline: Mid-Term

District Cooling Energy Conservation Measures

The top three district cooling priority projects within SAWS' district cooling plants are outlined below. Together, these projects represent approximately **13 million kWh per year in savings** and **6,900 Metric Tons CO2e per year in avoided emissions**. As stated above, these values are estimates and do not represent exact savings quantities.

Opportunity 1: High Efficiency Chillers (Downtown and Port San Antonio)

Background: There are a number of chillers within SAWS' district cooling plants that have reached the end of their useful life and are candidates for replacement.

ECM: Replacing this equipment will result in energy savings due to the more efficient equipment available in the market today. The equipment rebuild/replacement line items are already required investments to continue operations. Thus, any energy savings are ancillary to the equipment upgrades needed for continuation of service.

BY THE NUMBERS

Estimated Annual Savings: 3,500,000 kWh

Estimated Annual Avoided Costs: $275,000

Estimated Annual Avoided Emissions: 1,869 Metric Tons CO2e

Timeline: Near-Term

Opportunity 2: Plant Variable District Cooling Flow w/ Corrected Delta T (Downtown)

Background: Today, most of SAWS' district cooling customers deliver a poor delta T back to the plants. This alongside the current constant speed pumping scheme make the downtown district cooling system pump water faster than is needed which in turn results in excess energy use and wear and tear on pumps and motors.

ECM: The Commerce and Cherry St. plants are good candidates for conversion to a variable flow district cooling pumping scheme. Variable flow has the dual benefit of allowing for higher Delta T's and lower pump energy as the pump speed is modulated to match the cooling load.

SAWS should strongly recommend that customers operate their building pumps only to meet the internal pressure drop requirements for the customer HVAC systems and modulate the blending station valve and/or building pumps to meet the building heat load.

Additionally, it is recommended SAWS incorporate a Delta T adjustment charge into their district cooling service agreements.

BY THE NUMBERS

Estimated Annual Savings: 5,500,000 kWh

Estimated Annual Avoided Costs: $450,000

Estimated Annual Avoided Emissions: 2,937 Metric Tons CO2e

Timeline: Near-Term

Opportunity 3: Integrated Plant Control and Optimization (Downtown)

Background: The downtown Commerce Street plant contains a manned control room with a SCADA system that provides visibility and data aggregation from field instrumentation within the plant and at customer sites. The Cherry Street Plant has a stand-alone control system which feeds data to the Central Plant SCADA via Building Automation Control (BAC) net over Fiber. There is no control of the Cherry Street plant from Commerce Street plant; it can only be monitored.

ECM: A control system optimization software that will provide plant operational and staging recommendations for direct control of chilling, heat rejection and pumping assets.

The software will integrate and optimize the operation of separate plant systems into a repeatedly efficient and effective control strategy, using machine learning, prediction models, and real-time system "wire-to-water" efficiency calculations.

BY THE NUMBERS

Estimated Annual Savings: 3,750,000 kWh

Estimated Annual Avoided Costs: $300,000

Estimated Annual Avoided Emissions: 2,002 Metric Tons CO2e

Timeline: Mid-Term

U.S. DOE 50001 Ready Certification

International Organization of Standardization (ISO) 50001 is an international standard for the minimum elements of an energy strategy system. Approximately 23,000 sites worldwide, mostly associated with multi-national companies, are certified to ISO 50001. As with other ISO standards, a site must meet rigorous process and documentation standards and demonstrate compliance through regular audits to be certified.

50001 Ready is a U.S. DOE program to support the adoption of ISO 50001 principles within the industrial sector. It is a self-paced, low-cost way for organizations to build a culture of structured, continuous energy improvement that leads to deeper and sustained savings. The program is meant to provide an easy-to-implement framework for an energy strategy process that becomes part of running the business. There are 25 steps, about 65% of which are tasks included in the Year 1 SEM engagement SAWS completed. Many of the steps are to be reviewed and repeated each year, just like any continuous improvement program.

