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City of Roseville Electric Utility

Integrated Resource Plan Report 2018

CITY OF ROSEVILLE CALIFORNIA
Electric Utility

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1 Executive Summary

Roseville Electric Utility's 2018 **Integrated Resource Plan** (IRP) is a comprehensive plan for developing a portfolio of power supply resources to meet the Utility's objective of providing reliable and low priced electricity services while addressing the substantial risks and uncertainties inherent in the electric utility business. The IRP also supports Roseville Electric's mission to improve the quality of life of our community and customers with reliable electricity, competitive prices, exceptional service and a culture of safety.

The IRP meets the requirements of California Senate Bill (SB) 350 (de León, Chapter 547, Statutes of 2015), which requires publicly owned utilities (POUs) with an average annual energy load greater than 700 gigawatt-hours (GWh) to submit an IRP at least every five years to the California Energy Commission (Energy Commission or CEC).

The IRP discusses current and anticipated California regulatory and policy changes facing Roseville and the electric utility industry. Additionally, the IRP presents the analyses conducted and underlying assumptions, and outlines a resource plan to reliably and affordably meet customers' energy needs through December 31, 2030.

The electric utility industry has undergone significant changes since Roseville Electric prepared its last IRP in 2012. Figure 1 illustrates the status of key drivers in the 2018 IRP compared to the 2012 IRP.

Driver	2012 Status	2018 Status
Statewide GHG Goals	Statewide emissions reduced to 1990 levels by 2020	40 percent below 1990 GHG levels by 2030
Cap and Trade	Authorized through 2020	Extended though 2030
Renewable Procurement	33 percent by 2020 and beyond	50 percent by 2030 and beyond
Distributed Generation (Rooftop Solar)	Modest growth	High growth
Energy Efficiency	No direct target	State goal of doubling of energy efficiency by 2030
Energy Storage	No direct requirement	Requirement to study adoption of targets
Transportation Electrification	No direct requirement	Requirement to address procurement of electric vehicle infrastructure
Structured Markets	Hourly market	Intra-hour market
Resource Adequacy	Peak capacity	Peak and flexible capacity

Figure 1 - Key IRP Drivers 2012 vs 2018

Roseville Electric's IRP identifies key challenges faced by the Utility through 2030, and outlines a suite of resourcing strategies (RS) and risk management strategies (RM) to meet these challenges. Figure 2 below illustrates the challenges and strategies Roseville Electric will pursue over the next few years, known as the Preferred Plan.

Peak Capacity Portfolio

Portfolio Forecast to be Short 90-100 MW of Planning Reserve Margin by 2030

RS-1:	Maintain existing NCPA and Base Resource Contracts	2018
RS-2:	Improve operating reliability of Roseville Power Plant 2	2018
RS-3:	Study cost effective upgrades to REP to increase flexibility	2019
RS-4:	Procure transmission to Pacific Northwest	2018
RS-5:	Investigate demand response program enhancement	2018

Flexible Capacity Portfolio

Added Flexible Capacity Needed in 2025 and Beyond, Driven by Growth in Local Intermittent Resources

RS-6:	Evaluate Energy Storage Pilot Project as flexibility solution	2019
RS-7:	Develop comprehensive Distributed Energy Resource strategy including flexibility options	2020

Renewable Portfolio Standard

New Renewable Resources are Needed After 2024

RS-8:	Prepare RPS Execution Plan for RPS need	2019

Risk Mitigation

Cap and Trade Prices Have Potential to Increase Significantly

RM-1:	Develop Strategy to mitigate Carbon Market cost exposure	2018

Real Time Market Counterparties are Decreasing Due to Energy Imbalance Market

RM-2:	Evaluate the efficacy and financial viability of participating in the EIM to mitigate decreasing real-time market opportunities	2019

Figure 2 - Roseville Portfolio Challenges and IRP Action

Costs are projected to increase through 2030, primarily due to increasing environmental regulations and renewable integration costs. Costs are increasing, but retail energy sales are decreasing due to growth in residential rooftop solar, and are further expected to decline in 2020 and beyond due to building codes mandating new homes be net zero annual energy. The Preferred Plan forecasts power supply costs increasing by about 3% annually from 2018-2030.

Roseville Electric will provide public updates on the progress, successes, and new challenges over the implementation period of this IRP.

2 Purpose and Background

Roseville Electric has provided reliable and affordable electric service since 1912. This IRP is Roseville's plan to meet the needs of the City and its over 57,000 residential and business customers from 2018 through 2030. Roseville's IRP was the outcome of a thorough planning process driven by Roseville's IRP Priorities, in alignment with Roseville City Council priorities and the Utility's mission.

