Stantec

ENERGY SUSTAINABILITY PLAN



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Metropolitan Water District of Southern California

Energy Sustainability Plan

Report No. 1630

DRAFT

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***Metropolitan Study Leadership Team*:**

Greg De Lamare: Team Manager – Facility Planning, Engineering Services Group

Ha Nguyen: Senior Resource Specialist, Engineering Services Group

Shawn Bailey: Section Manager – Power Operations and Planning, Water System Operations

Austen Nelson: Assistant Engineer, Engineering Services Group

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It is warmly acknowledged that the following Metropolitan staff were instrumental in the development of this report:

Engineering Services Group

Ernie Ariza: Principal Engineer
John Bednarski: Group Manager – Engineering Services Group
Saurabh Shekhar: Senior Engineer
Ish Singh: Principal Engineer

Environmental Planning

Brenda Marines: Environmental Specialist
Tom Napoli: Principal Environmental Specialist
Malinda Stalvey: Senior Environmental Specialist

General Counsel

Mark Parsons: Senior Deputy General Counsel

Information Technology

Brian Brenhaug: Team Manager – Enterprise Water System Program

Water Resource Management

Grace Chan: Section Manager
Brad Coffey: Group Manager – Water Resource Management
Warren Teitz: Team Manager – Resource Development

Water System Operations

Mickey Chaudhuri: Assistant Group Manager – Water System Operations
Heather Collins: Section Manager - Water Treatment
Chris Gabelich: Principal Environmental Specialist
Tim Hutcherson: Unit Manager – Conveyance and Distribution
Keith Nobriga: Section Manager – Water Operations and Planning
Stacie Takeguchi: Senior Engineer
Brent Yamasaki: Group Manager – Water System Operations

Report written and prepared for Metropolitan by:

Stantec

PAUL REDVERS BROWN INC.

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Acronyms and Abbreviations

1932 Act	Metropolitan Water District Act of June 18, 1932
AB	Assembly Bill
AEPCO	Arizona Electric Power Cooperative
AI	Artificial Intelligence
a.k.a.	also known as
BESS	Battery Energy Storage System
CAISO	California Independent System Operator
CEQA	California Environmental Quality Act
CEC	California Energy Commission
CO_2-e	carbon dioxide equivalent
CPUC	California Public Utilities Commission
CRA	Colorado River Aqueduct
EF	emission factor
EMRS	Energy Management and Reliability Study
EO	Executive Order
ESP	Energy Sustainability Plan
GHG	Greenhouse Gas
GRP	General Reporting Protocol
ICS	Intentionally Created Surplus
kWh	kilowatt-hour
LADWP	Los Angeles Department of Water and Power
Metropolitan	The Metropolitan Water District of Southern California
MW	megawatt
MWh	megawatt-hour
NPV	Net Present Value
PPA	Power Purchase Agreement
REC	renewable energy credits
RPS	renewable portfolio standard
RPU	Riverside Public Utilities
SB	Senate Bill
SCADA	supervisory control and data acquisition
SCE	Southern California Edison
SGIP	Self-Generation Incentive Program
SWP	State Water Project
TOU	Time-of-Use
WAPA	Western Area Power Administration
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

The Metropolitan Water District of Southern California (Metropolitan) is a regional wholesaler providing a reliable supply of high-quality water to its 26-member public agencies, collectively serving nearly 19 million Southern Californians in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. Metropolitan's mission is to provide its service area with an adequate and reliable supply of high-quality water to meet present and future needs in an environmentally and economically responsible way. The conveyance, treatment, and distribution of water is an energy-intensive and energy-dependent process, and as such, Metropolitan has goals of controlling operational costs and conserving valuable natural resources.

Metropolitan's net energy use and costs are dominated by the pumping (transport) required to import water via the Colorado River Aqueduct (CRA) and State Water Project (SWP) systems (Figure ES-1). Given that Metropolitan does not have direct control over operations of the SWP, this plan focuses exclusively on the energy use and cost for CRA operations (wholesale power) and for Metropolitan's distribution, treatment, and office facilities (retail power), which on average totals $43.1 million per year.

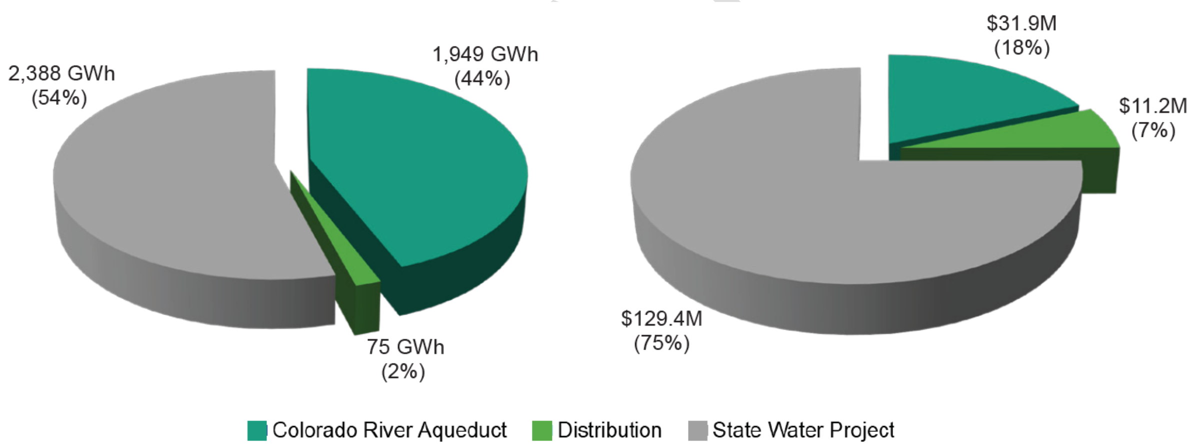
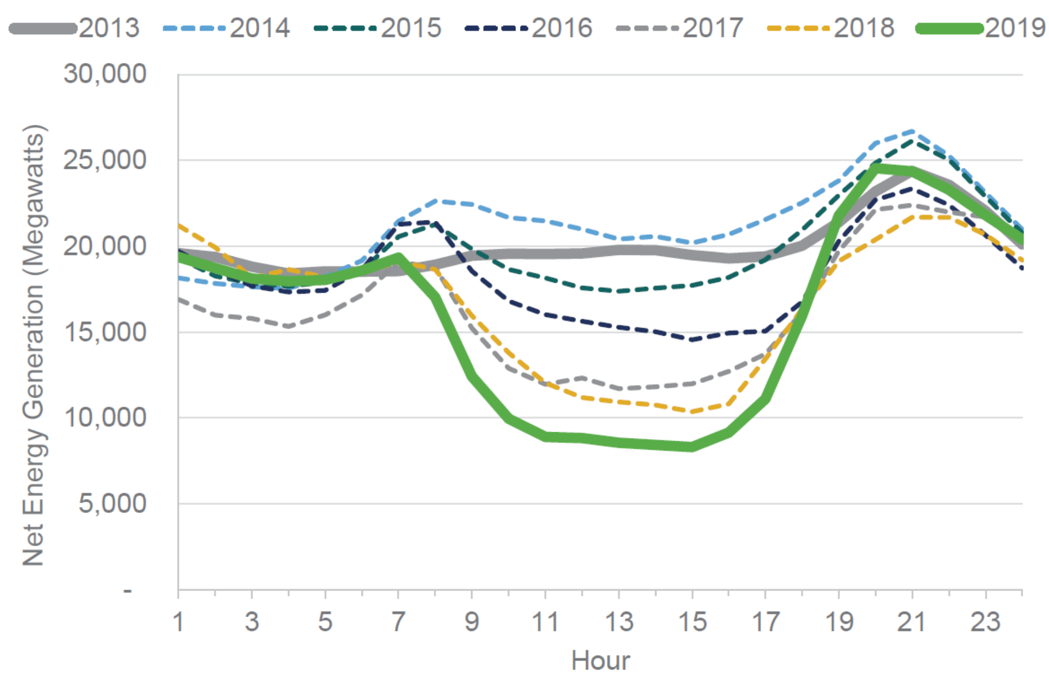


Figure ES-1 Metropolitan's overall electricity requirements and cost (average 2013-2018)

Over the past several decades, Metropolitan has implemented many energy initiatives that have reduced energy costs and use, while diversifying its energy portfolio. This has included 130 megawatts (MW) of small hydropower generating facilities, 5.5 MW of solar power generation installations, and a 50-year agreement executed in 2017 to receive low-cost carbon-free hydropower from Hoover Dam for CRA operations. Despite these efforts, external factors have resulted in increased energy costs. Five major drivers influence the future energy market and Metropolitan's corresponding energy sustainability strategy, including:

- ***Progression of environmental regulations***. California is leading the nation with energy and environmental policy initiatives that are driving electrical grid changes. In particular, California's shift to renewables and carbon-free energy by 2045 (Senate Bill 100) is a primary driver in future energy dynamics and will impact both the cost and volatility of energy markets.

- ***Energy market pricing uncertainty*****.** Approximately 50 to 85 percent of Metropolitan's energy for CRA pumping is supplied from low-cost federal hydropower, and the balance is supplied from supplemental purchases of wholesale energy from the market. The adoption of recent policies and state goals in greenhouse gas (GHG) emission reductions and environmental protection are fundamentally changing the wholesale electric grid and its operation. The high penetration of renewable generation across the state resulted in the "duck curve" effect which has shifted peak prices from periods when demand is highest (typically midday) to periods in which solar generation declines (typically evening hours) (see Figure ES-2). In certain times of the year, a significant net load drop occurs when solar generation decreases at the end of the day. This drop must be mitigated by conventional fossil fired energy generators. This effect creates over-generation during the middle of the day, which produces a "belly" appearance, and a steep ramp for fossil fuel generators during the late afternoon and evening, creating an "arch". The consequent changes in wholesale and retail energy price and structures are impacting hourly energy costs and operations at Metropolitan.



Source: IEA, 2019

Figure ES-2 CAISO's duck curve of average net electric load for a spring day in California

- ***Grid reliability***. California has historically been dependent on fossil-fired generation to provide for the bulk of its energy needs, as well as peaking capacity and operating reserves to balance the system and compensate for system contingencies. The state's environmental policies to reduce fossil generation emissions and cooling water impacts have and will continue to result in the retirement of fossil generation throughout the state and the region. The transition to renewable, non-emitting generation creates challenges for grid operators without the traditional sources of on-demand, fast-ramping capacity.

- ***Climate change and natural disasters.*** Natural disasters and a changing climate pose substantial risks to the availability and price of energy for Metropolitan. While the timing and extent of these events is unpredictable, their effects can be anticipated and estimated. The main challenge for Metropolitan and its energy providers will be to develop and nimbly execute energy management initiatives that preserve a high degree of long-term flexibility and stable costs.

- ***Technological advances and incentives***. New technological advancements and improved practices in the renewable energy and energy storage sectors provide viable options for Metropolitan's long-term energy management goals. For example, energy storage systems are able to capture the energy generated by renewables and store it until the energy is needed. Energy storage can address the power intermittency challenges from renewables and effectively increase utility resiliency and reliability. Several incentive and credit programs are also available, such as the California Public Utilities Commission Self-Generation Incentive Program (SGIP), to further improve the economic feasibility of battery energy storage projects.

The evolution in California's energy mix and resulting uncertainty in the reliability and cost of energy supplies affects the affordability and reliability of Metropolitan's water supply operations. Metropolitan's review of its energy strategies, practices and projects is an important step to help position itself as a leader in energy sustainability. This is a critical time for Metropolitan to develop a new Energy Sustainability Plan (ESP) and an updated implementation roadmap, to formulate actions and strategies that best position Metropolitan to adapt to future wholesale and retail energy market changes for its CRA operations and conveyance and distribution system. ***The ESP's purpose is to foster informed energy management decisions by Metropolitan through the development of a framework of sustainable actions focused on energy cost containment, reliability, affordability, conservation and adaptation – now and into the future.***

The main planning objectives of the ESP are to develop an adaptive energy management strategy and project implementation roadmap resulting in projects and initiatives that:

- Contain costs and reduce Metropolitan's exposure to energy price volatility
- Increase operational reliability and flexibility
- Move Metropolitan towards energy independence and sustainability
- Support Metropolitan's Climate Action Plan (CAP) effort to meet proposed GHG emissions reduction target

ES.1 APPROACH

The development of the ESP and associated roadmap was conducted using an innovative and holistic multi-phase planning approach, including:

- A review of energy management plans from multiple U.S. water utilities conducted to summarize the state of knowledge on energy sustainability goals and practices in the water sector.
- Data collection from internal and publicly available sources for the assessment of energy baseline operations at Metropolitan and projected energy market scenarios.
- Development of a list of potentially viable renewable energy and energy storage projects in the retail and wholesale energy market. These projects were assessed through a financial and environmental analysis, which considered the potential net present value (NPV), payback periods, and carbon emission reductions of the identified projects. Projects evaluated in the retail market involved expanding Metropolitan's solar generation capabilities and implementing battery energy storage to complement self-generation and provided a method to shift low-cost energy to periods of high cost. Projects that rely on energy from the wholesale market were evaluated for their ability to reduce the energy cost of CRA pumping operations and included large-scale renewable energy and energy storage projects. Energy best management practices were also identified.
- Comparison of relative project performance using a multi-criteria decision analysis (MDA) that looks beyond costs alone. The MDA ranks project options based on a variety of objective performance criteria, including improved cost containment, reduced exposure to price volatility, increased operational flexibility, increased redundancy, increased revenue potential, increased energy independence and reduced carbon footprint.

- Considering the uncertainties in the water and energy sectors, a detailed scenario analysis effectively "stress tested" each project option under a range of plausible future conditions (Figure ES-3).

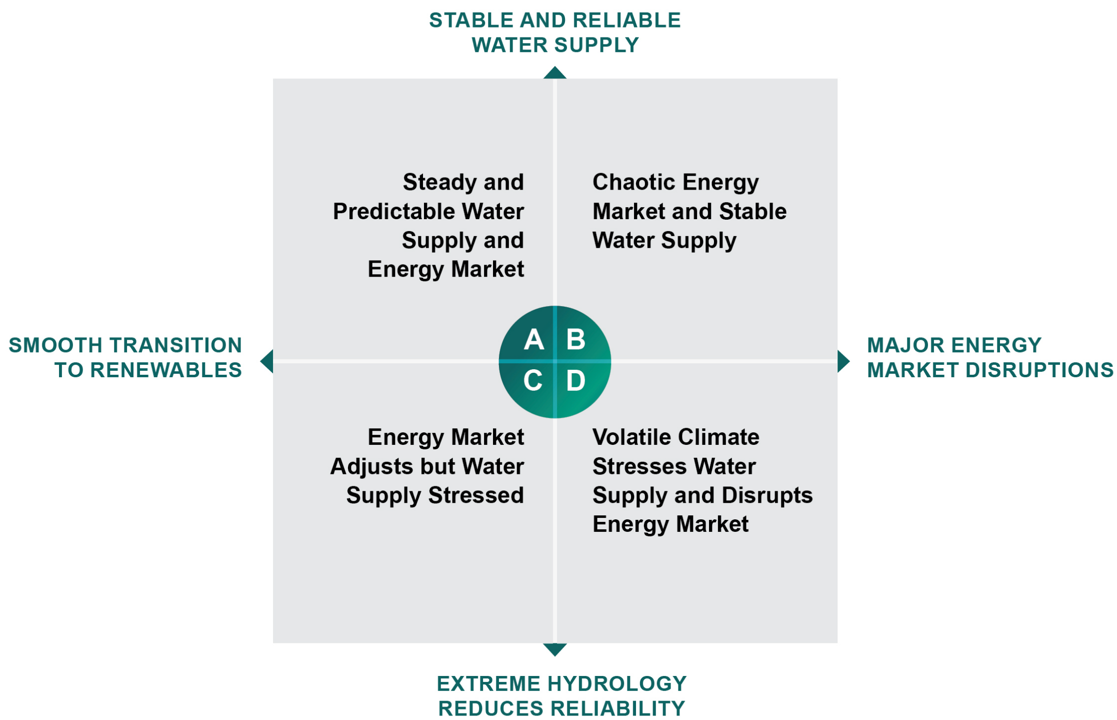


Figure ES-2 Scenario analysis matrix for evaluating robustness of identified projects and actions under uncertain future conditions

- Development of the ESP and related roadmap with recommended projects and actions for short- (less than three years), mid- (4-7 years) and long-term (up to 10 years) implementation to meet Metropolitan's policies and goals.

This planning approach and interim findings were validated through four interactive workshops that included participation of senior management and staff from different groups at Metropolitan (e.g., engineering, operations, environmental planning, and water resources management).

ES.2 KEY FINDINGS

The energy management initiatives included in the ESP address the significant energy market changes observed over the last decade and position Metropolitan as a leader in energy efficiency and forward-thinking energy management. The development of these initiatives incorporated considerations of the evolving regulatory landscape, economic considerations, water supply reliability, and development of new or existing technologies. As these factors change over time, options are recommended based on their economic and operational benefits that can serve Metropolitan's needs. The comprehensive evaluation of energy market drivers and their potential impact on Metropolitan's operations, revealed a number of key findings:

- The delivery of water and the demand for energy are intrinsically linked. Actions taken with regard to one will consequently have an effect on the other, for example, shifting high energy pumping operations to periods of low energy prices.

- The analyses and prioritization for renewable energy and energy storage projects in the retail and wholesale energy markets yielded similar results (see Table ES-1). This is in part due to the multiple benefits including improved cost containment, reduced exposure to energy price changes, increased operational flexibility, increased redundancy, increased revenue potential, increased energy independence and reduced carbon footprint. These options received high rankings in the MDA. The benefits of each project across multiple assessments including financial, carbon emission reduction, MDA, and scenario analysis provide Metropolitan with the perspective to consider projects that may not have the most optimal financial results but provide lower risk with increased flexibility to address future uncertainties.

- The preferred approach is to install and own small-scale energy storage units and plan for long-term energy management in anticipation of additional retail rate changes and programs that will enhance the value of usage flexibility. Metropolitan should evaluate the specific market conditions and drivers affecting power prices at its pump locations along the CRA to assess the benefits of large-scale energy storage. Considering the limited funding available for energy storage incentive and development programs, a swift implementation of the most economically and operationally beneficial energy storage projects is imperative.

- While Metropolitan is not directly affected by recent California legislation, such as Senate Bill (SB) 100, calling for 100 percent "carbon free" energy by 2045, the carbon emissions cap-and-trade system is imbedded into the cost of energy throughout the state. It appears that energy utilities and other load-serving entities are on track to hit these targets. Until then, carbon emission costs will continue to affect Metropolitan through its supplemental energy purchases for the CRA. Additional steps to reduce operational GHG emissions are under consideration through Metropolitan's CAP.

- Metropolitan engages in several energy best practices to reduce Metropolitan's overall energy consumption. These practices focus on energy auditing, monitoring and benchmarking, cost optimization of process and pumping operations, energy efficient design and rehabilitation measures, and providing staff training and communication strategies for energy management. Energy efficiency opportunities that reduce energy usage should be evaluated on a continuous basis for short- and long-term benefits to help reduce energy-related costs and GHG emissions.

- On a daily basis, the wholesale market includes significant price changes. The energy purchased for operation of the CRA pumping plants are subject to these price swings and pumping operations have minimal flexibility to dynamically adapt to the price changes. The addition of variable frequency drives, if and as feasible, to a few of these pumps would not only provide greater operational flexibility for supplying water to Southern California but could create added financial benefits by increased pumping during hours of low energy prices.

In general, the energy projects presented in Table ES-1 integrate well with the above factors and perform well in the multi-criteria and scenario evaluations demonstrating relative robustness now and robustness with respect to both current and future uncertainties.