For SAWS to attain 50001 Ready status, they will need to incorporate energy efficiency into design standards and procurement practices as well as create internal auditing practices to ensure energy efficiency efforts within SAWS become an ongoing, integrated part of doing business. These efforts will be a relatively easy lift compared to the work that was done during the Year 1 SEM engagement and should be pursued by the organization.

General Funding Recommendations

Funding of energy conservation and efficiency initiatives contemplated by this program will use well-understood processes that are consistent with SAWS guidelines, including the following characteristics:

1. **Budgeting.** Requests for energy-related capital and expenses will be made as a part of the annual budgeting process and scheduled to align with the January 1 fiscal year.
2. **Interim Funding.** Requests for funding of energy projects during a fiscal year will be considered by the CFO (among others) on a case-by-case basis, with decisions depending on the availability of funding as well as the payback associated with the request.
3. **Financial Return.** Projected simple payback period of seven years or less, or an equivalent ROI-based estimate of returns, will be required unless amended by the CFO's office.
4. **New Facility Capital Budgets.** Energy efficiency and conservation will be an important part of the design, construction, and operation of all future SAWS infrastructure. These considerations should begin at the procurement phase, including energy efficiency requirements and considerations in Requests for Proposals or Requests for Qualifications going forward. Initial designs will specify that energy performance will be optimal, and subsequent value engineering decisions will address impacts on energy performance, based on available information.
5. **Revolving Fund Consideration.** When a particular energy initiative has been proven to create financial benefit of a known amount, then a portion of those savings may be set aside to fund pending/future energy projects. Any criteria and amount of set-aside funding will be determined by senior management.

6 Renewable Energy Opportunities

Renewable Energy

The City of San Antonio's 2019 CAAP established six community mitigation strategies to reduce overall greenhouse gas emissions.[14] The first strategy is to increase carbon-free energy in part through supporting investment in large-scale renewable energy projects led by CPSE. As an important customer of CPSE, SAWS is in a position to support moving the needle on investment in new renewable energy projects to decrease greenhouse emissions associated with electrical energy use. After pursuing improvements in energy efficiency across the organization, SAWS should analyze the potential to contribute to San Antonio's carbon neutrality efforts through implementing onsite renewable energy projects. Analysis should include research into potential funding, which may be available through the US Department of Energy, Texas Water Development Board, Texas Facilities Commission Office of Energy Management, or through rebates or incentives from CPSE.

Renewable energy is a valuable tool in reducing energy costs and promoting sustainability for water and wastewater systems. San Antonio averages 220 days of sunshine a year, and SAWS has extensive land holdings around its three wastewater treatment plants, two water plants, and many of its large booster stations. SAWS should assess the viability of these sites for solar power generation. In addition, there are some limited applications where hydropower could be harvested with microturbine technology.

[14] SACRReportOctober2019.pdf (sanantonio.gov)

7 Energy Strategy Program Best Practices

Organizations that are successful at develop a culture that contains energy awareness and efficiency at every level. These teams don't always start with all the answers, but they take measured and consistent steps to improve their energy efficiency while they figure out the answers. There is a commitment to energy efficiency from the top of the organization and an empowerment of team members throughout the organization. Finally, they measure their progress and share successes and failures with their teams.

The following sections describe the **critical components of successful energy strategy programs** in more detail.

7.A Executive Commitment and Organizational Awareness

As stated in Section 2.C, executive support is the single most important factor in determining the success or failure of energy strategy programs. With support that is clear and constant, the energy strategy program creates a culture where energy expense control is a normal part of doing business. Strategy, organization, and resource allocation are brought to bear in coordinated ways, which produce significant financial and environmental dividends that continue to pay out year after year.

Executive support provides an important link between the OES and plant operations staff who may have conflicting priorities. It is vital SAWS senior leadership consistently vouch for the importance of bringing energy efficiency considerations into day-to-day operational activities.

7.B Organizational Goal Setting

SAWS' mission is to provide "Sustainable, Affordable Water Services," and its vision is "To be leaders in delivering responsible water services for life."