2.1 Roseville Electric Mission

Roseville's 2018 IRP is a comprehensive planning document to guide long-term power planning aligned with Roseville Electric's Mission, which states: *We improve the quality of life of our community and customers with reliable electricity, competitive prices, exceptional service and a culture of safety.* Accordingly, Roseville's IRP Priorities are:

- Compliance with local, state, and federal regulations
- Reliable power for customers
- Affordable electricity rates

These IRP Priorities are aligned to support the Utility's mission to implement City Council goals illustrated in Figure 3.

Figure 3 - IRP Priority Alignment

Across the industry, integrated resource planning has undergone significant changes in recent years. The objective of the IRP is to evaluate Roseville's portfolio of resources against the changing utility landscape and California's environmental requirements, while recommending strategies to ensure Roseville continues to meet the City Council's goals as Roseville's power supply transitions to more renewable resources.

2.2 California Energy Commission IRP Guidelines

This IRP is filed by Roseville in accordance with the requirements of SB 350, which requires certain POUs, including Roseville Electric, to submit an IRP to the CEC. Roseville's IRP must be adopted by Council by January 1, 2019, submitted to the CEC by April 30, 2019, and updated at least once every five years thereafter. According to SB 350, IRP filings must do the following:

- Ensure procurement of at least 50 percent renewable resources by 2030 (Sections 2.5.1, 3.2.3, 7.1, 9, 9.3, 9.4.4)

- Meet Roseville's share of the greenhouse gas emission reduction targets established by the California Air Resources Board (CARB) for the electricity sector, to enable California to achieve the economy wide greenhouse gas emissions reductions of 40 percent from 1990 levels by 2030 (Sections 2.6.1, 3.2.2, 3.2.3, 9, 11)
- Minimize impacts to customer bills (Sections 2.7.2, 10)
- Ensure system and local reliability (Section 7.2)
- Strengthen the diversity, sustainability, and resilience of the bulk transmission, distribution systems and local communities (Sections 3.1, 8, 9.4.1.1)
- Enhance distribution systems and demand-side energy management (Section 2.6.3, 5.2)
- Minimize localized air pollutants and other greenhouse gas emissions with early priority to disadvantaged communities (Section 11.1)
- Address procurement of each of the following:
    - Energy efficiency and demand resources that are cost effective, reliable and feasible (Sections 2.5.2, 5)
    - Energy storage (Sections 9, 9.5)
    - Transportation electrification (Sections 6.2, 9.3.1)
    - A diversified procurement portfolio of short term electricity, long-term electricity, and demand response products (Sections 5.2, 9, 9.4.1.3)
    - Resource adequacy (Sections 2.7.1, 9.4.1.2)

Publicly owned utilities like Roseville were asked to submit the following four Standardized Tables to the CEC as part of their IRPs:

- Capacity Resource Accounting Table (CRAT): Annual peak capacity demand in each year and the contribution of each energy resource (capacity) in the POU's portfolio to meet that demand.
- Energy Balance Table (EBT): Annual total energy demand and annual estimates for energy supply from various resources.
- RPS Procurement Table (RPT): A detailed summary of a POU resource plan to meet the RPS requirements.
- GHG Emissions Accounting Table (GEAT): Annual GHG emissions associated with each resource in the POU's portfolio to demonstrate compliance with the GHG emissions reduction targets established by the California Air Resources Board (CARB).

The four Standardized Tables for Roseville's IRP require historical 2018 data, and will be submitted prior to the April 30, 2019 due date, once this data is available.

This IRP serves as Supporting Information, as suggested in Chapter 2, Section D of the CEC guidelines:

> *Supporting Information for an IRP Filing refers to (1) analyses, studies, data, and work papers, or other material that the POU used or relied upon (including inputs and assumptions) in creating the IRP (such as, but not limited to, market conditions current at the time of the analyses, energy infrastructure, state policies and laws, and needs of the Filing POU) but are not included in the IRP itself; and (2) additional information required by these guidelines.*

Supporting Information supplements the data submitted in the Standardized Tables and must be submitted to the Energy Commission as part of the IRP Filing. Supporting Information can be developed specifically for the IRP Filing or can be an existing document submitted or incorporated by reference as described in Chapter 3.