Table ES-1 Retail and wholesale project options and results of financial, MDA, and scenario planning assessments

	NPV ($)	Payback Period (years)	Carbon Emission Reduction (MT CO_2/year)	MDA Ranking	Scenario Assessment Performance*			
					A	B	C	D
Retail Project Options								
Yorba Linda behind meter at Diemer	$5,000,000	4	1,061	1	Acceptable	Acceptable	Uncertain	Acceptable
Skinner – BESS + New Solar	$1,600,000	10	256	2, 3	Acceptable	Acceptable	Acceptable	Acceptable
Weymouth – BESS + Existing Solar	$345,000	5	10	4	Acceptable	Acceptable	Acceptable	Acceptable
Skinner – BESS + Existing Solar	$396,000	5	10	5	Acceptable	Acceptable	Acceptable	Acceptable
Jensen – BESS + Existing Solar	$275,000	5	10	6	Acceptable	Acceptable	Acceptable	Acceptable
Mills – BESS + New Solar	$356,000	14	131	7	Acceptable	Acceptable	Acceptable	Acceptable
Skinner – New Solar (PPA)	$277,000	-	271	8, 9	Acceptable	Uncertain	Acceptable	Poor
Skinner – New Solar (Owned)	$240,000	14	271	10, 14	Uncertain	Poor	Uncertain	Poor
Mills – New Solar (PPA)	$566,000	-	145	11	Acceptable	Uncertain	Acceptable	Poor
OC-88 – BESS + Grid	$308,000	5	10	12	Uncertain	Acceptable	Uncertain	Uncertain
Mills – BESS + Grid	$102,000	7	10	13	Uncertain	Acceptable	Uncertain	Uncertain
Mills – New Solar (Owned)	$140,000	14	145	15	Uncertain	Poor	Uncertain	Poor
Wholesale Project Options								
CRA Pump Upgrades	To be determined in the preliminary investigation of the CRA's pumps			1	Acceptable	Acceptable	Acceptable	Acceptable
Utility-Scale Battery Storage (Owned)	$17,800,000	15	Varies	2	Acceptable	Acceptable	Acceptable	Uncertain
Utility-Scale Wind Power	To be determined based on discussion with potential developers			3	Acceptable	Acceptable	Acceptable	Uncertain
Pumped Storage (Third Party)				4	Acceptable	Uncertain	Acceptable	Poor
Utility-Scale Solar Power				5	Acceptable	Acceptable	Acceptable	Uncertain
Pumped Storage (Owned)	Varies – see Appendix D			6	Uncertain	Acceptable	Poor	Poor
Small Hydropower	Varies – see Appendix D			7	Acceptable	Acceptable	Acceptable	Acceptable

Scenario Performance: Acceptable; Uncertain; Poor

*Scenario Descriptions: A: Steady and predictable water and energy; B: Chaotic energy market and stable water supply; C: Energy market adjusts but water supply stressed; D: Volatile climate stresses water and energy market disrupted.

Acronyms: BESS: Battery Energy Storage Systems; CRA: Colorado River Aqueduct; MDA: Multi-criteria Decision Analysis; MT: Metric Ton; NPV: Net Present Value; PPA: Power Purchase Agreement; Yorba Linda: Yorba Linda Power Plant.

ES.3 RECOMMENDATIONS

Metropolitan's adaptive energy management strategy incorporates a roadmap of actions and projects addressing issues surrounding energy management and cost mitigation (see Figure ES-4). The energy strategy roadmap addresses near- to long-term energy issues and achieves Metropolitan's overarching goals by including projects that address both retail and wholesale energy markets, and energy management best practices. The recommended actions are impacted by numerous factors, considered as indicators in this plan that will signal the acceleration or change of course for certain actions. The magnitude, nature, and timing of these signals will result in different responses and actions for Metropolitan in the long-term and should be continuously monitored over time.

As an immediate action, prior to implementation of the ESP roadmap, it is recommended that a dedicated Energy Sustainability team be established to further expand Metropolitan's current energy management practices.

Selected near-term actions (1-3 years) identified are:

- Coordinate the overall energy plan implementation, with the involvement of the Energy Sustainability team previously established and all interested parties and stakeholders.
- Continue to engage routinely with retail electric utilities (SCE, LADWP, RPU) regarding anticipated potential changes and/or increases to energy rate structures, or release of favorable electric utility programs and incentives.
- Begin implementation of reconfiguring Yorba Linda Power Plant feed to serve the Diemer water treatment plant (WTP) retail load behind the Southern California Edison meter.
- Begin the application process for SGIP funding for recommended BESS projects at the Weymouth, Skinner, Jensen, and Mills WTPs and the OC-88 Pumping Plant before funds decline.
- Evaluate the feasibility of integration and implementation of islanded operations for applicable projects for possible future microgrid purposes.
- Monitor wholesale energy market developments for major changes to CRA energy costs and evaluate appropriate options, such as generation or energy storage.
- Assess pump modifications at Intake and Gene pumping plants to implement targeted application of variable-speed pump drives.
- Continue to monitor third-party developer projects for opportunities in retail and large-scale wholesale renewable energy and energy storage opportunities.

Selected mid-term actions (4-7 years) identified include:

- Assess the performance of implemented BESS projects, and later implement the previously deferred project options based on first phase performance results.

- Implement renewable energy and/or energy storage projects with third-party developers, if determined feasible.
- Continue evaluating low/no carbon power for CRA pumping operations to hedge against rising carbon prices.
- Reevaluate small hydropower opportunities within the distribution system if project economics become favorable.

Long-term planning should focus on the next 10 years to adapt relevant actions and strategies to current conditions. The key goal for Metropolitan's long-term energy management plan is to continuously update the ESP, monitor implemented projects and initiatives, reassess the main market drivers to better understand potential project and energy management opportunities, and adjust the Plan and roadmap accordingly.

The framework is intended to be flexible by accommodating future projects, preferences, and localized needs, and be adaptable as Metropolitan's goals and technology evolve. The roadmap provides a plan for implementation of the recommended energy projects and initiatives, while accounting for changes in the future. Signals assigned to each action are meant to be monitored over time by Metropolitan staff to indicate when these actions and their economic and operational benefits can serve Metropolitan's needs.

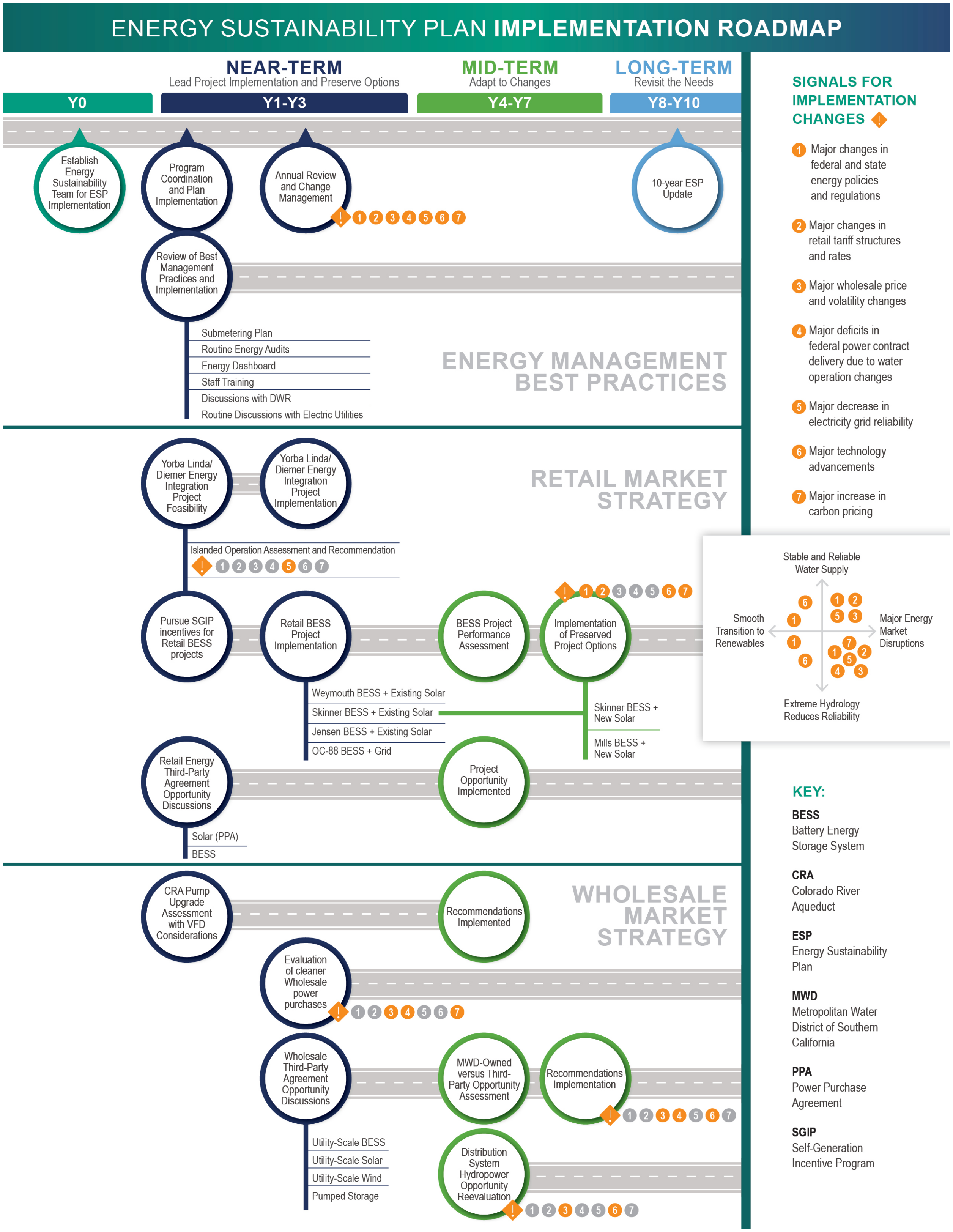


Figure ES-4 Energy Sustainability Plan Roadmap

1.0 INTRODUCTION

The Metropolitan Water District of Southern California (Metropolitan) is the nation's largest wholesale water provider. Metropolitan's mission is to provide its service area with an adequate and reliable supply of high-quality water to meet present and future needs in an environmentally and economically responsible way. During a normal year, Metropolitan moves approximately 1.3 - 2.0 million acre-feet (MAF) of water per year through its conveyance and distribution system, delivering supplies to 26 member agencies serving more than 19 million Southern Californians across six counties. The conveyance, treatment, and distribution of water is an energy-intensive, energy-dependent process. Metropolitan—as a steward of the public interest and in conjunction with its mission—has overriding goals of controlling operational costs and conserving valuable natural resources. Metropolitan continues to show leadership in the areas of energy resource sustainability and conservation.

Metropolitan imports water from Northern California via the State Water Project (SWP) and from the Colorado River via the Colorado River Aqueduct (CRA). About 45 percent of Southern California's water supply comes from these two sources, with the remainder supplied from the Los Angeles Aqueduct and local sources. The available supply mix from these sources can vary greatly as a result of the hydrologic conditions in a given year. Given the highly varied topography and sheer size of California, water moved throughout the state and imported into Southern California has an associated high energy intensity. Consequently, large amounts of electricity are required to pump water from its source to Southern California. Additional electricity is required to treat and deliver the imported water through Metropolitan's conveyance and distribution system.

Metropolitan owns and operates the CRA, five regional water treatment facilities and a conveyance and distribution system that delivers water throughout Southern California (Figure 1-1). Metropolitan has sole discretion in associated investments and management of these facilities for the purpose of water supply. Energy for these facilities comes from either the retail or wholesale energy markets.

In contrast, the SWP is owned and operated by the California Department of Water Resources (DWR), and Metropolitan, as an SWP contractor, is responsible for the largest share of operational costs (including energy costs). Although Metropolitan monitors the indirect costs associated with the SWP, it does not directly control SWP decisions related to electric power. Since the focus of this plan is the development of strategies to manage energy costs directly under Metropolitan's control, an analysis of SWP power costs is not included within the scope of this report. DWR has been proactive in managing its energy use and associated greenhouse gas (GHG) emissions. Metropolitan will continue working with DWR on its energy management activities and initiatives.

The Energy Sustainability Plan's purpose is to foster informed energy management decisions by Metropolitan through the development of a framework of sustainable actions focused on energy reliability, affordability, conservation and adaptation – now and into the future

The development of the Energy Sustainability Plan (ESP) represents an important milestone for Metropolitan in its adaption to changing energy market and water supply conditions. Recent significant changes in California's energy markets have created uncertainty in the reliability and cost of energy supplies, which in turn affects the affordability and reliability of Metropolitan's water supply operations. The purpose of the ESP is to foster informed energy management decisions through a framework of sustainable actions focused on energy cost containment, reliability, affordability, conservation and adaptation – now and into the future. Options were identified for improving efficiency of facility operations, enhancing Metropolitan's energy management practices, leveraging available resources to reduce energy costs and maintain water supply reliability. For each option, the potential GHG emissions reduction was estimated. The focus of this effort is to expand options for market adaptation and develop business strategies and recommendations for the next 10 years. To support the implementation, this ESP also includes a systematic approach and consideration for adaptation during implementation.

Figure 1-1 General overview of Metropolitan facilities

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1.1 HISTORY OF METROPOLITAN'S ENERGY MANAGEMENT INTIATIVES

Metropolitan has a long history of implementing energy management strategies that provide cost savings and carbon emission reductions for the agency, establishing Metropolitan's leadership in energy management (Figure 1-2). In the 1930s, during the construction of the CRA and Hoover and Parker Dams, Metropolitan secured power agreements for a portion of the generation from both dams. Over the next few decades Metropolitan's five water treatment plants (WTPs) and distribution system were designed and constructed to maximize the delivery of water to customers via gravity to limit the energy expenditures associated with the treatment and distribution of water. During the 1970s, Metropolitan began developing hydroelectric power recovery plants throughout its conveyance and distribution system. Currently, there are 15 power plants that generate over 200 million kilowatt-hours per year and the power is sold under contract to various load-serving entities at a value comparable with California-certified renewable energy. In the late 1980s, Metropolitan began investing in reliability improvements for pumping operations along the CRA by restoring pumps, motors and other systems for energy savings (Metropolitan, 1996).

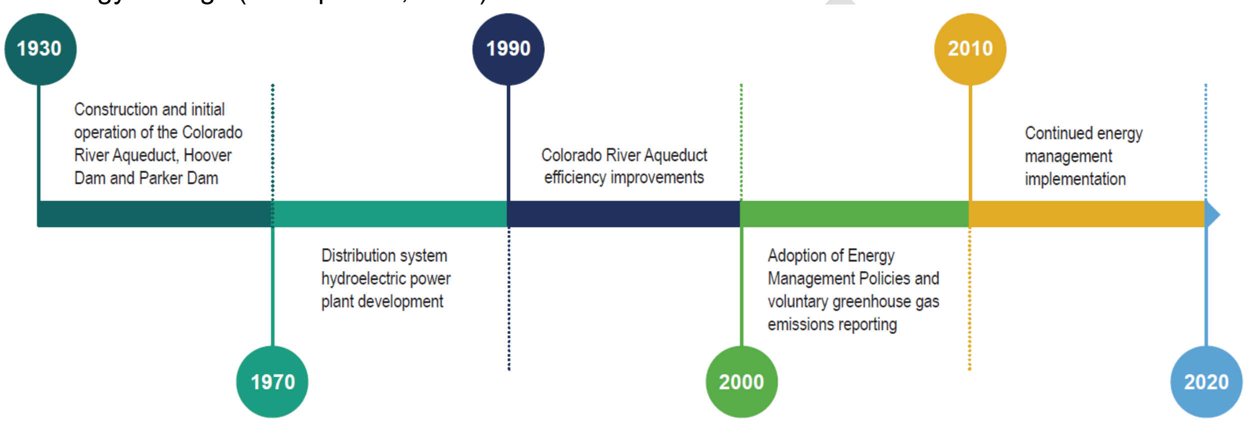


Figure 1-2 History of Metropolitan's energy initiatives

In 2007, Metropolitan began voluntary reporting of annual GHG emissions to the Climate Registry and continues to report GHG emissions to both the Climate Registry and the California Air Resources Board (CARB). In 2009, an Energy Management and Reliability Study (EMRS) was conducted and followed by the proposal and adoption of Metropolitan's Energy Management Policies, discussed below. Following adoption of the Energy Management Policies, cost effective projects, such as solar generating facilities at Skinner, Weymouth, and Jensen water treatment plants, were implemented to reduce energy costs with an added benefit of reducing GHG emissions.

In September 2017, Metropolitan successfully negotiated and secured a 50-year Energy Service Contract for low-cost carbon-free hydropower generated at the Hoover Dam for CRA operations. In 2018, Metropolitan joined the California Resilience Challenge. This is a new initiative to reinforce the state's recognition of, and reaction to, climate change. In 2019, Metropolitan participated in the development of and became a founding member of the Water Energy Nexus Registry, which was established to help water agencies and utilities better understand the energy and GHG emissions associated with each process in water management and use. More details on the energy initiatives and facility improvement achievements implemented by Metropolitan are provided in the following sections.

1.1.1 Energy management policies

After the completion of the 2009 EMRS, Metropolitan's Board of Directors adopted the Energy Management Policies in August 2010 (Figure 3). In accordance with the policies, all programs, projects, and initiatives related to strategic energy management at Metropolitan must meet the following major objectives:

- Containing costs and reducing Metropolitan's exposure to volatile energy prices;
- Increasing system reliability;
- Providing a revenue stream to offset energy costs; and
- Move Metropolitan towards energy independence and sustainability.

Metropolitan's energy management practices and the ability to adapt to changes in the energy sector are integral to achieving its mission to provide its service area with an adequate and reliable supply of high-quality water in an environmentally and economically responsible way.

Water/Energy Nexus	Identify collaborative programs and initiatives between the water and energy industries, constructing sustainable partnerships to reduce costs and provide enhanced reliability.
Regulatory	Track federal and state greenhouse gas regulations and develop strategies to hedge against price and regulatory risks toward Metropolitan.
Legislation	Pursue legislation to protect or enhance reliability of energy supply and mitigate energy cost risk.
Contracts	Maintain maximum flexibility on existing and future contracts with Hoover and other energy contracts to hedge against cost and regulatory risks.
Project/ Partnerships	Pursue cost-effective renewable energy projects and partnerships to hedge against energy price increases and regulatory risks, while reducing Metropolitan's carbon footprint.
Revenue Stream	Pursue revenue stream renewable energy facilities on operational lands to assist in cost containment.
Economic & Environmental Stewardship	Based on projected economic and regulatory conditions, develop cost-effective programs, projects and initiatives to control operational costs and move Metropolitan towards energy independence. Implementation of proposed Energy Management Plan activities would result in substantial reductions in GHG emission
Energy Management Updates	Staff will return to the Board on a regular basis to report on progress on the Energy Management Master Plan and the suitability of these policies, in light of changing regulatory and economic conditions.

Figure 1-3 Metropolitan Energy Management Policies

1.1.2 Recent energy management initiatives

Over the past decade, Metropolitan has implemented several energy initiatives consistent with the Energy Management Policies to move Metropolitan forward on the path towards comprehensive energy management. These initiatives range from planning studies aimed at evaluating energy savings opportunities to facility upgrades to increase energy efficiency. Prior planning studies are briefly summarized below by subject:

- **Hydropower**: Potential new hydropower opportunities within Metropolitan's conveyance and distribution system were evaluated, including increasing hydropower generation at existing sites, construction of new hydropower facilities and the implementation of new technologies (such as in-line hydropower). Based on recent analyses, new facilities or technologies are not considered cost effective. However, Metropolitan's current Capital Investment Plan includes a project to assess and rehabilitate each of the 15 existing small hydroelectric plants to develop a multi-phase program to rehabilitate the plants and optimize revenue generation over the next 30 years.
- **Solar**: Additional solar opportunities at Metropolitan's WTPs were studied. These studies led to the implementation of a total of 5 megawatts (MW) of solar generating facilities at Skinner, Weymouth, and Jensen WTPs.
- **Wind**: Opportunities for development of wind generation resources on or near Metropolitan-owned properties, specifically near the CRA were evaluated and found not to be cost effective.
- **Pumped Storage**: Pumped storage project opportunities were evaluated. Specifically, opportunities at Diamond Valley Lake were considered but found to be not cost effective.
- **Energy Efficiency Pilot Program:** Metropolitan is currently conducting an Energy Efficiency Pilot Program at the Weymouth WTP to evaluate the effectiveness of various approaches and upgrades for eventual implementation district-wide.

Metropolitan has also made numerous improvements at its facilities to increase energy efficiency with the objective of reducing overall energy costs. A full list of these energy efficiency accomplishments is presented in Appendix A.

1.2 DRIVERS FOR AN ENERGY SUSTAINABILITY STRATEGY UPDATE

Over the past several decades, Metropolitan has implemented many energy initiatives that have reduced energy costs and use, while diversifying its energy portfolio. Despite these efforts, new complexities of California's rapidly evolving electric grid have resulted in increased energy costs, which is a major driver of Metropolitan's energy management and sustainability strategy update. At the same time, technological advancements could also mitigate these effects and enhance the reliability of Metropolitan's supplies to its' member agencies. Overall, there are five major factors influencing the future of the energy market and Metropolitan's corresponding energy sustainability strategy, including:

- Progression of environmental regulations
- Energy market pricing uncertainty
- Grid reliability
- Climate change and natural disasters
- Technological advances and incentives

These drivers have and will continue to impact the feasibility of energy strategies implemented by Metropolitan, as discussed in Section 5.1. An in-depth analysis of the implications of each of these uncertainties on Metropolitan's operations is presented in the following sections.