Broadly speaking, SAWS is firmly committed to energy conservation, which goes hand-in-hand with the long-standing commitment to water conservation. If SAWS' facilities operate at optimal energy efficiency, the organization can measurably contribute to the success of regional climate programs of the City of San Antonio and CPSE, and operating costs can be lowered. If the facilities can operate with the lowest possible energy expenses, it will help to minimize the rates and charges assessed to SAWS' customers.

This ESMP guides ongoing efforts at SAWS to establish and maintain a system-wide strategy and tactical plans for annual progress tracking as well as creation of cross-functional teams to identify and evaluate energy savings ideas, prioritizing those activities alongside normal staff duties. In addition, financial resources and the measurement and tracking of energy performance cannot occur without organizational commitment. Talented professionals are doing great work with support from the executive team, but much more can be achieved with the addition of a disciplined program to guide the initiatives and measure the energy and financial savings.

Specific goals for reduction of SAWS' energy usage and energy expense are presented in Section 5.

7.C Consistent Resource Commitment

The investment of the resources necessary to meet the goals is critical to success. Decisions regarding resource needs for the energy strategy program must be given as much weight as the needs of other departments and initiatives. Among the resources that will be needed to achieve SAWS' energy goals are:

Human. The OES must be adequately staffed by technical and financial professionals. One of the responsibilities of the OES will be to constantly engage with all other departments in order to make energy decisions that are consistent with the program. Staff in other departments must understand their role and the impact they can have on SAWS' energy use reduction goals. This allocation of staff time from all departments is critical to success.

Financial. There will be a financial investment necessary to achieve success with the energy plan, particularly in the early years. SAWS should look at projects' Return on Investment (ROI) and not simply total cost. Funding mechanisms for the program are addressed in Section 5.

Education. Many of the initiatives that will reduce energy usage involve routine decisions made by operations personnel who are focused on the system's primary operating functions and maintaining compliance to protect public safety. Training will be necessary to support operations staff in identifying and implementing operational changes that protect the system's function while reducing energy consumption.

7.D Engineering

Maintaining a long-term energy strategy program requires technical analysis to identify opportunities for energy and cost savings. This includes tracking energy and water use, which SAWS has begun doing in earnest through the Year 1 SEM engagement. Engineering analysis should be an ongoing practice, including use of SAWS' hydraulic model to assess water and reclaimed water systems energy efficiency opportunities.

The engineering best practices that SAWS should prioritize for early implementation include:

- Energy forecasting to inform operating budget forecasts (ongoing)
- Sub-metering to inform opportunity identification and cost-benefit analysis
- Incorporating energy efficiency from the start into the design and procurement processes. This best practice should include:
  - **Equipment Purchases.** Ensure life cycle costs are included in the total project cost, so the lifetime savings of energy efficient equipment are considered even if up-front costs are higher.
  - **Equipment Replacements.** Review existing equipment specifications and operations to assess whether units can be downsized or replaced with two smaller units.
  - **Design Services Requests for Proposals.** Include energy efficiency as a design objective. Include design guidelines from third-party certification systems such as Energy Star, LEED-Buildings, or consultant-designed considerations specific to the project.
  - **Submitted Designs.** Require engineering design firms to:
    - Calculate the costs of running the systems from day one, based on expected flows and loads in year one,
    - Show how the plant will respond to flows and loads that are smaller than the design flows and loads expected 20 years in the future,
    - And include documents to show how the facility is turned down to meet lower flows and loads.

- Additionally, SAWS should consult an internal or external energy expert to review the designs with energy efficiency targets in mind.