2.3 Public Process

Roseville's IRP was presented for public review at the Roseville Public Utilities Commission (RPUC) on April 24, 2018. The IRP staff presented Roseville Electric's long-term IRP needs, analyses, and recommended actions for meeting those needs. IRP staff answered questions from Commissioners on issues including IRP requirements, IRP recommendations, renewable energy technologies and cost, and energy storage technologies. The RPUC unanimously recommended City Council approval of the IRP. A full video of the RPUC meeting is available at the following link: **Click here**

On June 20, 2018, Roseville's IRP was presented to Roseville's City Council for its review and approval. The City Council is the local regulatory authority with oversight responsibility over Roseville Electric. The City Council unanimously approved the 2018 Roseville Electric IRP. A video of the staff presentation of the IRP to City Council is available at the following link: **Click here**

2.4 Overview of IRP Methodology

Integrated resource planning is the process that utilities undertake to determine a long-term plan to ensure generation resources are adequate to meet projected future peak capacity and energy needs, while achieving other utility goals such as maintaining an adequate reserve margin for system reliability. Resource plans must ensure generation reliability is maintained at or above industry-standard levels. Sound IRPs also need to forecast long-term costs and potential rate impacts to customers to ensure that the utility can monitor and track trends with sufficient time to implement solutions to ensure reliability, compliance, and affordable electric service. An effective resource plan should also provide a reasonable degree of flexibility for the utility to deal with uncertainty in technological change and future regulations.

IRPs require the use of sophisticated analytical tools capable of evaluating and comparing the costs and benefits of a comprehensive set of alternative supply and demand resources. Supply options typically include the evaluation of new conventional generation resources, renewable energy technologies, and utility-scale and distributed energy resources. Demand options typically include consideration of demand response programs, energy efficiency programs and other "behind the meter" options which may reduce the overall load that the utility must be prepared to supply to meet customer energy needs.

IRPs utilize various economic analyses and methodologies to assess alternative scenarios (e.g., different combinations of supply and demand resources) and sensitivities to key assumptions to arrive at an economically optimal resource plan. It is important to understand, however, that the optimal economic plan derived through IRP analysis of generation resources only may or may not reflect the same conclusions that a pure financial analysis might reach. Thus, after incorporating environmental goals, constraints, and utility financial metrics, modifications to the preferred or recommended plan may result.

The key steps in the resource planning process are illustrated in Figure 4.

STEP 1

Examine Planning Framework and Risks

Identify and assess challenges inherent in the current business and regulatory environment. Develop a multi-faceted risk management approach that considers how plan drivers may change during the planning period.

STEP 2

Assess Needs

Develop forecasts of load growth, changing load shapes, existing plant conditions, contract terms, and operational constraints to determine resource needs over the planning period.

STEP 3

Consider Resource Options

Evaluate available generation resources, including conventional, renewable, and long-term market power purchases to identify the role each will play in meeting customer needs, and regulatory and policy goals.

STEP 4

Develop Resource Portfolios

Develop resource portfolios through a screening process, followed by a detailed quantitative and qualitative evaluation process for preferred portfolios. Evaluation relies upon GHG emission requirements, needs assessment, and planning data specified in previous steps.

STEP 5

Perform Scenario and Risk Analysis

Perform detailed evaluation of preferred resource portfolios through scenario and risk analysis, to assess performance under range of potential market and regulatory conditions.

STEP 6

Identify Plan

Identify a “preferred plan” based on the resource portfolio expected reliably serve demand at a reasonable long-term cost, while achieving compliance, accounting for inherent risks, and allowing for flexibility to respond to future policy changes.

Figure 4 - IRP Process

An IRP represents a snapshot of a continuous process that evolves and transforms over time. The conditions and circumstances in which utilities must make decisions about how to meet customers' future electric energy needs are ever-changing. The IRP process utilizes a methodology and framework for assessing a utility's ever-changing business and operating requirements, and adapting to factors such as changing technology, regulations, and customer behavior. Assumptions, scenarios, and results are all reviewed and updated as information and events unfold, and the process is continually revisited under formal or informal resource planning efforts.

2.5 Update to 2012 IRP

Roseville Electric's 2012 IRP outlined a set of action items to achieve RPS compliance, meet GHG requirements while utilizing auction proceeds to benefit customers, and evaluate a demand-side management strategy. This section will provide an update on those action items.