1.2.1 Progression of environmental regulations

California is leading the nation with energy and environmental policy initiatives that are driving electrical grid changes. Key state initiatives include:

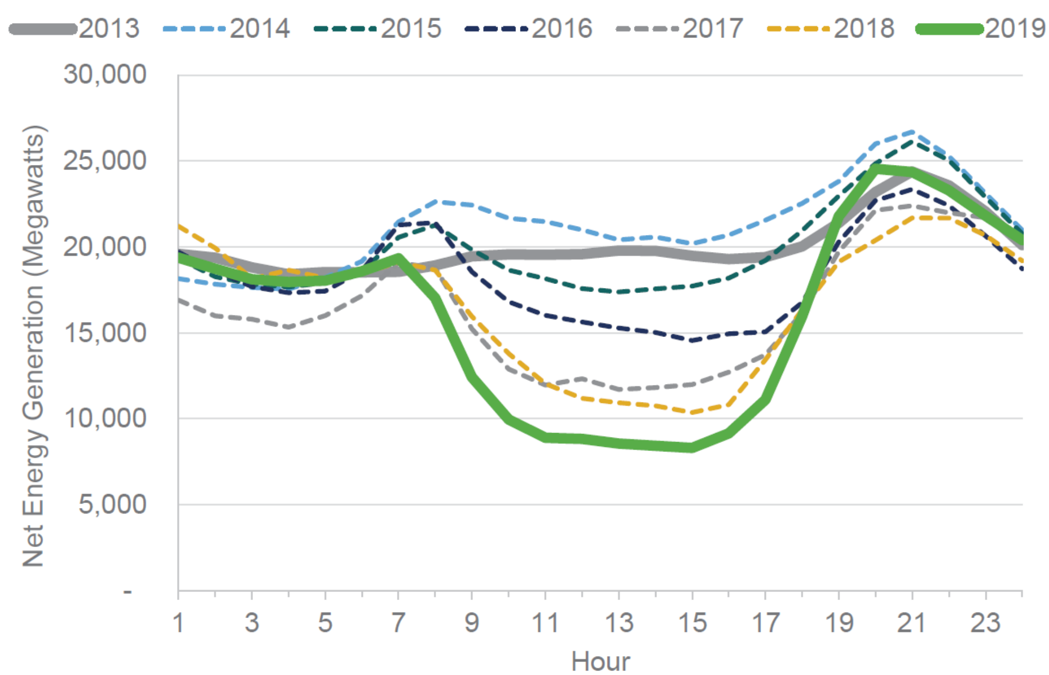
- Executive Order (EO) S-3-05, requiring the state to reduce its GHG emission levels to 2000 levels by 2010, to 1990 levels by 2020, and to a level 80 percent below 1990 levels by 2050
- Assembly Bill (AB) 32 (a.k.a. the Global Warming Solution Act of 2006), requiring the CARB to develop regulations and market mechanisms to reduce California's GHG emissions to 1990 levels by 2020
- The California Public Utility Commission's (CPUC) 2008 Energy Action Plan Update, establishing the policy and preferences regarding distributed generation
- The State Water Resources Control Board's 2010 Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (Once-Through Cooling Policy), requiring power plants that use coastal water for cooling to either repower, retrofit, or retire within the next decade
- CARB's Cap-and-Trade Program for carbon dioxide equivalent (CO_2-e) launched in 2013 in accordance with AB 32, setting a state-wide limit on sources responsible for 85 percent of California's GHG emissions, and establishing a price signal needed to drive long-term investment in cleaner fuels and more efficient use of energy
- EO B-16-12 and B-48-18, setting the targeted number of zero emission vehicles at 1.5 million by 2025, and 5 million by 2030
- Senate Bill (SB) 32, expanding upon AB 32 by establishing a new GHG emissions reduction target of 40% below 1990 levels by 2030
- EO B-55-18, establishing a new state-wide GHG reduction goal of carbon neutrality as soon as possible, and no later than 2045, and meeting the goal of net negative emissions thereafter
- Senate Bill (SB) 100, requiring 60 percent of California utility-provided electricity from renewable power sources by 2030, and 100 percent from "carbon free" sources by 2045

California's shift to renewables and carbon-free energy by 2045 is a primary driver in future energy dynamics and will impact both the cost and volatility of energy markets.

The implementation of these key initiatives has a significant effect on Metropolitan's exposure to energy market change and uncertainties. For example, Metropolitan's carbon emissions from energy purchases will decrease significantly due to the implementation of SB 100. However, the added cost of carbon embedded in the wholesale and retail energy consumed by Metropolitan will directly affect the overall energy cost as carbon prices are expected to increase over time.

1.2.2 Energy market pricing uncertainty

The adoption of the aforementioned policies and state goals in GHG emission reductions and environmental protection are fundamentally changing the wholesale electric grid and its operation. In 2013, CAISO published a chart representing the difference between forecasted load and expected electricity production from variable generation resources (a.k.a. the "duck curve") to illustrate the changing conditions in future renewable scenarios (CAISO, 2016). In certain times of the year, a significant net load drop occurs when solar generation decreases at the end of the day. This drop must be mitigated by conventional fossil fired energy generators (see Figure 1-4). This effect creates over-generation during the middle of the day, which produces a "belly" appearance, and a steep ramp for fossil fuel generators during the late afternoon and evening, creating an "arch". The progression of this trend is illustrated in Figure 4 and follows the increased penetration of solar in California from 2013 to 2019. During times of over-generation, CAISO may curtail or restrict renewable energy generation in order to balance supply and demand on the grid. In 2019 alone, over 11 million MWh of wind and solar energy was curtailed across the state. Due to this effect, the variation of daily wholesale energy market real-time prices ranges from greater than $1,000/megawatt hour (MWh) to less than $0/MWh. This trend in the wholesale energy market can also affect the retail market, as discussed in later sections.



Source: IEA, 2019

Figure 1-4 CAISO's duck curve with net load from fossil fuel generation plotted versus time for a spring day in California

The potential risk of over/under generation is likely to increase as utilities bring additional solar generation online (i.e., a deepening duck curve) to meet the California mandate for 100 percent carbon-free energy by 2045. While balancing the grid is always a challenge, the duck curve signals a recognition of the high penetration of variable generation from renewable sources and the need for new operating practices that allow greater system flexibility. Two types of responses have been deployed in the market by energy utilities to ease the impacts. The first response is to "fatten" the duck by increasing the flexibility of the power system—which means changing operational practices to enable more frequent power plant cycling, starts and stops, and so on. The second response is to "flatten" the deepened duck curve by shifting demand to the solar hours and using energy storage to shift solar energy to non-solar hours.

The duck curve effects can be observed through two energy price forecasts (Wood Mackenzie and S&P Global Platts) demonstrating alternative future price profiles (Figure 1-5). The main difference between the two forecasts is the assumptions regarding large-scale implementation of energy storage throughout the state. The Wood Mackenzie forecast assumes swift and large implementation of energy storage, which will help mitigate the hourly variability in wholesale prices. The S&P Global Platts forecast assumes the implementation of large-scale energy storage will not keep up with the continuing implementation of renewables on the market, resulting in greater hourly wholesale price variability.

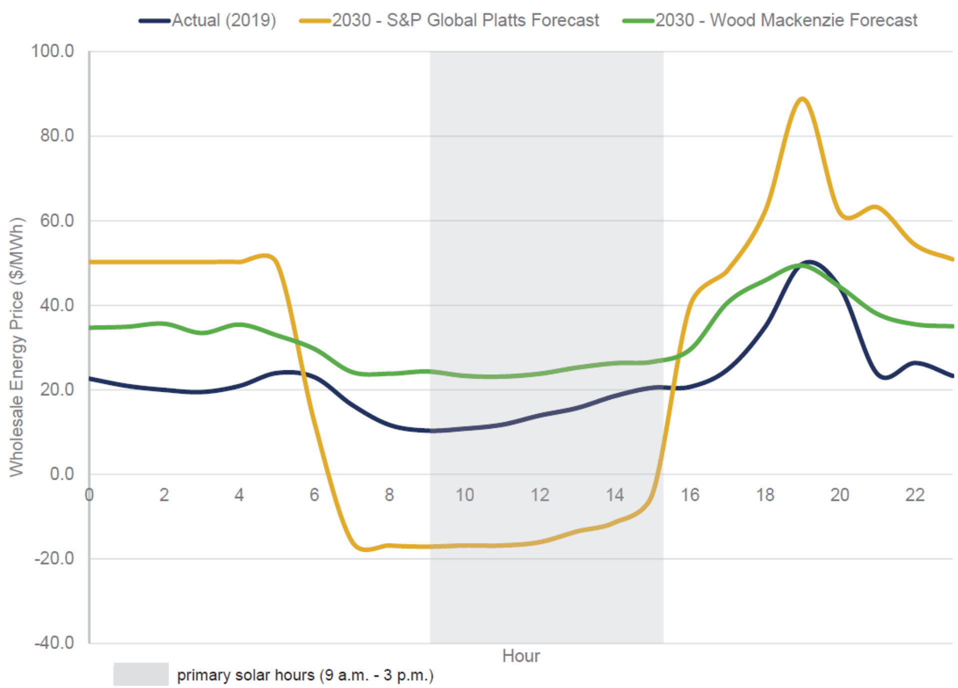


Figure 1-5 Average June hourly wholesale energy price forecasts

These shifts in hourly peak pricing are resulting in new retail time-of-use (TOU) tariffs and are expected to further alter retail prices in the future. As stated previously, the high penetration of renewable generation across the state resulted in the “duck curve” effect which has shifted peak pricing from periods when demand is highest (typically midday) to periods in which solar generation declines (typically evening hours). Current operations at Metropolitan’s facilities and previous renewable energy implementations (i.e., solar) were employed to avoid peak prices as much as possible. For example, filter backwashes were rescheduled to off peak pricing periods at the WTPs and load shedding has been employed at Intake and Gene Pumping Plants to address high

Strategies to reduce exposure to energy price volatility are important for Metropolitan’s long-term energy management planning as the future of California’s energy market is uncertain.

wholesale prices. Recent discussions with Metropolitan's utility providers indicate continued shifts of TOU pricing periods, which would require operations to adapt as necessary to avoid peak prices. These shifts have been considered for this analysis in addition to trends of increasing retail prices. More details on these assumptions and forecasted retail pricing is presented in Appendix D.

Consequently, the duck curve effect has changed wholesale and retail energy price and structures, which are impacting energy costs and operations at Metropolitan.

1.2.3 Grid reliability

California has historically been dependent on fossil-fired generation to provide for the bulk of its energy needs, as well as peaking capacity and operating reserves to balance the system and compensate for system contingencies. At the beginning of the 21st century, California had high and volatile energy prices. At the time, the Federal Energy Regulatory Commission removed state-imposed price caps and the average cost of energy in California proceeded to reach $300/MWh. This ultimately led to precipitous price increase, market manipulation by generators and marketers, and the collapse and eventual bankruptcy of the state Power Exchange and Pacific Gas and Electric Company. In addition, large-scale rolling blackouts were seen across the state that affected thousands of customers, both residential and commercial.

As a result of this energy crisis, CAISO made significant changes to the way that the state's transmission grid is planned, operated and priced in the form of the Market Redesign and Technology Upgrade. Under the new market structure, there are thousands of pricing nodes, which are adjusted every 5 minutes. Utilities and other electricity providers purchase wholesale electricity from the CAISO markets at a given node, and the price is determined by a function of the energy, transmission losses, congestion, and other key factors in the day ahead and real-time optimization. However, the state's environmental policies to reduce fossil generation emissions and cooling water impacts have and will continue to result in the retirement of fossil generation throughout the state and the region. The transition to renewable non-emitting generation creates challenges for grid operators without the traditional sources of on-demand, fast-ramping capacity.

Securing supplemental power independent of California's energy grid reduces Metropolitan's exposure to power reliability.

Approximately 50 to 85 percent of Metropolitan's energy for CRA pumping has historically been supplied from low-cost federal hydropower transmitted to the CRA pumps via Metropolitan-owned transmission lines. In 2017, Metropolitan negotiated new long-term power contracts for the CRA power system, securing continued, low-cost federal hydropower from the Hoover Dam and balancing services from the CAISO. More details on these contracts is provided in Section 3.1. However, Metropolitan is still dependent on supplemental purchases of wholesale energy, which exposes Metropolitan to price increases and variability due to grid reliability issues.

1.2.4 Climate change and natural disasters

Natural disasters and a changing climate pose substantial risks to the availability and price of energy for Metropolitan. While the timing and occurrence of these events is unpredictable, their effects can be anticipated and estimated. For these reasons, events that could affect Metropolitan's or its retail energy providers' (e.g., Southern California Edison [SCE], Los Angeles Department of Water and Power [LADWP], Riverside Public Utilities [RPU]) infrastructure represent an opportunity to manage and, where possible, mitigate risk. California's power grid is vulnerable to rapidly evolving hazards (e.g., earthquake, flooding, fires) and slowly unfolding threats (e.g., climate change) that could cause major disruptions to operations within the region. Due to California's interconnected power grid, electricity providers have recently begun to pre-emptively turn off customers' electricity (i.e., Public Safety Power Shutoffs) during extreme dry-and-windy weather conditions to reduce the risk of overloading the system and power lines sparking wildfires. While Metropolitan has not been significantly affected by these forced blackouts to date, it is probable that this could become a regular occurrence in the future. Separate from this effort, Metropolitan has conducted studies to evaluate the vulnerability of the CRA electric system assets and taken measures to reduce the consequences of failure while increasing system flexibility and redundancy.

Potential climate change impacts remain wide and uncertain. Energy management initiatives that preserve a high degree of long-term flexibility, increase energy independence (i.e., reduced reliability on the grid for power) and stabilize costs are essential.

Future changes in Colorado River flow and storage in Lake Mead, due to climate change, may translate to reductions of low-cost power from the Hoover and Parker power plants and associated energy cost increases. In addition, more frequent and extended drought conditions in the Colorado River Basin may pose a significant risk to the availability of Colorado River water supplies. The low-cost hydropower from Hoover and Parker Dams is delivered to Metropolitan's CRA pumping plants through a series of power transmission lines, which themselves are at risk for interruptions and failures. Maintaining adequate and reliable water supply and low-cost hydropower is key to the long-term cost and operational viability of the CRA system.

1.2.5 Technology advances and incentives

Over the past few decades, California has begun shifting away from fossil fuel energy and moving towards renewable and carbon-free energy. Non-fossil energy generation methods (such as hydropower) have been used for centuries, but only recently have other technologies achieved the necessary factors required for large-scale implementation and self-generation. These include low capital costs, regulatory support, stable incentive program funding, and higher efficiency. Solar photovoltaic, biogas, landfill methane capture, and wind are all viable technologies for consideration as sources of energy and may even be more cost-effective if paired with an energy storage system, such as a battery.

To address the challenges associated with the deployment of renewable energy and the volatility of energy prices, battery energy storage systems (BESS) are able to capture the energy generated by renewables and store the energy until it is needed. BESSs also have the potential to overcome the availability and intermittency challenges of power from renewable sources, and to prevent curtailment of periods of oversupply by storing renewable energy and then releasing energy when the renewable sources are not available. Battery storage can effectively increase utility resiliency and energy reliability, as it supports energy loads by providing backup power during significant power outages or other emergency situations when utilized in an islanded, or microgrid, mode disconnected from the grid.

These new technological advancements and improved practices in the renewable and energy storage sectors provide additional, viable options for Metropolitan's long-term energy management (e.g., the use of battery energy storage for increased reliability, energy regulation, and savings). There are several incentive and credit programs, such as the CPUC Self-Generation Incentive Program (SGIP) and investment tax credit (ITC), that further improve the economic feasibility of battery energy storage projects.

New technological advancements and improved practices in the renewable energy and energy storage sectors provide viable options for Metropolitan's long-term energy management.

In the past several years, Metropolitan has taken advantage of these advancements by installing solar power generating facilities at its WTPs to reduce retail electricity costs, increase Metropolitan's energy independence, and lower Metropolitan's overall GHG emissions. The capital costs for installing solar power generating facilities have drastically decreased in recent years. Power utilities have reduced their incentives for additional solar installation and are beginning to modify their tariff rate structures as discussed above, resulting in decreases in potential cost savings from self-produced solar energy. Many water utilities in California have also installed in-line hydropower units where economically justifiable to recover energy in their system and offset energy demand (CEC, 2020). Similarly, pumped-storage systems that fell out of favor in past decades are now being evaluated because of the changes in California's energy market and the need to store supplies of renewable energy.

1.3 OBJECTIVES OF THE ENERGY SUSTAINABILITY PLAN

Energy management is critical for mitigating the effects of the factors stated above. Developed from Metropolitan's Energy Management Policies (Section 1.1.1), the main planning objectives of the ESP are to develop an adaptive energy management strategy and a project implementation roadmap resulting in projects and initiatives that:

1. **Contain costs and reduce Metropolitan's exposure to energy price volatility** –In general, projects and strategies that provide a payback period less than an asset life are considered favorable to Metropolitan. The changing energy market landscape provides Metropolitan with opportunities to implement projects and measures that reduce its energy and demand charges. Projects that protect against price volatility and respond to shifting tariff structures also help position Metropolitan to preemptively contain future energy costs.

2. **Increase operational reliability and flexibility** – Water system operations are critical for Metropolitan to continue delivering high-quality water to its customers throughout Southern California. The reliability of these operations is dependent on a multitude of factors, including the flexibility of where, how, and when water is delivered. Energy storage options that add flexibility in water operations also provide greater reliability.

3. **Move Metropolitan towards energy independence and sustainability** – While it is unlikely that Metropolitan could (or should) be fully independent from the energy grid (either in the retail or wholesale markets), implementation of projects with non-grid sources of energy can provide Metropolitan with a more reliable and resilient system. The ability to take advantage of high

and low energy prices in the market by adapting energy usage throughout the day allows Metropolitan more control over its energy costs, leading to more energy independence.

4. **Support Metropolitan's CAP effort to reduce GHG emissions** – California's GHG-related regulations (such as SB 100) are driving the state towards 100 percent carbon-free energy by 2045. Comprehensive programmatic planning documents, known as Climate Action Plans (CAP), are designed to identify GHG reduction actions and programs that offset future GHG emissions. Metropolitan is developing a CAP to inventory existing and historical GHG emissions, set a target for future emissions reductions and streamline the environmental review of GHG emissions from future capital projects. The ESP will support the CAP's GHG reduction target, if adopted by the Board, and evaluate projects that support the GHG emission reductions goals.

The purpose of this ESP is to develop a framework of sustainable actions focused on near-term and mid-term issues, and recommendations surrounding energy management, cost control, reliability, and adaptation on the CRA (which utilizes wholesale power) and the conveyance and distribution system (which utilizes retail power).

While the ESP focuses on energy management and cost control, this planning effort will also support other efforts and initiatives within Metropolitan, including integrated resource planning, the CAP, capital investment planning, compliance with requirements of California Environmental Quality Act (CEQA) documents (0), partnerships with member and peer agencies and utilities, ongoing discussions with DWR regarding SWP operations and costs, and supporting and influencing legislation beneficial to Metropolitan and its customers.

2.0 METROPOLITAN'S ENERGY SUSTAINABILITY PLANNING PROCESS

The development of the ESP and associated roadmap was conducted using an innovative multiphase approach, as presented in Figure 2-1 and detailed in the following sections. This plan has taken a holistic approach to energy sustainability planning, not only to evaluate energy opportunities for their financial viability but also to include a multitude of benefits, such as operational reliability, revenue generating potential, energy independence, and carbon emission reduction.

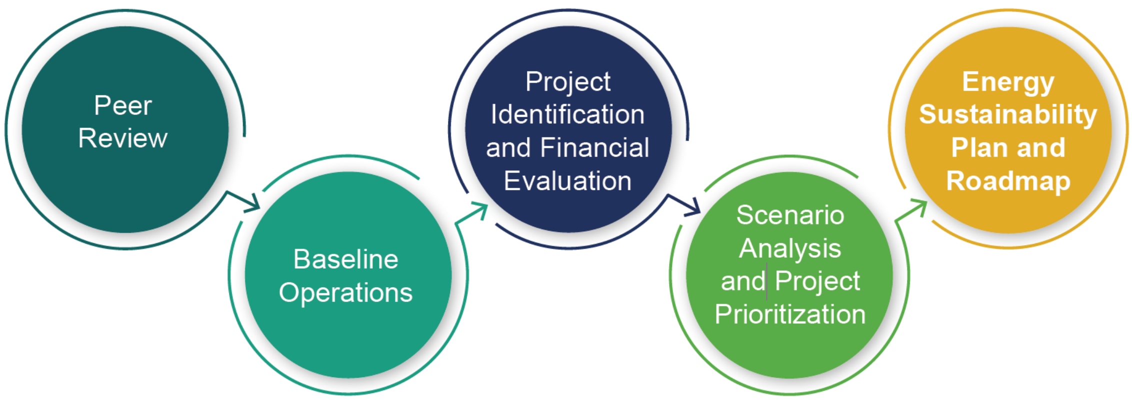


Figure 2-1 Conceptual approach used to develop Metropolitan's Energy Sustainability Plan

2.1 PEER REVIEW OF BEST PRACTICES FOR ENERGY SUSTAINABILITY IN THE WATER SECTOR

A review of energy management practices of 17 water utilities was conducted to define energy sustainability best practices in the water sector. The assessment identified each agency's energy management goals, planning approach, initiatives, and achievements. In combination with the peer review, workshops were held with staff from five California water and wastewater utilities to foster knowledge transfer on energy management and planning topics.