7.E Implementation Action Planning

Implementation action plans should be developed by OES and the energy teams and reviewed annually to track progress. Annual reviews should include:

- Prioritizing projects for the year
- Assigning project leads, timelines, and resources
- Incorporating new information as it becomes available
- Documenting successes throughout the year
- Assessing key water and energy metrics against goals

7.F Tracking and Reporting

Tracking and reporting on an energy strategy program is important for quantifying program success. Four best practices are:

- **Establishing program goals.** This ESMP establishes a five-year goal for the program. It is important to also quantify steps within that goal, such as annual goals, and any longer-term strategic goal that senior leadership may set.
- **Tracking key performance metrics.** The key water and energy metrics used in Section 4 Baseline Assessment should be updated at least annually. SAWS should also establish a system for documenting changes to the water and wastewater systems, so that changes in energy use can be accurately attributed.
- **Verifying savings from the program.** SAWS should maintain the energy regression models developed during Year 1 of the SEM engagement. To quantify savings attributable to the energy management program, energy and cost savings are calculated as the difference between the expected energy use and the actual energy use. Over time, the difference between expected and actual use will grow as energy efficiency projects are implemented.
- **Reporting within energy teams and to senior leadership.** OES should communicate progress with energy teams, operations leadership, and SAWS senior leadership, including:
  - Facilitating meetings with the energy teams monthly to review progress on efficiency initiatives and to identify any obstacles.
  - OES should report overall program status to the Vice President of Operations Support & Innovation on a quarterly basis, summarizing ongoing initiatives and addressing any obstacles.
  - OES should report overall program status to SAWS senior leadership at least annually, summarizing program initiatives, savings, costs, and other pertinent information. Consistent tracking and reporting on energy usage creates an accountability structure for energy performance, reinforcing the culture of leadership support required for long-term program maintenance.[15]

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[15] Podell-Eberhardt, Z; Bachman, J; Shimojima, K; Deyton, A; *SEM at Scale: OMG, My Cohort Has 142 Facilities!,* ACEEE Summer Study on Industry, 2021.

Table 5. Energy Strategy Program Update Cycles

Timeframe	Recommended Activities
Monthly	• Energy Team meetings
Quarterly	• Status report from OES to Vice President of Operations, Support & Innovation
Annual	• Status report from OES to SAWS senior leadership • Energy Teams, with OES leadership, review Implementation Action Plans
Every Three Years	• OES updates the ESMP, documenting projects completed, energy and costs saved, and identifying the next priority projects for the following three-year cycle

8 Appendices

8.A Appendix A – Full Opportunity Registers

The following lists represent the full opportunity registers developed during SAWS' Year 1 SEM engagement. These lists should be used to pursue further energy savings in future ESMP updates after the ECMs recommended in Section 5 are completed.

Water System

Holistic Potable Water System Opportunity Register

1. Calculate the Energy Intensity of Different Water Sources and Develop Sourcing Strategies that also Account for Energy Costs
2. Consider Energy Intensity within Production Infrastructure
3. Revisit the 60 Day Idle Well Rule on Well Sampling / Allow Wells to Sit Longer During the Winter Months to Avoid Demand Charges
4. Manage Peak Demand
5. Operate the Distribution System so Pumps Operate on the BEPs
6. Determine the Most Efficient Wells at the Pump Stations and Prioritize Their Use
7. Draw From the ASR System During Summer to Augment Supply, Recharge in the Winter
8. Determine the Most Efficient Pumping Combinations at Booster / High Service Pumps / Secondary Pump Stations
9. Incorporate Energy Efficiency into the Master Plan
10. Verify Isolation Valves Are in the Right Positions
11. Automate the Auxiliary Valves / Train Operators
12. Improve Communications Between SAWS Groups
13. Use Smaller Pumps Longer Instead of Larger Pumps Shorter
14. Look Into Time-of-Use Metering
15. Adjust PRV Settings @ Briggs PRV
16. Look at Recycled Water Model
17. Consider Situations of "Losing" Around Ground-Level Tanks in the Distribution System
18. Adjust Tank "Loading" Strategies on Weekends
19. Find the Division Valve That is Filling the Tank in Pressure Zone 1080
20. Repair Deferred maintenance Items in the Distribution System

Opportunities for the Edwards Water Supply and ASR Recharge/Supply are included in this opportunity register.