Key findings from the review of the energy management plans and workshop discussions were as follows:

- A limited number of water utilities develop energy master plans or have energy and sustainability targets that drive the selection of energy management strategies.
- Common energy management policies and goals focus on reducing energy cost and uncertainty, improving energy efficiency and reducing carbon emissions.
- Energy management plans are utility- and goal-specific; however, they often follow similar approaches used for evaluation and prioritization of energy sustainability initiatives.

- BESS options are now being integrated into water utility energy portfolios to provide opportunities for cost savings, operational flexibility, and better management of on-site renewable generation.
- Agencies implemented renewable energy and energy storage projects through power purchase agreements (PPA) or shared saving structures, which shifts project risks from the agencies to a third-party developer and allows monetization of federal tax incentives.
- Understanding energy use, generation, and wastage at water utilities is critical, and can be improved through advanced data management programs, conducting energy audits, and improving data acquisition processes through submetering.
- Communicating with the electric utilities and understanding electric utility programs is critical for a cost-effective management of energy use and power generation at water utilities.

An in-depth summary of the information collected through the workshops and the review of the energy management plans developed by the selected water and wastewater utilities is presented in Appendix C. This review, in conjunction with other resources, was used to identify potential energy projects and benchmarking initiatives for evaluation, as described in Section 4.0.

2.2 ASSESSMENT OF ENERGY BASELINE OPERATIONS

A large quantity of data was collected for the assessment of energy baseline operations at Metropolitan (Section 3.0) from a variety of sources, including supervisory control and data acquisition (SCADA), previous internal reports, third-party analysts, and electric utilities. The key data obtained for the assessment at Metropolitan's facilities (e.g., WTPs, conveyance and distribution system, CRA) can be broadly segmented in the following main categories:

- Site locations and constraints;
- Power demands of WTPs and major pump stations, including those from CRA operations (over the last 5-10 years);
- Energy generation from on-site renewable sources (e.g., solar, hydropower) at WTPs and other facilities (over the last 5-10 years);
- Energy bills and TOU structures from various energy suppliers (SCE, RPU, LADWP);
- Retail and wholesale energy market price forecasts (e.g., Wood Mackenzie and S&P Global Platts);
- Levelized cost of energy and levelized cost of storage;
- Federal contract hydropower and other constraints;
- Future capital improvement projects impacting Metropolitan's energy demands; and
- GHG emission factors and cost of carbon.

The data was gathered in relation to baseline assessment conditions and projected energy market scenarios, and was checked for accuracy, consistency, and completeness. In addition, relevant publicly available literature was reviewed and discussions were held with technology providers to assess the capital and operations and maintenance costs of renewable energy and energy storage systems. A description of the use of the above-mentioned data for the evaluation of projects selected for the ESP is detailed throughout the various sections of Appendix D.

2.3 IDENTIFICATION AND EVALUATION OF PROJECTS

The ESP identified a list of potentially viable project options to pursue for further evaluation. The project list is not exhaustive and is meant to be modified over time, as this plan provides an adaptive framework approach to evaluate new project options when they become applicable to Metropolitan's needs. The selection of projects was based on the findings of the previous EMRS, a review of previous energy management efforts at Metropolitan, a peer-review of other proactive water and wastewater utilities, and discussions with Metropolitan staff. The projects differ based on the type of facility and energy management project, the retail or wholesale market they participate in, and the type of technology assessed (e.g., renewable energy, battery energy storage, pumped storage, and hydropower). Identified projects fit in the following three major categories:

- **Retail energy market projects** - Renewable energy and energy storage projects within Metropolitan's WTPs and conveyance and distribution systems
- **Wholesale energy market projects** - Renewable energy and energy storage projects along the CRA
- **Energy management best practices** - Other utility-wide energy management initiatives, including energy efficiency and best management practices to increase internal resource advancement

The methodology used to assess the selected projects' financial and environmental feasibility is summarized in Figure 2-2. A summary of the outcomes of the project financial and environmental feasibility analyses is presented in Section 4.0. Detailed information on the approach, assumptions, and results of the financial and environmental feasibility assessment is presented in Appendix D.

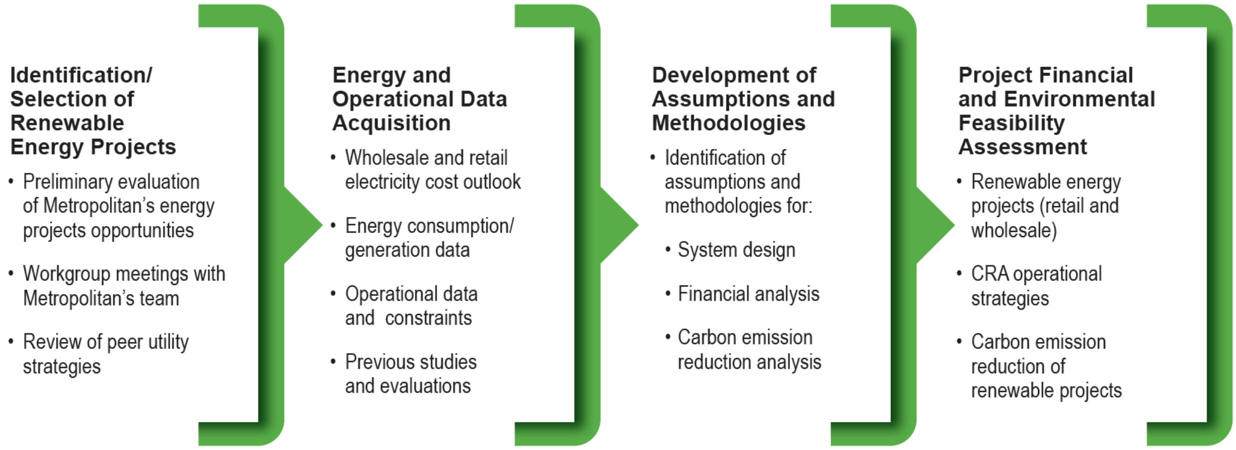


Figure 2-2 Conceptual methodology used to develop the financial and environmental feasibility assessment of selected renewable energy and storage projects at Metropolitan

Projects that involve third-party contracts (such as large-scale renewable energy along the CRA, or pumped storage projects) were identified in this plan as options for Metropolitan to consider but were not fully evaluated. These types of projects have numerous considerations besides financial payback, including environmental constraints, permitting, land use, risk mitigation, and third-party contract agreements. Due to these factors, each project requires its own in-depth evaluation with potential third-party providers, which is beyond the scope of this plan.

2.4 PROJECT RANKING, PRIORITIZATION, AND SCENARIO ANALYSIS

Following the financial and environmental assessment, identified projects were further evaluated using two alternative decision-making tools:

- A multi-criteria decision analysis (MDA) that compares the relative performance of options based on considerations that go beyond costs alone, and
- A detailed scenario analysis that effectively "stress tests" each option under a range of plausible future conditions based on the key energy market drivers identified in Section 1.2.

These comparative analyses utilize both quantitative and qualitative criteria for the purpose of ranking the relative performance of options against one another (in an MDA) and under alternative future scenarios. The combination of the MDA and scenario assessments is intended to assist in the decision-making process and illustrate trade-offs that should be considered when setting priorities. The scenario evaluation was also helpful in identifying future conditions that might justify reprioritizing options or signal a change in the energy market's direction.

Planning tools were developed and applied during a series of four interactive workshops that included participation of senior management and staff from different groups at Metropolitan, including engineering, operations, environmental planning, and water resources management. The workshop process, including the topics covered and outcomes, is presented in Figure 2-3.

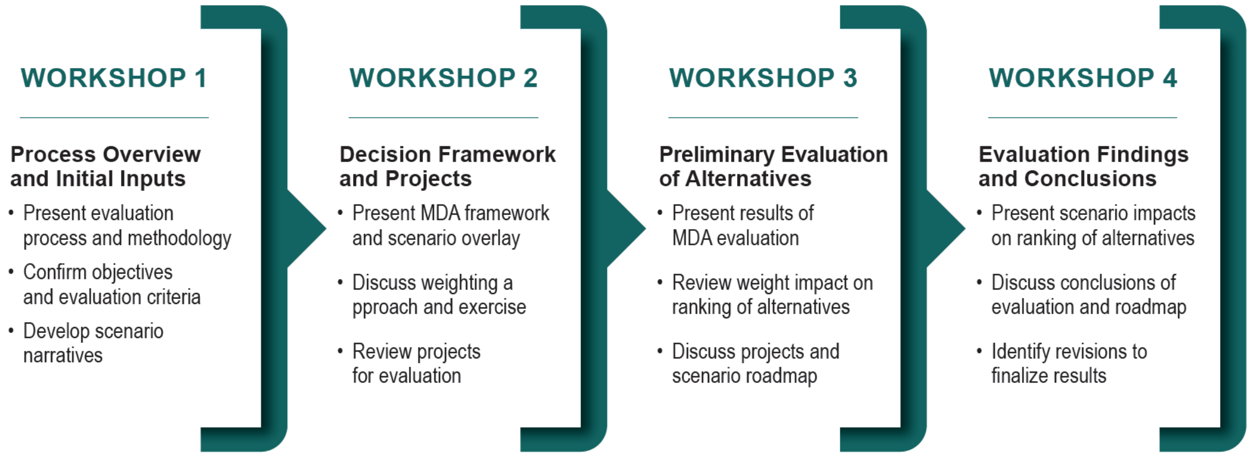


Figure 2-3 Overview of workshop process, topics, and outcomes

Together, the two approaches highlighted the trade-offs among options, while indicating the robustness of options under plausible future conditions. The approach and process undertaken during the workshops, and the details of the MDA and scenario frameworks, are presented in Section 5.0 and Appendix E.

2.5 DEVELOPMENT OF ENERGY SUSTAINABILITY PLAN AND ROADMAP

The information collected through the steps identified in the previous sections was used to develop the ESP and a related roadmap to direct the short-term (less than three years) to long-term (up to 10 years) future projects and activities Metropolitan should consider to meet the policies and goals described in Section 1.0. The roadmap and related description are presented in Section 6.0.

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3.0 METROPOLITAN BASELINE FACILITIES AND OPERATIONS

Metropolitan's net energy use and costs are dominated by the pumping (transport) of water over the CRA and SWP systems. For the period of 2013-2018, approximately 93 percent of Metropolitan's annual electricity costs were for the SWP and CRA systems, and the remaining 7 percent of energy costs were associated with retail electricity purchases for water treatment plants and other Metropolitan facilities (Figure 3-1).

During this period, 75 percent of Metropolitan's total annual energy expenditures were associated with the SWP, which accounted for approximately 55 percent of total annual energy consumption to pump water into Southern California. This disproportionate energy cost is attributed to a higher unit price for electricity to pump water along the SWP, as compared to the unit price of electricity for the CRA (which includes low cost federal hydropower from Hoover and Parker Dams). Additionally, the large energy cost is also due to the higher energy intensity of SWP supplies (approximately 3,300 kWh/AF) compared to CRA supplies (approximately 2,000 kWh/AF).

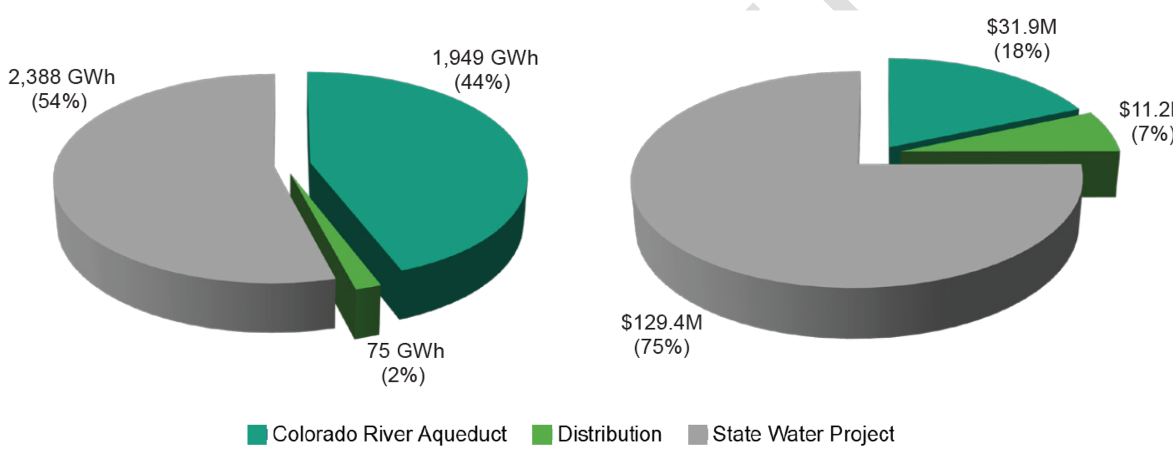


Figure 3-1 Metropolitan's overall electricity requirements and cost (average 2013-2018)

Given that Metropolitan does not have direct control over operations of the SWP, the remainder of this section will focus exclusively on the energy use and cost for CRA operations (wholesale power) and for Metropolitan's treatment, distribution and office facilities (retail power).

For wholesale power, Metropolitan has proactively maintained several power contracts with various suppliers that have contract prices and terms set to help Metropolitan and its member agencies maintain a favorable overall low cost for wholesale electricity related to transporting water via the CRA. Today, Metropolitan has existing advantageous contracts with the U.S. Department of Interior, Bureau of Reclamation (USBR), Western Area Power Administration (WAPA) and others. Details on these contracts are discussed in the following sections. Annual costs for wholesale electricity have varied widely due to a variety of factors, including pumping volume, the utilization of energy banking provisions, and the volatility in the energy markets. Additionally, California's cap-and-trade program established in 2013 resulted in an added cost to market prices for energy with GHG emissions, including imported electricity, and affects Metropolitan's wholesale energy cost. Due to this embedded cost of carbon, Metropolitan's carbon footprint is evaluated as a continuing future factor in higher wholesale energy costs and is an essential aspect of energy cost mitigation recommendations. Additional information on this is provided in Appendix D.

Metropolitan relies on retail power from several local retail energy providers for its water treatment facilities and conveyance and distribution system. Retail energy providers utilize tariff structures and TOU rates to establish more stable energy rates for their retail customers. For this reason, retail energy costs are more predictable, although historically greater, than wholesale energy costs. Additional information on this is provided in Section 3.1.5.

In addition to low cost hydropower from Hoover and Parker Dams, Metropolitan employs a diversified portfolio of energy sources, including renewable energy, that helps offset a small share of its energy demand and/or incurred cost. Metropolitan's energy portfolio includes 15 small hydropower generating facilities at various locations within the conveyance and distribution system (total nameplate capacity of approximately 130 MW) and four solar power installations (total capacity of 5.5 MW). In addition, at all critical facilities, Metropolitan maintains diesel emergency generators that support operations in case of grid power outages at all critical facilities (e.g., treatment plants, pumping plants).

3.1 ENERGY SUPPLIERS AND POWER CONTRACTS

Metropolitan's energy needs are supplied by generators within CAISO as well as energy imports into CAISO. The following sections provide information on Metropolitan's federal hydropower contracts and wholesale energy arrangements to serve CRA loads, and electric utility service for Metropolitan's retail loads.

3.1.1 CRA power management

Metropolitan is entitled to the largest single share of energy from Hoover Dam at 27 percent, 12 percent of Hoover Dam's generation capacity, and the largest single share of power generated at Parker Dam at 50 percent. Depending on the CRA pumping level and generation from these large federal hydropower projects, Metropolitan may purchase supplemental energy from the CAISO or bilateral spot markets in the Southwest. When Metropolitan imports power from Hoover Dam, Parker Dam, or Southwest purchases using its transmission system, it avoids transmission costs associated with receiving power from the CAISO. However, the build out of renewable wind and solar generation in recent years to meet the California renewable portfolio standards (RPS) has depressed power prices in the CAISO during mid-day hours (the duck curve). During some periods, power prices from the CAISO are sufficiently lower than those available from the Southwest, that it is more economic to purchase power from the CAISO and pay the CAISO transmission charges rather than import power. This trend is expected to continue as additional solar and wind capacity is built in eastern California to meet the SB100 renewable goals. Purchasing power from the CAISO when economic also allows Metropolitan to better optimize the value of its federal hydropower energy during higher priced periods in early morning and late in the day.

Metropolitan is also optimizing its' CRA power operations by disaggregating its pumping loads. The Metropolitan pumping locations have been historically aggregated into a single load aggregation point for the purposes of scheduling and settlement with the CAISO. In March of 2020, Metropolitan disaggregated its pumping loads in order to optimize the use of CAISO purchases or imports to each individual pumping location for each hour. This strategy along with further optimization of Hoover and Parker Dams energy scheduling noted previously, is expected to generate substantial savings in CRA power costs moving forward.

3.1.2 CRA capacity obligations

Metropolitan and other load-serving entities in California are required to have and make available sufficient Resource Adequacy capacity to meet peak loads in the CAISO balancing area. Metropolitan's federal hydropower entitlements and the ability to interrupt loads at Gene and Intake Pumping Plants have generally been used to meet Metropolitan's capacity obligations. However, the CAISO capacity obligations have evolved to require flexible capacity attributes that are not met by static schedules from the federal hydropower projects. In order to meet these requirements, Metropolitan implemented dynamic scheduling of its Hoover Dam capacity entitlement in April 2020. Other California contractors of Hoover Dam capacity have also implemented dynamic scheduling of Hoover capacity to gain flexibility. Absent this development, Metropolitan would be required to purchase flexible capacity from third party generators to meet its flexible capacity obligation, at substantial additional cost.

3.1.3 Federal hydropower supply for CRA

Hoover Contract (WAPA)

Metropolitan has a 50-year Energy Service Contract through September 30, 2067, with WAPA for a portion of hydropower generated at the Hoover Dam. Hydropower is generated by the release of Colorado River water stored in Lake Mead. The cost of Hoover Dam power is typically between $0.018 and $0.020 per kilowatt-hour (kWh) ($18 to $20 per MWh), but varies year-to-year based on rates set by WAPA. The cost is based on funding operating and maintenance costs, extraordinary maintenance items, capital additions, and paying back capital costs invested by the U.S. government associated with Hoover Dam hydropower.

The Energy Service Contract contains a new provision for Hoover contractors to voluntarily request that WAPA reallocate its portion of capacity and energy. Other contractors that accept a reallocation from WAPA are responsible for paying for the established rates associated with the reallocation. Until a reallocation is complete, a contractor is obligated to continue paying for such capacity and energy. In the event of a contractor default, such contractor remains responsible for paying for the established rates until a reallocation is complete. In addition, there are also ongoing concerns over future changes in hydrology which may result in a reduction in energy generation and thus increase the energy rates paid by the contractors. As such, this creates a short- to medium-term uncertainty for energy costs to serve CRA operations.

Parker Contract (USBR)

The Parker Dam is owned and operated by the USBR and hydropower is generated by the release of Colorado River water stored in Lake Havasu. The contract with the USBR entitles Metropolitan to 50 percent of the Parker Power Plant capacity and the associated energy in perpetuity. Energy availability is contingent on the availability of Colorado River water. Costs for Parker Dam hydropower are based on dam operating and maintenance costs, extraordinary maintenance items, and capital additions.

The long-term reliability of Parker Dam hydropower output is also dependent on Colorado River hydrologic conditions. As discussed in Section 1.2.4, it is possible that climate change could significantly alter future hydrologic conditions along the Colorado River. Therefore, Metropolitan is working closely with federal agencies and other entities with interests in maintaining fundamental operations along the Colorado River.

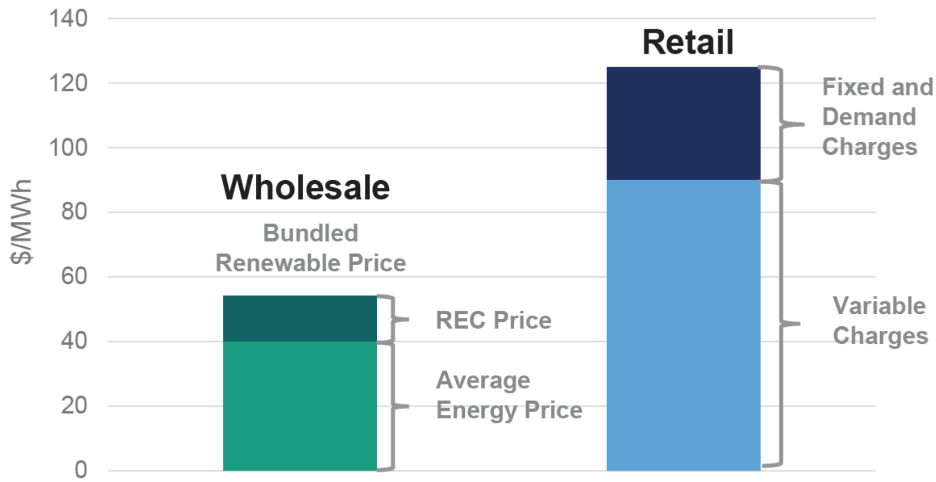
3.1.4 Supplemental energy services at CRA

Metropolitan has two long-term agreements with AEPCO to support CRA operations. The scheduling and trading agreement with AEPCO provides for energy scheduling from Hoover and Parker Dams, procurement of supplemental energy for CRA operations, trading services, and power system operations services. The operations services agreement establishes AEPCO as the operator of the CRA transmission system and identifies tasks to be delegated to Metropolitan to comply with the North American Electric Reliability Corporation electric reliability standards.

Metropolitan also has a new long-term agreement with CAISO to provide balancing area services to support CRA operations. CAISO is a not-for-profit, public-benefit corporation charged with operating the majority of California's high-voltage wholesale power grid as of March 31, 1998. Although Metropolitan's transmission lines are within CAISO's control area, Metropolitan maintains ownership and control of its transmission lines.

3.1.5 Retail energy providers

While the majority of Metropolitan's energy usage is derived from CRA pumping operations, the remainder of operations within the conveyance and distribution system, including water treatment plants, pump stations, reservoirs, office buildings and other ancillary facilities, relies on retail grid-power. Energy for these facilities is dependent on the retail power provider where each Metropolitan facility is located. The primary retail energy providers for Metropolitan are SCE, LADWP, and RPU. Retail energy prices have historically always been greater than wholesale energy prices due to added transmission, distribution, and other charges included in retail energy rates. Retail rates include both variable and fixed charges, which contribute to an overall higher average price than wholesale energy rates. Retail variable charges are dependent on energy usage and demand and can therefore be reduced by decreasing overall energy usage. Fixed charges are independent of energy usage and do not change on a customer's monthly bill. On the other hand, wholesale rates are dependent on the energy price determined on the spot market. Figure 3-2 illustrates that on average, retail rates can be twice as high as average wholesale rates for the CRA.



REC: Renewable Energy Credit

Figure 3-2 Typical wholesale and retail energy costs

In general, per-MWh costs of retail power rise from year to year due to factors related to cap-and-trade program compliance, RPS goal compliance, electricity grid expansion/upgrades, and the decommissioning of local generating stations. The costs of these efforts are borne by the electric entities but are passed along over time to their customers. With the emergence of the "duck curve" effect in the wholesale energy market (Section 1.2.2), retail energy providers are beginning to revise their tariff structures accordingly and shift their TOU periods to be more in-line with the new patterns seen in the wholesale market (Figure 3-3).

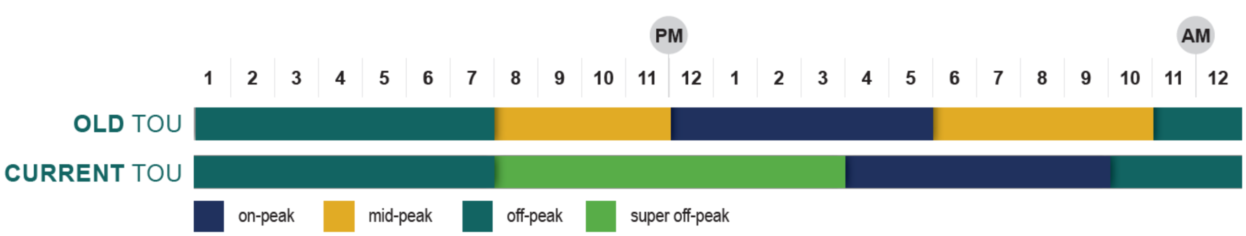


Figure 3-3 Summer weekday retail energy rate time-of-use (TOU) shift

In general, the only practical strategies available to consumers to mitigate such retail energy costs are to shift the timing of demand through operational changes or energy storage; by implementing energy efficiency measures by reducing use, generally; or self-generating their own (non-grid) power. Metropolitan has adopted similar strategies in the past to hedge against rising retail costs.

3.2 ENERGY DEMAND AND COST

Metropolitan's energy demand profile consists of energy use for CRA pumping operation, and for retail distribution and treatment facilities. Wholesale electricity is used to meet the CRA load while retail electricity is used to meet all other conveyance and distribution system needs, including five water treatment plants, the Union Station Headquarters, OC-88 pumping station, Diamond Valley Lake pumping facilities, reservoirs, and other Metropolitan ancillary facilities (Figure 3-4). Of the electricity that Metropolitan purchases directly, 96 percent is wholesale electricity used to meet the CRA load, 2 percent is retail energy utilized at the treatment plants, and the remaining 2 percent is energy used at other facilities supplied by retail providers. Although the CRA accounts for 96 percent of Metropolitan's energy usage, the CRA only accounts for 74 percent of Metropolitan's direct energy costs, which is primarily due to the low-cost federal hydropower energy from Hoover and Parker Dams.

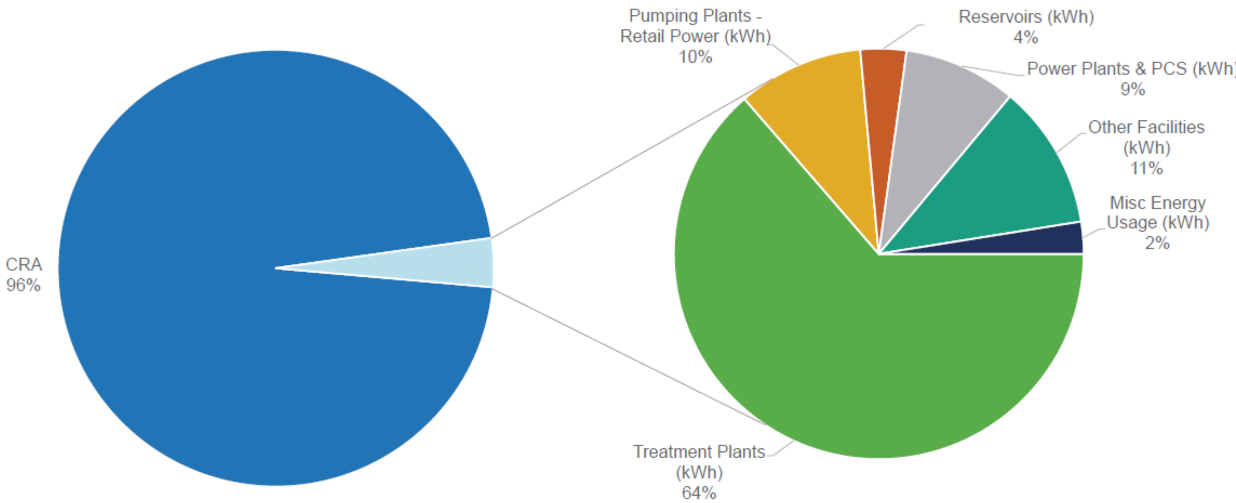


Figure 3-4 Average direct energy usage distribution at Metropolitan facilities

3.2.1 CRA energy demand

As shown in Figure 3-5, CRA water deliveries and electricity loads historically have been highly correlated and vary annually. Recent planning efforts anticipate CRA water deliveries at an average of 900 thousand acre-feet per year in the future (Metropolitan, 2015) and electricity needs along the CRA can be expected to be similar to periods with deliveries of that magnitude. Generally, it takes 2 MWh to pump an acre-foot of water on the CRA. Of this electricity, approximately 50 to 85 percent is supplied by low-cost and no-GHG electricity from the Hoover and Parker Dams, while the remaining demand has been met with wholesale electricity purchases. All wholesale power purchases derived from carbon-fueled sources will carry an additional cost in the form of purchased carbon allowance credits, which is reflected in the wholesale energy price Metropolitan pays for purchases from the CAISO, and the incremental cost of allowances Metropolitan must purchase for imports to support CRA operations.

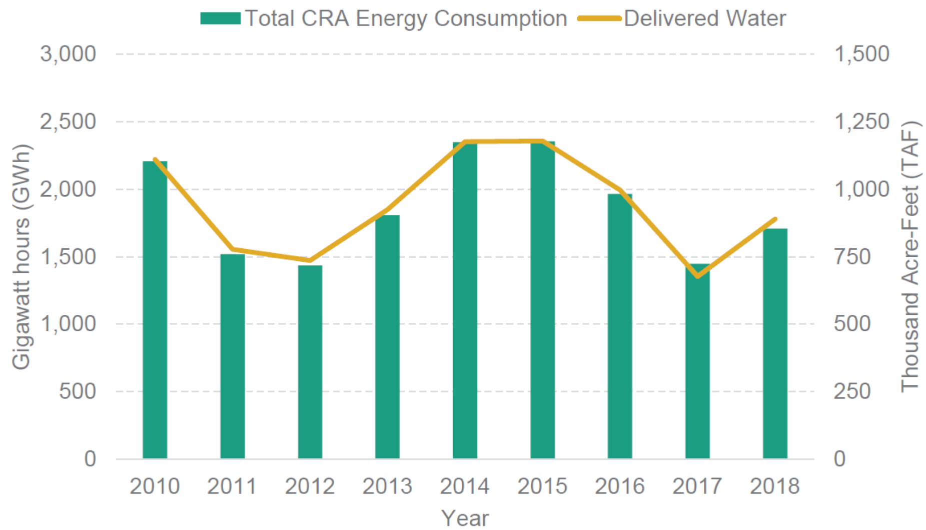


Figure 3-5 Historical CRA energy consumption and volumes of water delivered

Figure 3-6 illustrates that the annual energy use for the CRA is not directly proportional to cost. While historical electricity consumption has varied between 1,300 to 2,400 GWh, costs have fluctuated between $0.17 million to greater than $47.5 million. The price of Hoover Dam and Parker Dam power is extremely low relative to retail market rates and average on-peak (and sometimes off-peak) wholesale market rates, and fairly constant (e.g., $18-$20 per MWh for Hoover Dam power).

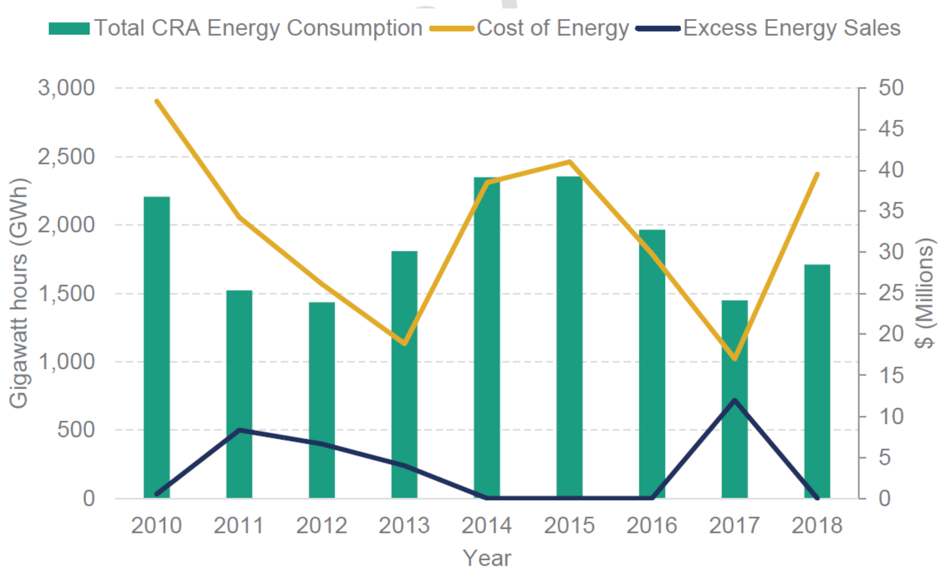


Figure 3-6 Historical CRA energy consumption and cost

3.2.2 Retail energy demand

Excluding the SWP, retail energy accounts for 4 percent of Metropolitan's total energy consumption and 26 percent of total energy costs (see Figure 3-1). This disproportionate cost for retail energy as compared to wholesale energy is due to higher retail energy rates (Figure 3-2) and the availability of low cost federal hydropower for the CRA, as noted in Section 3.1.5. Metropolitan's demands for retail energy are directly impacted by population growth and conservation efforts; and unlike the CRA, retail energy usage and costs are directly correlated (Figure 3-7). Moving forward, shifts in retail TOU rates or increases in the rates themselves can have significant impacts to Metropolitan's total energy costs.

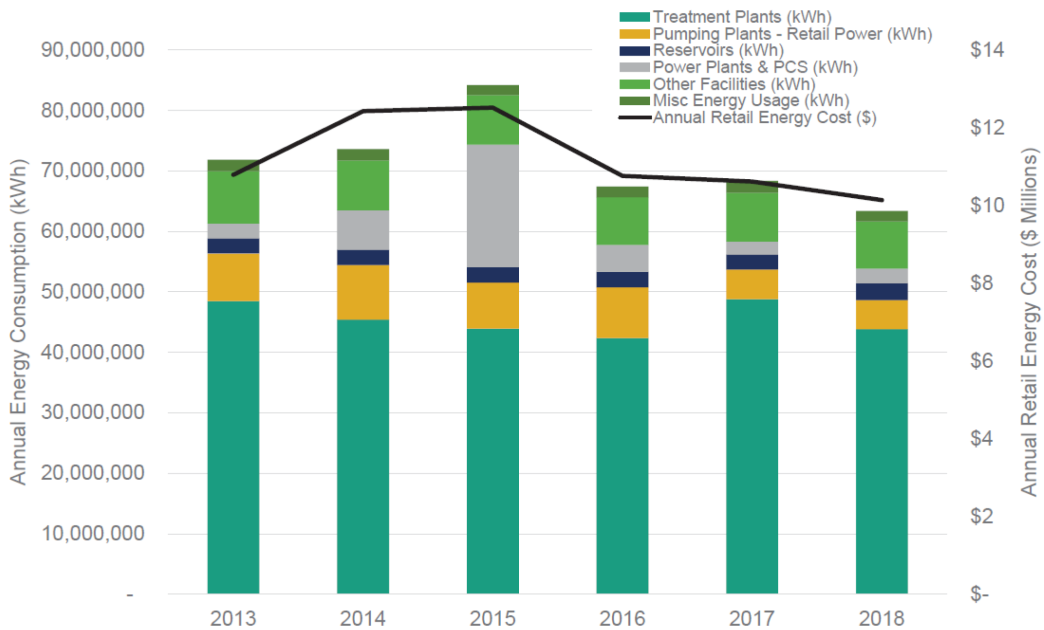


Figure 3-7 Historical annual retail energy consumption and cost (2013-2018)

3.3 ENERGY GENERATION

Metropolitan's energy portfolio includes renewable and non-renewable sources that help offset a small share of its energy demand and/or incurred cost. The following sections provide details on the small hydropower and solar generating facilities that are currently in operation at various locations within Metropolitan's service area.

3.3.1 Small hydropower

Metropolitan owns and operates 15 small hydropower facilities at various locations within its conveyance and distribution system. These facilities each have a design capacity under 30 MW, which qualifies them as renewable resources under current California law. As renewable resources, these facilities generate renewable energy credits (RECs), in addition to electricity, which can be sold to third parties (e.g., electric utilities) at wholesale rates to meet those parties' (or the end-purchaser/users) RPS goals. Currently, the generated hydropower (with associated RECs) is sold at a contracted, fixed rate, and it is not used to offset the energy demand of Metropolitan's facilities.

Since 2005, cumulative annual energy production at all of Metropolitan's small hydropower generating facilities has ranged from 138 to 525 gigawatt hours per year (Figure 3-8). Hydropower production has seen a downward trend in the last decade, which can be attributed to drought conditions throughout

California reducing SWP deliveries and local conservation efforts that have altered flows in the conveyance and distribution system.

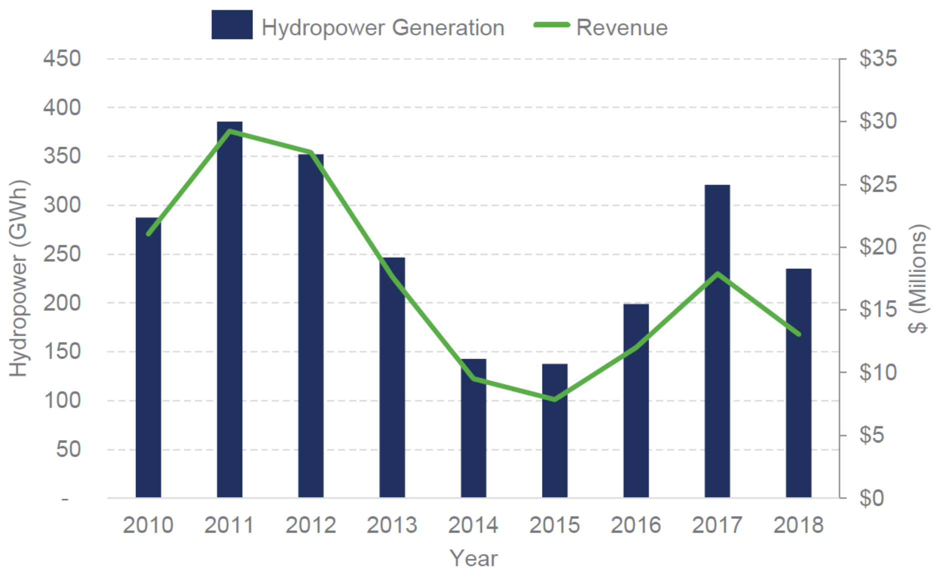


Figure 3-8 Historical annual generation and revenue from small hydropower facilities

3.3.2 Solar generation

Since 2006, Metropolitan has operated four solar power generating facilities for a total of 5.5 MW of solar generating capacity. The first solar installation was installed at the Diamond Valley Lake Visitor Center, with 0.5 MW of roof-mounted photo-voltaic panels. Subsequent solar facilities of 1 MW, 3 MW, and 1 MW were installed over the following decade at Skinner WTP, Weymouth WTP, and Jensen WTP, respectively (Figure 3-9). The solar generation is used directly at the above facilities to not only decrease retail energy costs at these sites, but also contribute to reducing Metropolitan's carbon footprint. The implementation of these solar facilities has subsequently reduced Metropolitan's carbon emissions by approximately 2,000 metric tons of carbon dioxide per year.

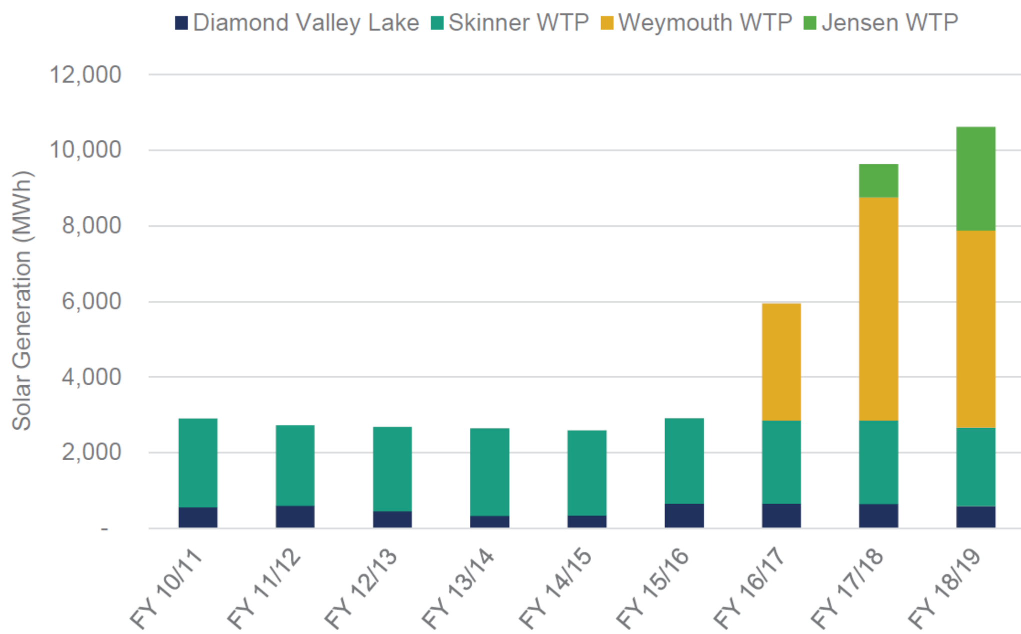


Figure 3-9 Historical annual solar generation at Metropolitan facilities

On any given day, solar generation may exceed the energy demand at the site and the excess renewable generation is utilized by Metropolitan through participation in the following two programs:

- **Net-metering** allows self-generation customers to receive bill credit for excess power fed back to the local power utility provider. Net-metering applies only to grandfathered, on-site self-generation.
- **Renewable Energy Self-Generation – Bill Credit Transfer** allows self-generation customers to receive a credit for any excess power at a facility, and that credit can then be applied to the energy portion of the bill for multiple other accounts within the same utility territory.