H2Oaks Campus Opportunity Register

1. Incorporate Energy Intensity into Well Sourcing Choices for ASR Wells
2. Incorporate Energy Intensity into Well Sourcing Choices for Local Carrizo Wells
3. Occasionally Reduce Water from Desal
4. Optimize Desal Well Start-ups
5. Reprogram HVAC Set Points in the BMS
6. Adjust ASR Backwashes Based on Turbidity Readings
7. Adjust ASR Filter-to-Waste Based on Turbidity Readings
8. Consider Idling Desal for Demand Response Savings
9. Develop Remote-Building HVAC Standards – Consider Summer vs. Winter Operations
10. Lengthen Backwash Timing from 80 Hours to 120 Hours
11. Investigate Initiating Backwashes on Head Loss Instead of Time
12. Investigate Installing VFDs on Degassifier Blowers
13. Install a VFD on Filter Backwash Pumps
14. Pipe Permeate to the ASR Plant and Eliminate the Need for Post Treatment
15. Change the Desal Membrane Well Rotation Strategy

Opportunities for the Desalination and ASR Treatment plants are included in this opportunity register.

Wastewater System

Steven M Clouse WRC Opportunity Register

1. Consider Increased Automation (in general)
2. Add Energy Efficiency Considerations into the Mater Plan
3. Balance Treatment Between the Clouse and Leon Plants (send more flow to the most efficient plant)
4. Add Anoxic Zone to 1st Stage Aeration
5. Replace Aeration Blowers with Higher-Efficiency Blowers (turbo)
6. Regularly Clean and Replace Diffusers
7. Turn Off Channel Blowers 6-12 Hours a day
8. Repair Grit System
9. Check Biogas System for Leaks
10. Replace Boilers and Heat Exchangers
11. Digester Mixer Replacement
12. Reduce NPW Use
13. Repair NPW Leaks

14. Replace NPW Spray Nozzles
15. Optimize Backwash on the Diamond Filters
16. Repair Compressed Air Blowouts/Leaks
17. Turn Off Area Lights
18. Setbacks on AC and Lights @ O&M Building
19. Reduce the Number of Aeration Blowers in Operation
20. Reduce Sludge Blanket in Primary Clarifiers
21. Reduce First Stage SRT
22. Reduce Second Stage SRT
23. Refurbish Airflow Meters and DO Control of Drop Valves in One First Stage Train
24. Evaluate Potential Improvements in Biogas Fuel Valve

Leon Creek WRC Opportunity Register

1. Flow Pace RAS
2. Reduce Aeration when NH_3 is Low
3. Reduce Channel Aeration
4. Blower Adjustments (diurnal)
5. Analyze the Energy Intensity of Each Plant, Send Higher Flow to the Lower-Energy Plant (Leon and Clouse)
6. Nest Thermostats
7. Turn Off Lights When not in Use
8. Reduce NPW Use in Plant
9. Open Throttled WAS Discharge Valve
10. Sludge Pumping to Clouse; Rotate Transfer Stations 201 and 202 Monthly
11. Repair SCFM Meter
12. Repair DO Probes and Incorporate MOV Control
13. Explore Balancing Load Between Leon and Clouse
14. Explore Denitrifying with Anoxic Zone (head of basin)
15. Reduce the Use of Redundant Equipment
16. Leaking Expansion Point
17. Reduce the Number of Sludge Pumps
18. Better Clean the Diamond Filters to Increase the Time Between Backwashes
19. Repair Leaking Mud Valve

20. Blower Lead-Lag Control Strategy

Medio Creek WRC Opportunity Register

1. Reduce Wasting Footprint and Reduce WAS Aeration
2. Reduce Aeration in Plant 2 Carousels
3. Replace UV Ballasts & Bulbs that are Not Working, Adjust Operation for Transmissivity
4. Reduce the Number of Carousels Operating During Low Flow at Plant 1
5. Replace Pressure Gauges at Influent Pumping Station
6. Resize Lift Station Pump to Old Plant and Separate Pumping to Each Plant
7. Investigate the Flow Surge into the Plant 1 Clarifiers
8. Turn Off Yard Lights / Replace Broken Ballasts
9. Schedule HVAC Setbacks for O&M Buildings
10. Fix Clarifier Weirs
11. Install VFDs on Aerators on Plant 1
12. Put Plant 1 on SCADA
13. Fix Grit Removal System in Plant 1
14. Control/reduce SRT in Plants 1 and 2
15. Optimize Backwash on the Diamond Filters

8.B Appendix B – EMA Results

The full results from the EMA conducted in October 2022 are embedded below.