3.3.3 Wholesale generation

Under current conditions, federal hydropower from Hoover and Parker Dams is on average the least expensive source of power for the CRA operations. Development of new wholesale generation by Metropolitan may only be financially beneficial if generating energy is less expensive than purchasing energy in the spot market. However, as seen in Figure 3-10, Metropolitan's demand for energy on the spot market varies widely by year. In some years, hundreds of thousands of MWh are purchased, some of which are imported from carbon-derived fuel sources, which requires Metropolitan to purchase and surrender carbon allowances under the CARB cap-and-trade regulation. Given the range of wholesale energy needs, Metropolitan-sponsored generation along the CRA has the potential to produce excess electricity. In such a case, Metropolitan would sell excess power at wholesale rates back to the market (e.g., CAISO or exported to the southwest), thereby offsetting a portion of its wholesale energy costs.

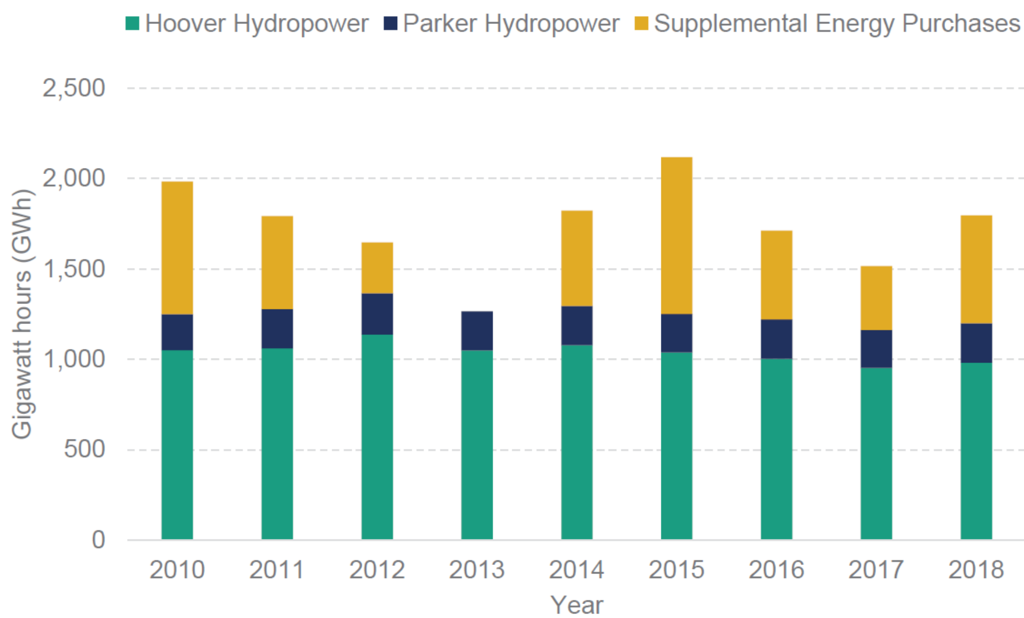


Figure 3-10 CRA pumping energy sources

3.4 GHG EMISSIONS

Since 2005, Metropolitan has been tracking its GHG emission inventory and reporting to CARB and to the Climate Registry beginning in 2007. Under CARB Mandatory Reporting Regulations, Metropolitan is required to report electric power transactions and the GHG emissions associated with power imported to, exported from, or wheeled through California. Metropolitan is also required to report fugitive sulfur hexafluoride (aka SF_6, an insulating gas used in electrical equipment) from its distribution systems, substations, and circuit breakers. Under the Climate Registry General Reporting Protocol (GRP) and Electric Power Sector Protocol, Metropolitan reports its Scope 1 and Scope 2 GHG emissions from district-wide operations, which include the CRA pumping plants, water treatment plants, pressure control structures, and various other administration and operations buildings.

GHG emissions from energy consumption is reported under Scope 2 of the GRP protocol. Just as the majority of Metropolitan's direct-pay energy demand is used to meet the CRA load, approximately 80 to 90 percent of Metropolitan's annual GHG emissions are from wholesale electricity purchased for CRA pumping operations, as shown in Figure 3-11 below. GHG emissions for 1990 were estimated based on available data and calculations using CARB guidelines and are currently used as a baseline to calculate GHG emissions reduction.

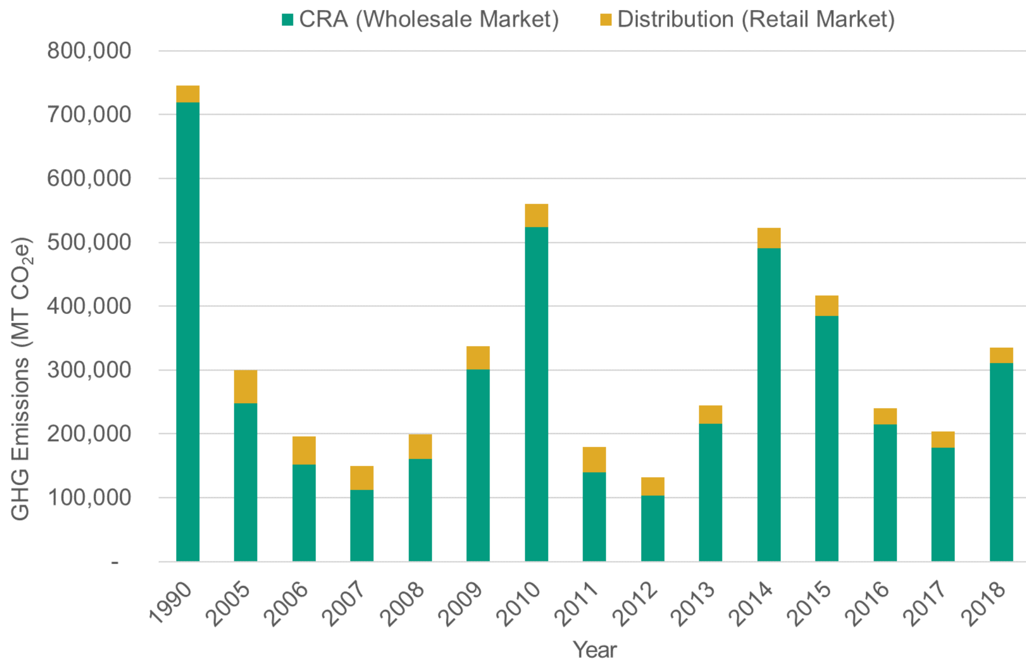


Figure 3-11 Metropolitan's annual GHG emissions by energy market

Historically, GHG emissions from the CRA system varied widely, as shown in Figure 3-12. The calculated CRA system emission factor (EF) ranged from 0.072 kilograms (kg) CO_2e/kWh for a low flow year (2012) to 0.239 kg CO_2e/kWh for a high flow year (2010). A higher EF is the direct result of a higher percentage of supplemental non-hydro energy purchases for CRA pumping energy demands and, as such, should be one of the main focuses when developing strategies to reduce Metropolitan's GHG emissions.

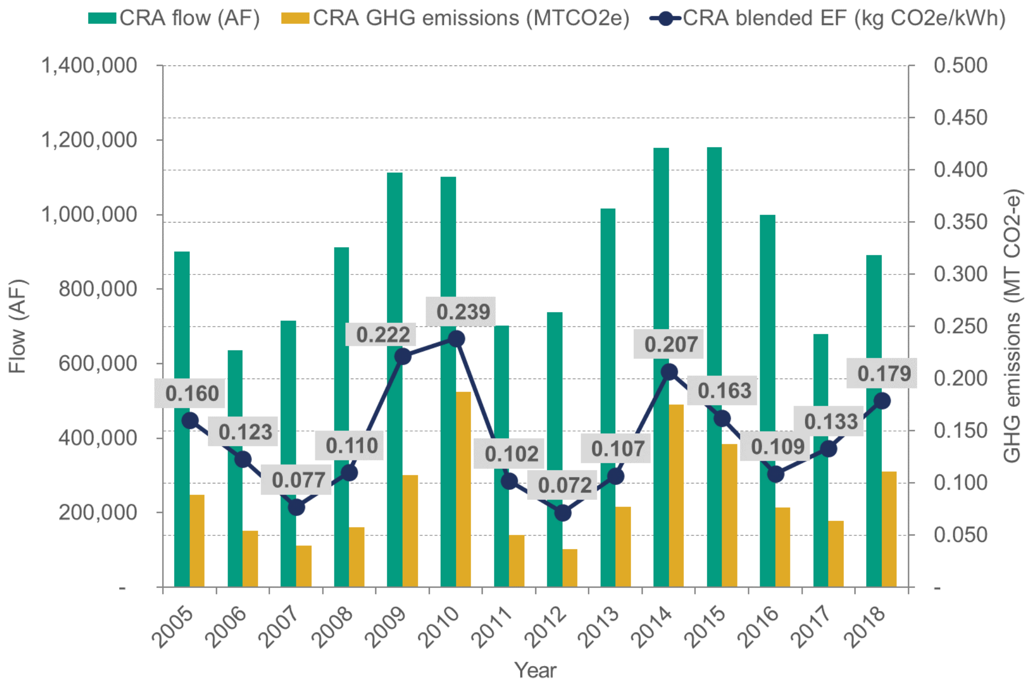
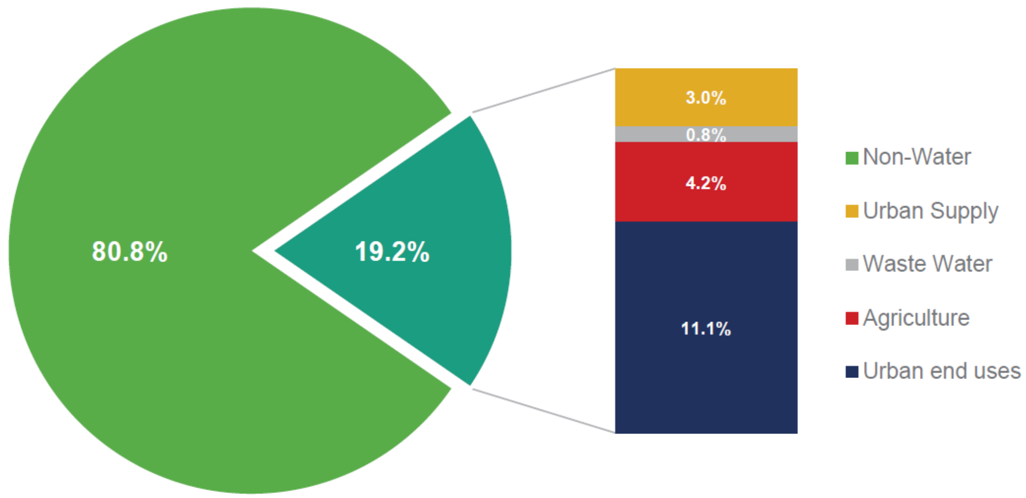


Figure 3-12 Historical GHG emissions from CRA operations energy demand

3.4.1 Water energy nexus

Water and energy are often managed separately, despite the important links between the two resources. Water is used in the production of nearly every major energy source. Likewise, energy is used in multiple ways and at multiple steps in water delivery and treatment systems. Therefore, a sustainable management of either resource requires consideration of the other.

In California, this water-energy relationship is significant, since water-related energy use consumes 19 percent of the state's electricity (Figure 3-13) (Schwarzenegger, 2005). Of the 19 percent of water sector electrical use, approximately 3 percent is associated with urban water agency conveyance, treatment and distribution. Over half of the water-related electricity use is attributed to consumer end uses such as heating and cooling. The 3 percent of electricity associated with urban water supply represents the "embedded energy" in water, whereas the 11 percent of electricity attributed to end uses represent a direct use of energy by consumers. The sources of energy used to power these water activities is directly tied to the volume of GHG emissions emitted into the atmosphere.



Source: CEC, 2005

Figure 3-13 California's water sector electricity usage breakdown

To address this, the California Environmental Protection Agency and the Climate Registry launched a Water-Energy Nexus Registry in May 2019 for organizations operating in California. The new registry will help water agencies and utilities better understand the energy and GHG emissions associated with each process in water management and use; provide standardized methodologies to quantify the GHG emissions embedded in the complete water use cycle; and develop reporting registries based on these methodologies. In turn, this will help these agencies become more energy efficient and reduce their carbon footprints.

Metropolitan is one of the founding members of the Climate Registry, participated in its development and will begin to report its GHG intensity metrics in 2020. Metropolitan maintains an internal team to coordinate Metropolitan Water-Energy Nexus activities.

4.0 ENERGY MANAGEMENT PROJECT EVALUATION

As stated in Section 1.3, the main objective of this plan is to develop an adaptive energy management strategy resulting in projects and initiatives that provide multiple benefits to Metropolitan. Identified prospective projects and initiatives for this strategy fall under one of the following categories:

- **Retail energy market projects** - Renewable energy and energy storage projects within Metropolitan's WTPs, and conveyance and distribution systems
- **Wholesale energy market projects** - Renewable energy and energy storage projects along the CRA
- **Energy management best practices** - Other utility-wide energy management initiatives, including resource development, energy efficiency, and best energy management practices

The main focus of this planning effort was on renewable energy and energy storage projects due to the potential benefits they provide and declining costs. For these projects to be considered part of Metropolitan's adaptive energy management strategy, they must first be considered financially feasible. Economically feasible projects are those that have a payback period less than the asset life and a positive net present value (NPV). In addition to financial feasibility, identified projects were also assessed for carbon emission reductions, as applicable, to determine additional environmental benefits. A summary of this evaluation is discussed in the sections below with final results presented in Section 5.3. The full report detailing the specifics of each project evaluation, including capital costs, payback, and NPV, is found in Appendix D.

4.1 RETAIL ENERGY MARKET PROJECTS

Potential renewable energy and energy storage project opportunities within Metropolitan's WTPs and conveyance and distribution system are presented in Table 4-1.

Projects evaluated on Metropolitan's treatment and distribution system involved expanding Metropolitan's solar generation capabilities and implementing battery energy storage to complement self-generation and enable low-cost energy to be used during periods of high energy prices. Another project evaluated was connecting Yorba Linda Power Plant behind the SCE meter at Diemer WTP to fully meet the plant's energy demand with carbon-free hydropower when the hydroelectric plant is running. All evaluated projects were considered financially feasible and provided additional GHG emission reduction benefits. However, it should be noted that financial feasibility of BESS projects would rely heavily on available incentives through the SGIP.

Table 4-1 Renewable and energy storage projects evaluated in the retail energy market

Energy Provider	Project Location	Technology/Project
Southern California Edison	Weymouth WTP	BESS with existing solar or grid
	Skinner WTP	Solar expansion (Metropolitan-owned vs PPA)
		BESS with solar expansion
		BESS with existing solar or grid
	Diemer WTP	Yorba Linda connected behind retail energy meter
	OC-88 Pumping Plant	BESS (stand-alone)
Riverside Public Utilities	Mills WTP	New solar (Metropolitan-owned vs PPA)
		BESS with new solar
		BESS (stand-alone)
Los Angeles Department of Water and Power	Jensen WTP	BESS with existing solar or grid

BESS = Battery energy storage system

PPA = Power purchase agreement

WTP = Water treatment plant

The energy storage industry is relatively new and expected to grow as BESS technology is placed in wider ranging and challenging environments. Thus, there are recognized risks and concerns pertaining to the product warranties and financial health and flexibility of the companies involved on provisioning the systems. End-of-life and disposal is also a concern for BESS, but would be further evaluated during project implementation with consideration for future innovations in energy storage technologies.

4.2 WHOLESALE ENERGY MARKET PROJECTS

Renewable energy and energy storage project opportunities identified on the wholesale energy market are presented in Table 4-2. These include hydropower within the conveyance and distribution system, and projects along the CRA.

Table 4-2 Renewable and energy storage projects evaluated in the wholesale energy market

Energy Provider	Project Location	Technology/Project
California Independent System Operator (CAISO)*	Conveyance and Distribution System	Small-scale hydroelectric facilities
		In-line hydroelectric facilities
		Pumped storage
	Colorado River Aqueduct (CRA)	Pumped storage (Metropolitan-owned vs. third-party developer)
		Large-scale solar
		Large-scale wind
		BESS (stand-alone)
		Operational flexibility

BESS = Battery energy storage system

*CAISO is a public-benefit corporation in charge of operating the wholesale power grid and provides balancing area services to support CRA operations

Considering that energy for CRA pumping operations constitutes the majority of Metropolitan's electricity purchases, large-scale renewable energy and energy storage projects along the CRA are potential options to manage energy costs. With respect to large-scale wind and solar projects along the CRA, SB 100 imposed an RPS of 60 percent by 2030 on utilities and other energy service providers (Metropolitan is not subject to the standard). RPSs are already resulting in deep penetration of solar generation as the preferred choice in California and throughout the southwest based on declining capital cost, tax credits, and efficiency gains. Although the 60 percent goal is 10 years away, the solar buildout has already resulted in depressed mid-day energy prices during much of the year. In evaluating the economics of building additional solar to directly serve the CRA pump load, the results indicate that continued build out of solar to meet the utility RPS and further declining wholesale energy prices affecting Metropolitan's pump locations make this option uneconomic at this time.

This same dynamic enhances the value of energy storage and load shifting, taking advantage of the duck curve effect. Energy stored during the mid-day hours can be used during peak price periods in the evening and early morning hours, when solar generation is not available and higher cost gas-fired peaking capacity must be used to meet load. Energy storage projects evaluated included both pumped and battery energy storage but due to the high capital costs and possible operational effects of pumped storage, battery energy storage is considered more viable at this time.

Similarly, to the degree that pumping operations can be modulated to respond to this price dynamic, energy costs can be reduced. The implementation of variable frequency drives (VFD) on the CRA pumps at Intake and Gene Pumping Plants in conjunction with the use of the reservoir storage available at Gene Wash and Copper Basin can facilitate this load shifting and reduce CRA energy costs. The implementation of VFDs should be studied in conjunction with the reliability upgrades already planned for the CRA pumping operation.

4.3 ENERGY MANAGEMENT BEST PRACTICES

As noted in Section 1.1.2, Metropolitan already participates in several best practices associated with energy management that have helped reduce Metropolitan's overall energy consumption. However, there are several additional practices and initiatives that Metropolitan could begin implementing to further reduce Metropolitan's energy usage and exposure to changes in energy prices. Increasing Metropolitan's energy management best practices includes the following:

- Establish a dedicated Energy Sustainability team to further expand Metropolitan's current energy best practices and implement the recommendations of this ESP
- Expand staff and resources for energy management by organizing regular staff trainings on operational and maintenance strategies to reduce energy and related costs
- Facilitate knowledge transfer within and outside Metropolitan on various aspects related to energy management to keep continued conversations with electric utility providers and other water utilities

Best practices to be maintained, enhanced or added to Metropolitan's energy management strategy include:

- Conduct regular facility energy auditing, monitoring through a submetering program and benchmarking with key performance indicators
- Evaluate energy and cost optimization of processes and pumping operations
- Promote energy efficient design and rehabilitation measures such as adding VFDs to pumps and motors, evaluating energy efficiency at administrative and support facilities, and including energy efficiency practices in project solicitations

While the detailed evaluation of these practices is outside the scope of this plan, these types of energy management best practices are known to reduce energy costs if implemented on a continual basis.

5.0 PROJECT PRIORITIZATION

California's electric system transition from fossil fuels to renewables is a massive undertaking. To accomplish the transition during a period of deep climate uncertainty—with impacts that could severely disrupt both water supply and energy supply reliability—requires a new approach to energy management. In this context, decision-making and strategy development must go beyond the evaluation of the least-cost solutions. Forecasts of cost-effectiveness rely on assumptions based on historical data and predictable future conditions. While historical data is plentiful, predicting future conditions is highly uncertain.

For these reasons, the evaluation of energy management options in both the retail and wholesale markets was undertaken using two alternative decision-making tools:

- A detailed scenario analysis that effectively "stress tests" each project option under a range of plausible future conditions, and
- A multi-criteria decision analysis that compares the relative performance of options based on considerations that go beyond costs alone.

The combination of these tools affords decision makers the ability to: (1) identify preferred options that achieve sustainability criteria under current assumptions, and (2) assess the resilience of those options under potential future scenarios that radically differ from the base assumptions. Options that perform well in both evaluations demonstrate relative strength now as well as robustness in an uncertain future.

Further, the scenario exercise allows planners to identify early indicators ("signals") of how the future may be unfolding. Remaining alert to these signals enables decision makers to adapt strategy, correct course, and implement new options that have been prepared in advance for emerging conditions. It is a process of dynamic, adaptive planning that can be coordinated with and complement Metropolitan's other integrated planning efforts.

The following sections present the approach and process that was undertaken for project prioritization. The MDA evaluation provided a comparative analytical tool based on available planning data, qualitative assessments, and assumptions regarding expected future conditions. The scenario framework provided an additional overlay, allowing for the introduction of significant uncertainties and possible impacts on the preferences identified in the MDA process. Together, the two approaches highlighted the trade-offs among options under current assumptions, while indicating the robustness of options under plausible future conditions.

5.1 SCENARIO DEVELOPMENT AND APPLICATION

Scenario-based planning was used to assess the performance of investment options under four future conditions. Scenarios were then developed using a two-by-two matrix constructed based on an assessment of the deepest uncertainties, threatening the greatest impact, on the future context within which options were expected to perform. As shown in Figure 5-1, these two axes of impact and uncertainty were identified within Metropolitan's water-energy context as:

- The water supply and demand conditions that Metropolitan will be faced with over the next several decades (vertical-axis), from a condition of a stable and reliable water supply to a condition of extreme hydrology that reduces the availability of hydropower from Hoover and Parker Dams; and
- The unknown market consequences of implementing the state-mandated transition to renewables (horizontal-axis), that can swing from a smooth transition to renewables to a volatile energy market with major disruptions.

> ***"Electric systems with large shares of variable renewable energy penetration will see profound changes in average electricity prices, diurnal price patterns, and price volatility"***
> ***- Lawrence Berkeley National Laboratory (2018)***

Scenario narratives for each quadrant are attached in Appendix E. From an analysis of historical water supply stability and reliability at Metropolitan, as well as energy market volatility observations over the last several years, Metropolitan is believ7ed to be facing the challenges near the top of quadrant D, as graphically pointed out in Figure 5-1. Due to yearly variations in water supply and availability, Metropolitan fluctuates between quadrants B and D.

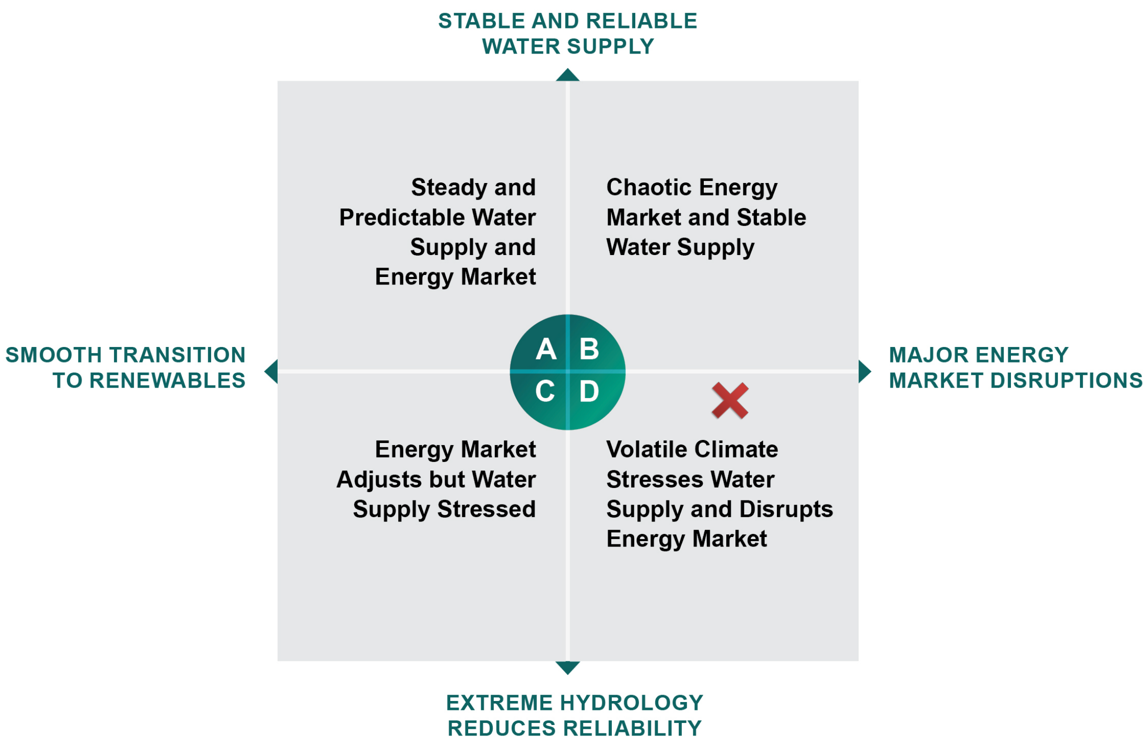


Figure 5-1 Scenario matrix and quadrant descriptions

While this scenario planning approach is not designed to predict the future, it can provide insights into the resilience of various options under plausible future conditions. All else being equal, options that can continue to deliver expected performance under all scenarios are preferable to those that only perform under a narrow range of assumptions. Both the retail and wholesale options were evaluated for vulnerabilities and weaknesses under the four scenario narratives. For example, stand-alone solar projects provide more benefit in a market with high mid-day prices than a market saturated with solar energy where (as currently seen with the "duck curve") solar facilities are producing when energy prices are already low. A high-level summary for each option is provided in Appendix F.

Each of these scenarios is driven by major changes in the energy and water sectors, which will influence the future performance of renewable energy and energy storage project opportunities. These drivers are the same that warranted the development of Metropolitan's ESP, as provided in Section 1.2 and highlighted in Figure 5-2.

In addition to characterizing the performance of retail and wholesale options under the four scenarios, the scenario drivers were also used to identify signals that would potentially indicate significant changes in the energy market and water supply environment. Figure 5-2 provides a list of those signals mapped to the drivers from which they can originate. Each signal may affect only certain energy project opportunities, but all are important from a strategic energy management perspective. Ongoing scanning for these signals could provide Metropolitan with an early warning regarding the unfolding future as configured in the scenario framework.

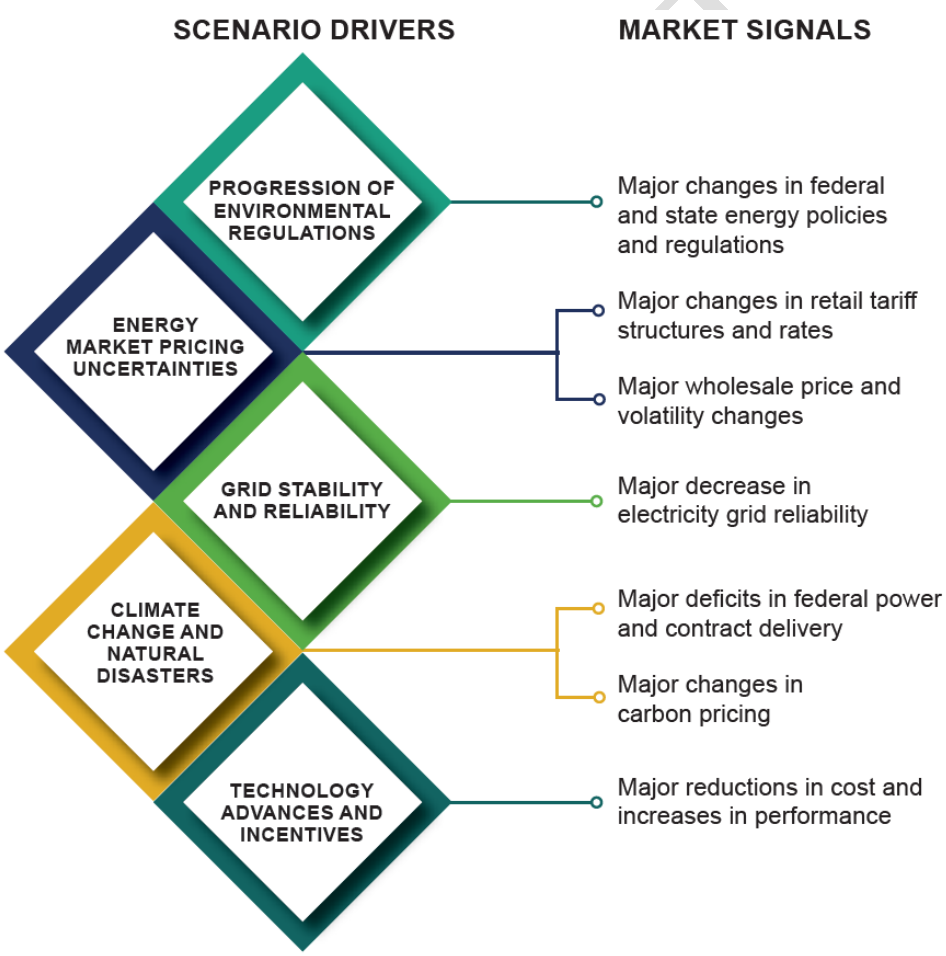


Figure 5-2 Scenario drivers and market signals

5.2 MULTI-CRITERIA DECISION ANALYSIS

MDA is a widely used method for ranking options based on a variety of objective performance criteria and the subjective weightings of decision makers regarding the relative importance of the criteria themselves. The overall process steps included:

- Establish objectives, evaluation criteria, and performance metrics.
- Develop quantifiable performance metrics (e.g., cost data, GHG emissions).
- Develop qualitative performance comparisons (expert ratings on a 1-to-5 scale).
- Apply weightings on an individual and group basis.
- Identify preferred options and the reasons for preferences.

A description of the project evaluation criteria, performance metrics, and weighting used for the MDA are presented in Section 5.2.1. The outcomes of the MDA for the selected retail and wholesale projects are included in Section 5.2.2 and 5.2.3, respectively.

5.2.1 Selection of project evaluation criteria and weighting

The first step in establishing evaluation criteria and associated performance metrics is a review of the overall objectives that Metropolitan's ESP is designed to achieve. Developed from Metropolitan's Energy Management Policies (Section 1.1.1), Table 5-1 summarizes the planning objectives and maps them to the specific evaluation criteria used in the analysis.

Table 5-1 Planning objectives and evaluation criteria

Planning Objective	Evaluation Criteria	Definition
Contain costs and reduce exposure to price volatility	Improved cost containment	Predictable annual average energy costs
	Reduced exposure to price volatility	Reduced hourly peak prices
	Increased revenue potential	Ability to produce net revenue within reasonable payback period
Increase operational reliability	Increased operational flexibility	Increased ability to avoid peaks and shed load
	Increased redundancy	Protection from generation and transmission disruptions on grid
Move toward energy independence	Increased energy independence	Power for direct use by Metropolitan outside of the grid
Support Metropolitan's CAP effort to reduce GHG emissions	Reduced carbon footprint	GHG reduction credited to Metropolitan

The performance measures used to compare options included a combination of:

- Quantitative metrics: estimated energy cost savings and estimated GHG emission reductions, where applicable
- Qualitative rankings: operational flexibility, redundancy, revenue potential and independence from the grid

The qualitative rankings were based on the expert judgements of the workshop participants and technical staff. In addition, the evaluation separated options in the retail markets (located at WTPs and facilities within the service area), from those in the wholesale market (CRA pumping and storage facilities). The quantitative and qualitative rankings were converted into dimensionless scores for comparison of the relative performance of options. More details on the combined quantitative metrics and qualitative scores for the project options evaluated in the MDA are found in Appendix F.

In order to capture the differences in importance placed on objectives by individual decision makers, each of the 16 participants in the workshop process described in Section 2.4 was asked to complete a survey used to compute relative weightings of planning objectives. Table 5-2 presents the total number of weighting points awarded to each criterion and the resulting percentages used to weight the performance scores of each option.

Table 5-2 Evaluation criteria weightings

Evaluation Critiera	Points	Percentage
Improve Cost Containment	57	17%
Reduce Impact of Price Volatility	49	15%
Increase Revenue Creation	24	7%
Increase Operational Flexibility	88	26%
Increase Redundancy	51	15%
Increase Energy Independence	26	8%
Reduce Carbon Footprint	41	12%
Total	**336**	**100%**

5.2.2 Retail market project option rankings and preferences

The results of the MDA on the weighted retail market project options is presented in Figure 5-3, with project options sorted from highest score to lowest. For each of the criteria, a range of dimensionless scores from the highest ranked option (assigned a score of 1.0) to the lowest ranked option (assigned a score of 0.0) was developed. The highest performing retail option is a new direct connection from the Yorba Linda Power Plant to the Diemer WTP (behind the SCE meter). As the figure illustrates, this investment has the potential to offer Metropolitan significant savings and a short payback of the initial capital investment. In addition, this project is anticipated to eliminate exposure to retail price increases of electricity purchased from SCE, allowing Diemer operations to function free from consideration of TOU penalties, and provide an alternative renewable power source to the grid at the Diemer WTP. The potential for the increased revenue criterion is not satisfied by this option since Yorba Linda hydropower is currently sold under a term contract, so utilizing it for Diemer WTP energy demand involves a trade-off of reduced energy sales.

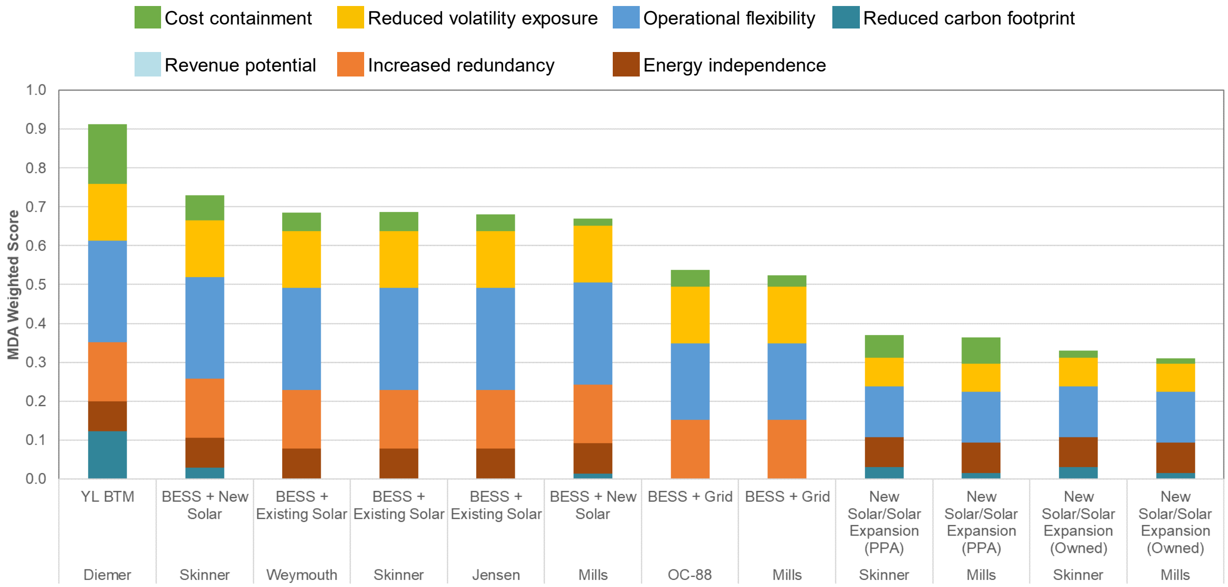


Figure 5-3 Breakdown of retail option weighted scores by criterion

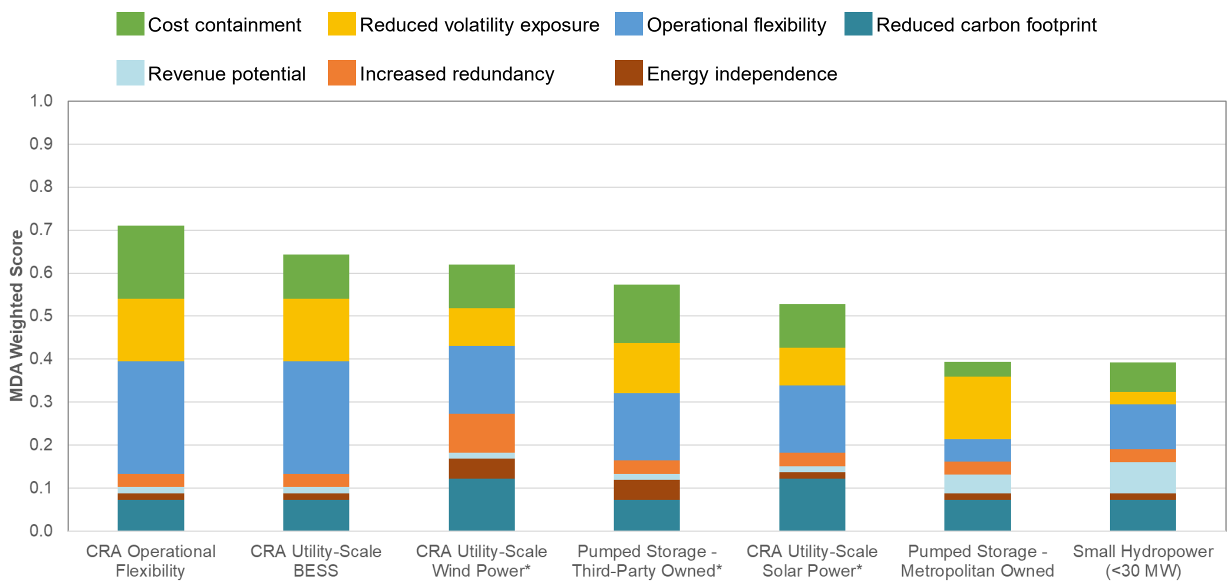
Options with battery energy storage integrated with existing or expanded solar are the next highest performing investments after the Yorba Linda configuration. These projects have somewhat longer payback periods but enable treatment plants to utilize battery energy storage to optimize solar power generation throughout the day, reducing costs and providing TOU flexibility for operations. In addition, batteries charged with renewable energy reduce the potential for GHG emissions. The combination of battery energy storage and solar generation could also offer treatment plants the potential to operate independently from the grid in a microgrid configuration for a limited period, in conjunction with backup emergency generators. However, allowing microgrid (or islanded) operations at Metropolitan facilities has not yet been assessed.

The options that include expanded solar facilities provide the additional benefit of further reducing carbon emissions. Procurement methods involving PPAs versus Metropolitan ownership would transfer project cost risk to the developer and monetize solar tax credits. An evaluation of the actual tradeoffs will require further development of PPA options versus Metropolitan's costs.

Options that utilize stand-alone battery storage to shift power purchases from the grid to off-peak hours can arbitrage TOU pricing periods and provide flexibility for operations relative to hourly pricing differences. However, unlike the combination of battery storage and solar generation, the quantification of the GHG emission reduction potential is challenging and only possible if the batteries are charged from renewable power. New innovative technologies to track the source of GHG emissions could enable both price arbitrage and GHG reduction tracking.

5.2.3 Wholesale market project option rankings and preferences

The MDA evaluation was also applied to the wholesale market project options considered in this plan. Unlike the approach used for the retail market project options, the project alternatives considered for the wholesale market were only scored qualitatively, and their ratings were only based on input from the workshop participants. A brief explanation of the scores assigned for each option is presented in Appendix F. Figure 5-4 presents a comparison of the wholesale market project options with weighted scores by criterion, sorted from highest score to lowest.



**Note: Projects involving third-party developers are subject to large uncertainty due to legal and contract considerations for energy generation along the CRA. Benefits of these projects should be reevaluated once contract conditions are determined.*

Figure 5-4 Breakdown of wholesale option weighted scores by criterion

As illustrated, the CRA pump upgrades were the highest ranked option due to the high level of importance placed on increased operational flexibility, expected cost savings, and reduced exposure to and the ability to take advantage of price volatility. CRA utility-scale BESS also provides a similar level of operational flexibility, a reduced exposure to price volatility by taking advantage of the depressed prices of the duck curve, and the potential to reduce GHG emissions and obligations to purchase offsets for imported fossil fuel energy. Small hydropower scored lowest for reduced volatility, since Metropolitan-generated hydropower is sold at a contracted price and the counterparty would receive those benefits. Metropolitan-owned pump storage scored lowest for operational flexibility because this asset is relatively high cost and would operate independent of CRA pump operations. Adding pumped storage operations may impair the already limited flexibility Metropolitan has for CRA pumping and distribution operations. However, this is dependent on the annual supply through the CRA and would require a more detailed study to evaluate impacts to CRA operations.

As indicated in Figure 5-4, wholesale energy projects involving third-party developers (including wind, solar, and pumped storage) are subject to large uncertainty in the contract terms and conditions for energy generation projects along the CRA. These projects exchange CRA variable costs for fixed costs, but project economic assessment indicates that these options have a long payback and the benefits are uncertain as they are highly dependent on contract conditions with third-party developers. The results presented above are offered for comparison but should be reevaluated once contract conditions are determined.

5.2.4 Energy management best practices rankings and preferences

Energy management best practices were not evaluated on a project-level basis and, therefore, were not included in the MDA evaluation. In general, energy efficiency improvements (e.g., submetering, energy audits, energy dashboards) would typically rank high for cost containment, reduced exposure to volatility, and carbon emissions reductions due to reductions in overall energy usage through consistent implementation of these practices.

5.3 COMBINED EVALUATION CONCLUSIONS

Table 5-3 below provides a consolidated picture of the retail and wholesale energy market project options, respectively, presenting the ranking of the option in the MDA, as well as an assessment of the performance of the option in each of the four scenario settings. The table also provides, in parallel, the financial and carbon emission reduction assessment results. The vulnerabilities and weaknesses under the four scenario narratives were reported in a color-coded format, with the green square indicating acceptable performance, the red square indicating poor performance or stranded assets, and the yellow square used when the impact on the performance is uncertain. The rationale for the color codes used for each project under the different scenarios is presented in Appendix F.