SAWS%20EMA%201
0-22-Summary%20Ta

8.C Appendix C – Heating and Cooling Thermostat Setpoints Policy Memorandum

In an effort to curtail energy waste and support San Antonio Water System's (SAWS) energy intensity reduction goals, the SAWS locations listed herein should adhere to the following setpoints. In addition to lowering energy consumption, reducing greenhouse gas emissions, and saving utility dollars, these setpoints support the goals and initiatives of The City of San Antonio's Climate Action Plan.

- Cooling Setpoints: 72 °F - 74 °F (occupied) and 80 °F - 85 °F (unoccupied)
- Heating Setpoints: 70 °F - 72 °F (occupied) and 60 °F - 65 °F (unoccupied)

All specified locations shall maintain the cooling and heating setpoints within the ranges listed above. Occupied is the time period during the normal building operating hours and unoccupied is considered any time period outside of the occupied period. Cooling temperatures will be set typically during the months of March through October. Heating temperatures will be set typically during the months of November through February.

These setpoints are consistent with American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommendations and City of San Antonio municipal buildings setpoints. Buildings subject to these setpoint requirements are as follows:

- HQ Tower 1 and 2 (as is possible)
- Northeast Service Center
- Van Dyke Service Center
- Eastside Service Center
- Mission Service Center
- Westside Service Center
- Northwest Service Center
- Northside Operations Center
- Clouse WRC Buildings 16 and 17
- Clouse WRC Environmental Lab Admin Building
- Medio WRC Buildings
- Leon WRC Buildings
- H2Oaks (All Building)
- Agua Vista

8.D Appendix D – SAWS Baseline Energy Intensity Methodology

Total energy consumption is the amount of energy used over a period of time. Energy intensity, on the other hand, is a measure of energy per a specific unit (i.e. kWh/gallon). Because energy intensity is largely independent of outside factors like weather or demand, it is a better metric for measuring true energy savings. For example, during a rainy year, energy consumption may be reduced and look like apparent energy savings. However, in this case energy wasn't saved due to efficiency efforts but rather a reduction in water demand. Therefore, the better metric would be kWh/gallon or "how much energy does it take SAWS to produce one gallon of water?"

With this in mind, energy savings associated with this plan will be measured in energy intensity. Each business unit, including water, wastewater, district cooling, and buildings will have its own energy intensity metric.

The metric for each business unit as well as the baseline energy intensity is included below. The baseline energy intensity will be the metric to which the 10% goal is applied to:

- Water (kWh/million gallons produced): **3,233**
- Wastewater (kWh/million gallons treated) **1,698**
- District Cooling (kWh/1,000 ton-hours of cooling provided): **997**
- Buildings (kWh/square feet of space): **13**

It is important to note that because each of the four business units contribute to SAWS' overall energy consumption differently (i.e., water uses more energy than district cooling), the contribution to SAWS' 10% energy intensity reduction goal is different for each. For example, district cooling represents 9.3% of SAWS' annual energy consumption so a hypothetical 50% reduction in district cooling's energy intensity would represent a 4.6% overall reduction in SAWS energy intensity (9.3% x 50%).

A summary of each business unit's contribution to SAWS' overall energy consumption is included below:

Business Unit	Energy Intensity Metric	Energy Intensity	% of SAWS Total kWh
Water	kWh/MG	3,233	69.5%
Wastewater	kWh/MG	1,698	19.5%
District Cooling	kWh/1,000 ton-hrs	997	9.3%
Buildings	kWh/sq.ft.	13	1.7%