Both methods produced similar results, in part due to the multiple benefits offered by options that received high rankings in the MDA. For example, an option that significantly increases operational flexibility (i.e. Solar paired with BESS, CRA pumps upgraded with VFDs) is more robust under a wide range of scenarios. It should be noted that while the projects in the above tables are ordered based on the MDA results, this is not the final ranking of project prioritization. The benefits of each project across multiple planning assessments (financial, carbon emission reduction, MDA and scenario analysis) are meant to be used by Metropolitan staff to consider projects that may not have the most optimal financial results but could provide less risk with added benefits in an unknown future.

Both of these evaluation tools, working together, go well beyond a simple cost-benefit calculation and provide a framework for dynamic planning into an uncertain future. They consider benefits beyond cost savings and can guide Metropolitan towards adaptive and sustainable energy management solutions, as found in the roadmap provided in Section 6.2.

Table 5-3 Retail and wholesale project options and results of financial, MDA, and scenario planning assessments

	NPV ($)	Payback Period (years)	Carbon Emission Reduction (MT CO_2/year)	MDA Ranking	Scenario Assessment Performance*			
					A	B	C	D
Retail Project Options								
Yorba Linda behind meter at Diemer	$5,000,000	4	1,061	1	Acceptable	Acceptable	Uncertain	Acceptable
Skinner – BESS + New Solar	$1,600,000	10	256	2, 3	Acceptable	Acceptable	Acceptable	Acceptable
Weymouth – BESS + Existing Solar	$345,000	5	10	4	Acceptable	Acceptable	Acceptable	Acceptable
Skinner – BESS + Existing Solar	$396,000	5	10	5	Acceptable	Acceptable	Acceptable	Acceptable
Jensen – BESS + Existing Solar	$275,000	5	10	6	Acceptable	Acceptable	Acceptable	Acceptable
Mills – BESS + New Solar	$356,000	14	131	7	Acceptable	Acceptable	Acceptable	Acceptable
Skinner – New Solar (PPA)	$277,000	-	271	8, 9	Acceptable	Uncertain	Acceptable	Poor
Skinner – New Solar (Owned)	$240,000	14	271	10, 14	Uncertain	Poor	Uncertain	Poor
Mills – New Solar (PPA)	$566,000	-	145	11	Acceptable	Uncertain	Acceptable	Poor
OC-88 – BESS + Grid	$308,000	5	10	12	Uncertain	Acceptable	Uncertain	Uncertain
Mills – BESS + Grid	$102,000	7	10	13	Uncertain	Acceptable	Uncertain	Uncertain
Mills – New Solar (Owned)	$140,000	14	145	15	Uncertain	Poor	Uncertain	Poor
Wholesale Project Options								
CRA Pump Upgrades	To be determined in the preliminary investigation of the CRA's pumps			1	Acceptable	Acceptable	Acceptable	Acceptable
Utility-Scale Battery Storage (Owned)	$17,800,000	15	Varies	2	Acceptable	Acceptable	Acceptable	Uncertain
Utility-Scale Wind Power	To be determined based on discussion with potential developers			3	Acceptable	Acceptable	Acceptable	Uncertain
Pumped Storage (Third Party)				4	Acceptable	Uncertain	Acceptable	Poor
Utility-Scale Solar Power				5	Acceptable	Acceptable	Acceptable	Uncertain
Pumped Storage (Owned)	Varies – see Appendix D			6	Uncertain	Acceptable	Poor	Poor
Small Hydropower	Varies – see Appendix D			7	Acceptable	Acceptable	Acceptable	Acceptable

Scenario Performance: Acceptable; Uncertain; Poor

*Scenario Descriptions: A: Steady and predictable water and energy; B: Chaotic energy market and stable water supply; C: Energy market adjusts but water supply stressed; D: Volatile climate stresses water and energy market disrupted.

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6.0 FINDINGS AND RECOMMENDATIONS

The energy management initiatives included in the ESP address the significant energy market changes observed over the last decade and would help position Metropolitan as a leader in energy efficiency and forward-thinking energy management. Establishing this cost-effective and more reliable energy system will promote Metropolitan's mission of providing its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way. This plan provides a framework of sustainable actions focused on energy reliability, affordability, and conservation and adaptation – now and in the future. The proposed actions address many factors, including the evolving regulatory landscape; economic considerations; water supply demand, availability, and reliability; and the development of new or existing technologies. As these factors change over time, actions have been recommended for consideration when their economic and operational benefits can serve Metropolitan's needs. For this plan, the timing of these actions was categorized in the near-, mid- and long-term, as detailed in the following section.

In general, there is higher confidence in the outcomes and benefits of near- and mid-term actions due to a lower uncertainty in the factors of influence. Long-term outcomes can be impacted by unpredictable internal and external factors, such as carbon policy and costs, and technology cost declines. However, the scenario assessment and associated risks identified in Section 5.1 indicate that in the long-term there are significant energy price and water supply risks to Metropolitan that are not easily mitigated unless action begins in the near- and mid-terms.

The following sections summarize the key outcomes of the ESP effort conducted by Metropolitan and provide a roadmap of adaptive energy-related initiatives and strategies for the next decade.

6.1 SUMMARY OF ESP FINDINGS

In order to develop an adaptive energy strategy to protect against future price volatility and changing energy regulations, this plan evaluated Metropolitan's energy portfolio and historical energy usage, future energy, GHG-related regulations, and factors that can impact the future price of energy. This comprehensive evaluation of energy markets and drivers, and the potential impact to Metropolitan's operations, revealed a number of important considerations:

- The delivery of water and the demand for energy are intrinsically linked. Actions taken with regard to one will consequently have an impact on the other, such as shifting pumping operations to periods of low energy prices. Water costs and supply management strategies are inextricably tied to energy management and the ability to control operational energy-related costs.
- The rise of renewable energy installations throughout California resulted in the "duck curve" effect and have contributed to the rise of energy storage projects. Energy storage is considered essential to flattening the duck curve and reducing the volatility observed in the wholesale energy market. Despite its known benefits, the regulatory and deployment future of energy storage is unknown. However, near-term incentives make the preferred approach to install and own small-scale energy storage units and plan for long-term energy management in anticipation of additional renewable and storage development. The plan suggests additional

investigation into future energy prices at the CRA pump locations and the cost of large-scale energy storage.

- Within the last two decades, regulatory requirements and tax incentives have led to the emergence and acceleration of renewable energy and energy storage technological advancements with significant cost reductions. The resulting decrease in prices for solar, wind, and battery storage facilities has increased the feasibility of implementing these projects. Current incentive programs, such as the SGIP, are key to making energy storage projects financially viable. In consideration of the limited funding availability for these incentive programs, a swift implementation of the most economically and operationally beneficial energy storage projects is imperative.
- The emergence of new technologies, in particular battery energy storage, has created a dynamic and competitive market for developers to install and operate their systems throughout California. Developers fill water utilities' knowledge gaps relative to these new technologies and offer contract opportunities based on PPAs or shared savings models, which reduces much of the risk typically associated with these projects. As a result, developers are able to operate the systems for multiple methods of energy regulation and gain additional financial benefits beyond energy bill savings.
- While Metropolitan is not directly affected by recent California legislation, such as SB 100, which calls for 100 percent "carbon free" energy by 2045, the cap-and-trade system regulating carbon emissions is embedded into the cost of energy throughout the state. It appears that energy utilities are on track to hit their targets, but the transportation sector, which includes roughly half the program, is lagging. On this basis, carbon emission costs will continue to rise and affect energy customers, including Metropolitan, which is obligated to purchase carbon allowances for its supplemental energy imports. These imports, along with purchases from CAISO and the federally contracted hydro contracts, power the CRA pumping operations.
- Energy efficiency opportunities that reduce energy usage should be evaluated on a continuous basis for short- and long-term benefits to help reduce energy-related costs and GHG emissions.
- On a daily basis, the wholesale market includes significant price variation, with energy prices ranging from over $1,000/MWh to under $0/MWh. The CRA pumping plants are subject to these price swings. Considering that the pumps have minimal flexibility to dynamically adapt to the price changes throughout the day, the targeted application of VFDs at Intake and Gene Pumping Plants, if and as feasible, would not only provide greater operational flexibility for supplying water to Southern California, but could create added financial benefits by increased pumping during hours of low energy prices.

In general, energy project opportunities that take into consideration the above factors, along with high performance in both multi-criteria and scenario evaluations, demonstrate relative strength now and robustness with respect to future uncertainties.

6.2 ROADMAP

The overriding objective of the ESP was to develop an adaptive energy management strategy that is integrated with Metropolitan's water resource management plans and activities, which include maximizing operational reliability and flexibility. This strategy was developed through a roadmap of actions and projects Metropolitan should consider in order to address issues surrounding energy management and cost mitigation. The conceptual elements and modules of the roadmap are presented in Figure 6-1.

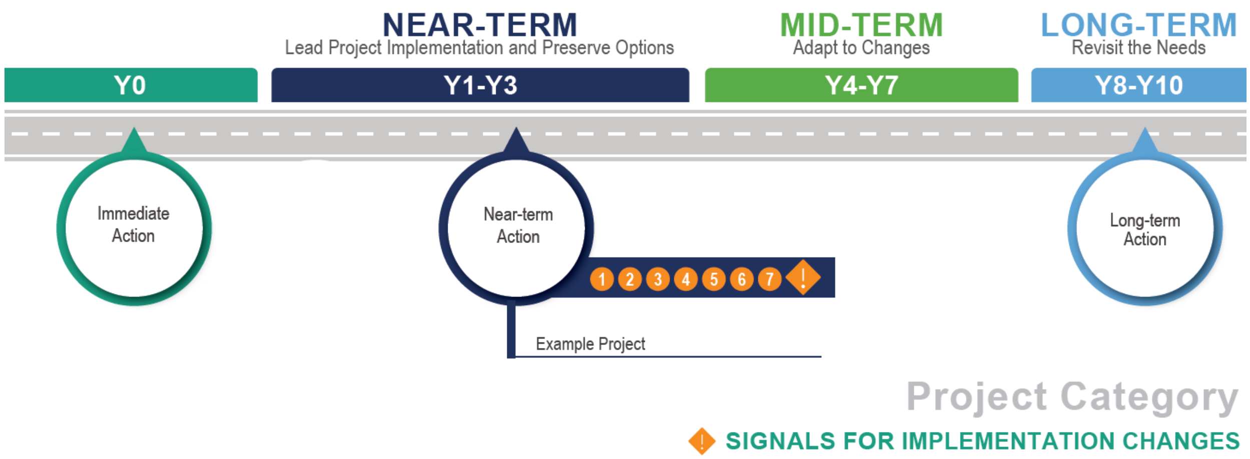

Figure 6-1 Conceptual elements of the ESP implementation roadmap

Briefly, the roadmap addresses near- to long-term energy issues at Metropolitan and, as such, was developed around three timeframes and their overarching goals:

- **Immediate** (current) – Actions that should start immediately to develop near-, mid-, and long-term projects
- **Near-term** (years 1 through 3) – The prioritization of project implementation begins while preserving other project options for consideration in the future
- **Mid-term** (years 4 through 7) – The performance of implemented projects is assessed and adaption to changes is performed as needed
- **Long-term** (years 8 through 10) – The overall roadmap performance is evaluated and Metropolitan's changing energy needs revisited

The roadmap was categorized to include the main categories of projects evaluated for this plan and described in detail in Section 4.0 (i.e., projects addressing the retail and wholesale energy markets, energy management best practices).The factors and constraints affecting each of these categories is distinctly different and the resulting actions, while all connected to Metropolitan's main goals around energy, should be reviewed and implemented within the context of each category. Based on the outcomes of the financial evaluation, and the holistic MDA and scenario assessment presented in Sections 4.0 and 5.0, respectively, a number of initiatives and projects were proposed under these specific timeframes and project categories.

The recommended actions are impacted by numerous factors, considered as indicators in this plan, that will signal the acceleration or change of course for certain actions. The magnitude, nature, and timing of these signals will result in different responses and actions for Metropolitan in the long-term and should be continuously monitored over time. A list of the potential signals to monitor are reported as numerical values within the roadmap (1 through 7) and include:

- Major changes in federal and state energy policies and regulations (Signal 1)
- Major changes in retail tariff structures and rates (Signal 2)
- Major wholesale price and volatility changes (Signal 3)
- Major deficits in federal power and contract delivery (Signal 4)
- Major decrease in electricity grid reliability (Signal 5)
- Major technology advancements (Signal 6)
- Major changes in carbon pricing (Signal 7)

The framework is intended to be flexible for accommodating future projects, preferences, and localized needs, and to be adaptable as goals and technologies evolve. The roadmap provides a plan for implementation of recommended energy projects and initiatives, while accounting for unknown changes in the future by assigning signals to each action for Metropolitan staff to monitor as the roadmap progresses. For a visual representation of the roadmap, refer to Figure 6-2 below.

6.2.1 Immediate to Near-Term Actions (Years 1-3)

As an immediate action, prior to implementation of the ESP roadmap, it is recommended that a dedicated Energy Sustainability team be established to further expand Metropolitan's current energy best practices; implement the recommendations of the ESP; review existing energy management practices; identify other recommended initiatives around energy data collection, analysis, open data initiatives, and visualization; and routinely monitor energy market conditions.

There are near-term actions that can be taken within the next three years that are consistent with and support the Energy Management Policies. These recommendations were assessed to be cost-effective, feasible, and provide an array of benefits that go beyond economics.

The near-term actions identified within energy management best practices:

- Coordinate the overall energy plan implementation, with the involvement of the Energy Sustainability team previously established and all interested parties and stakeholders.
- Review existing energy best management practices and Metropolitan's facilities energy baselines, and start implementing energy initiatives (e.g., energy audits, submetering, energy dashboards, pump and process optimization, staff trainings). These energy initiatives should be reviewed annually, and organizational change management executed as needed.
- Continue discussions with DWR concerning SWP energy prices and mitigation efforts.

- Continue to engage routinely with retail electric utilities (SCE, LADWP, RPU) regarding anticipated potential changes and/or increases to energy rate structures, or release of favorable electric utility programs and incentives.
- Set up a tracking system for market signals (e.g., retail tariff change, wholesale market price volatility, etc.) for the Energy Sustainability team to monitor routinely.

The near-term actions identified within the retail market strategy:

- Begin implementation of reconfiguring Yorba Linda Power Plant feed to serve the Diemer WTP retail load behind the SCE meter in order to meet the entire plant's energy demand when Yorba Linda is in operation.
- Begin the application process for SGIP funding for recommended BESS projects at Weymouth, Skinner, and Jensen WTPs, and OC-88 Pumping Plant before funds decline. Funds are allocated on a first-come, first-served basis, and the availability of SGIP incentives in the highest step is declining. Once SGIP funding has been secured, implement the aforementioned projects and begin to monitor battery use and energy savings. It is not recommended to pursue a BESS at Mills WTP at this time due to both the absence of existing on-site solar and the dynamics of RPU's rate tariffs.
- Evaluate the feasibility of integration and implementation of islanded operations for applicable projects, including battery storage and the Yorba Linda Power Plant, for possible future microgrid purposes.
- Engage in conversations with third-party developers to obtain pricing for solar generation and/or battery storage projects at a competitive energy price that is lower than the average retail energy price.

The near-term actions within the wholesale market strategy:

- Monitor wholesale energy market developments for major changes to CRA energy costs and evaluate appropriate options, such as generation or energy storage.
- Assess pump modifications at Intake and Gene pumping plants to implement targeted application of VFDs to accommodate effective load shifting, improve synchronization between Intake and Gene pumps, and fully utilize available storage capacity at Gene Wash and Copper Basin reservoirs.
- Continue to evaluate the purchase of low/no carbon power for CRA pumping operations to hedge against rising power prices impacted by rising carbon prices.
- Continue to monitor third-party developer projects for opportunities in large-scale renewable energy and energy storage opportunities along the CRA.

6.2.2 Mid-Term Actions (Years 4-7)

The mid-term actions identified within energy management best practices:

- Continue review and implementation of energy best management practices and initiatives.

The mid-term actions within the retail market strategy:

- Assess the performance of implemented BESS projects, and later implement the previously deferred project options based on first phase performance results.
- Implement renewable energy and/or energy storage projects with third-party developers, if determined feasible.

The mid-term actions within the wholesale market strategy:

- Continue monitoring wholesale energy market development and adapt the strategy as needed.
- Continue evaluating low/no carbon power for CRA pumping operations to hedge against rising power prices impacted by rising carbon prices
- Assess large-scale renewable energy and/or energy storage projects and more favorable options (e.g., Metropolitan-owned versus third-party).
- Reevaluate small hydropower opportunities on the distribution system if project economics become favorable.

6.2.3 Long-Term Actions (Years 8-10)

Considering the uncertainties of California's energy markets and climate, long-term planning should focus on the next 10 years in order to maintain relevant actions and strategies for current conditions. Therefore, the key goal for Metropolitan's long-term energy management plan is to monitor implemented projects and initiatives, reassess the main market drivers to better understand potential project and energy management opportunities; thus, adjusting the Plan and roadmap accordingly.

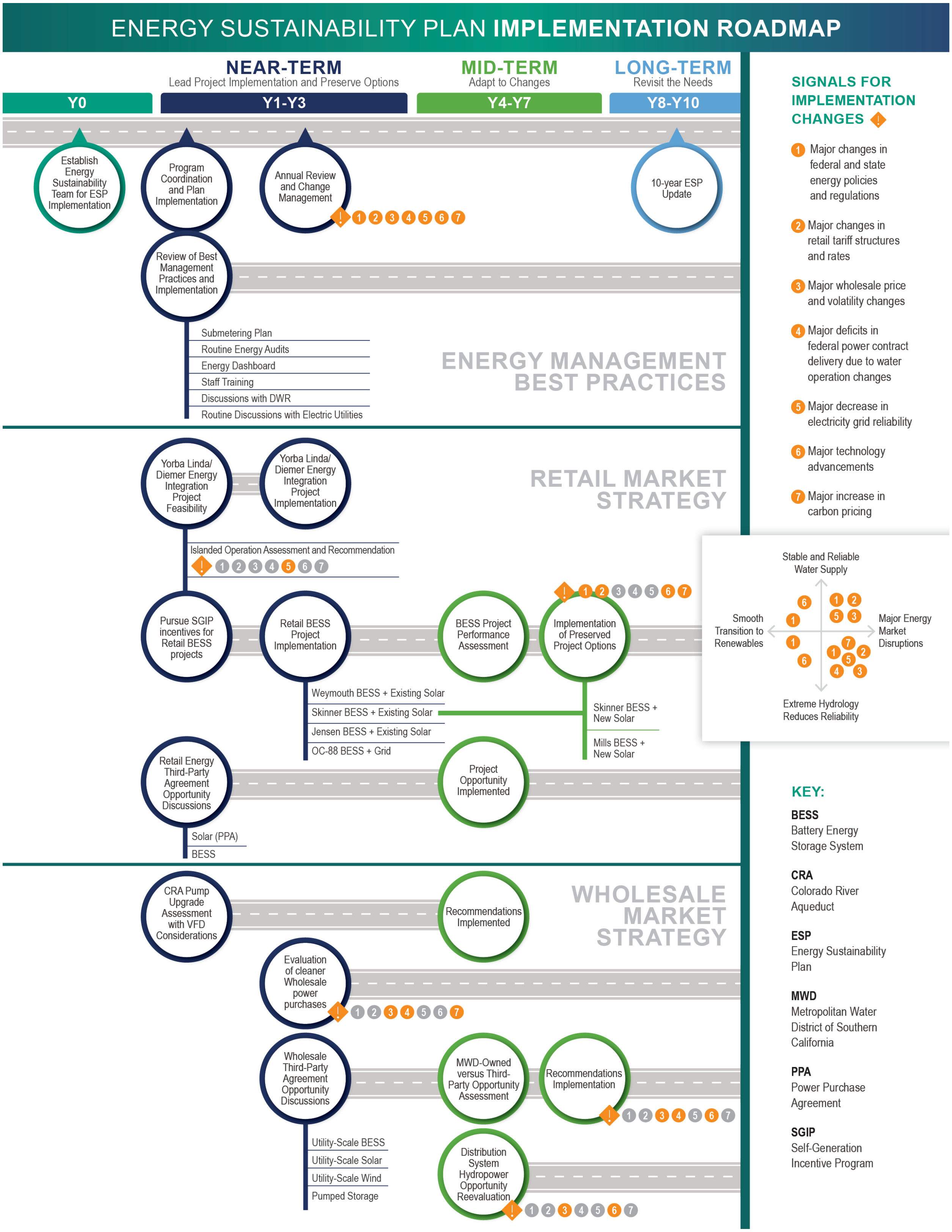

Figure 6-2 Energy Sustainability Plan Roadmap

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