2.5.1 Renewable Portfolio Standards

In December 2012, Council approved the Roseville RPS Procurement Plan to comply with SB X1-2. Roseville Electric subsequently updated the RPS Procurement Plan in 2013 and 2015 to reflect new regulations. With the adoption of SB 350, Roseville is proposing Council adopts an updated RPS Procurement Plan in conjunction with this IRP. SB 350 requires Roseville to procure a minimum quantity of electricity from eligible renewable energy resources as a specified percentage of total kilowatt hours sold to the Utility's retail end-use customers to achieve the following targets:

- 25% by December 31, 2016,
- 33% by December 31, 2020,
- 40% by December 31, 2024,
- 45% by December 31, 2027 and
- 50% by December 31, 2030 and subsequent years.

Based on current forecasts, Roseville will be compliant with the mandate through 2024.

Since the 2012 IRP, Roseville has entered into five Power Purchase Agreements (PPA) for RPS compliance, as summarized in Figure 5.

Counterparty	Term	Fuel
Silicon Valley Power	2013-2022	Geothermal
Lost Hills Solar, LLC	2015-2024	Solar
Blackwell Solar, LLC	2015-2024	Solar
Avangrid Renewables	2014-2024	Wind
Powerex Corp	2016-2025	Wind

Figure 5 - Executed Contracts for Renewable Energy

These agreements, along with existing renewable contracts, are projected to provide sufficient coverage to comply with Roseville's RPS requirements through the 40% by 2024 target set by SB 350. Roseville will fulfill the RPS mandates beyond 2024 with future renewable agreements, discussed later in this IRP.

Roseville has successfully participated in quarterly GHG allowance auctions, both for procuring the GHG allowances necessary to meet its regulatory obligations, and for consigning a portion of its directly allocated GHG allowances to auction. Auction proceeds have been used to benefit Roseville's customers and reduce GHG emissions. Proceeds have not only been directly returned to customers as a bill credit based on customer class, but also used to fund Advanced Metering Infrastructure (AMI), low-income and multi-family energy efficiency retrofit programs, and new electric vehicle (EV) rebates.

2.5.2 Utility Customer Programs

Roseville Electric achieved GHG reductions through several customer targeted programs including distributed solar, energy efficiency (EE), and other demand-side management programs. Customers received 52,983,500 kWh[1] of savings from energy efficiency programs since the 2012 IRP. In addition to EE, Roseville worked with customers to integrate an additional 11,512,000 kW[2] of distributed solar since the 2012 IRP.

New technologies provide an opportunity to create a portfolio of Demand-side Management (DSM) strategies centered on AMI. Roseville will complete AMI deployment by early 2020, which will allow the Utility to quantify distribution, resource, and operations planning needs. This will allow Roseville to design more effective DSM strategies and rates with greater customer participation and benefits, as well as lower-cost grid and environmental benefits.

2.6 2018 Regulatory Environment

Roseville's values are safe, affordable, and reliable electricity for its customers. In recent years, legislative and regulatory changes in California have added another major driver to Roseville's integrated resource planning: GHG emissions reductions. This mandate is embodied in both overarching goals, specific GHG targets, and prescriptive mandates such as the RPS. California's energy policy emphasis on GHG reductions has expanded Roseville's planning and procurement to both supply side and demand-side resources.

The key challenge will be maintaining safe, affordable, and reliable electricity for Roseville's customers while addressing the many specific issues arising from GHG-related mandates, such as more intermittent renewable resources, which will require greater flexibility from existing and future resources.

2.6.1 GHG Reduction

In 2006, California passed Assembly Bill (AB) 32[3], formally known as the California Global Warming Solutions Act of 2006. AB 32 is a mandate for several sectors, including the electricity sector, to reduce GHG emissions to 1990 levels by 2020. In 2016, AB 32 was augmented by Senate Bill (SB) 32[4], which mandated a statewide GHG emissions reduction target of 40% below 1990 levels (433.33 MMT CO_2e[5]) by 2030 (260 MMT CO_2e). For the electric sector, a 40% reduction by 2030 amounts to approximately 62 MMT CO_2e total sector emissions. The implementation of SB 32 directed the proposed 2017 CARB Scoping Plan[6] (Scoping Plan) which presents more stringent targets for 2030, 30 to 53 MMT of total electricity sector wide CO_2e, further addressed in this section.

1 Total energy savings as reported in Roseville's annual SB 1037 report from 2013-2017.
2 Total capacity of incremental rooftop installations of distributed solar from 2013-2017.
3 https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32
4 https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32
5 Million metric tons of carbon dioxide equivalent.
6 https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

California's goal of reducing GHG emissions will be achieved through a combination of market mechanisms (Cap and Trade) and prescriptive mandates (RPS) to retire and replace high emitting resources with cleaner resources.

2.6.1.1 Cap and Trade

"Cap and Trade" is a market-based mechanism, authorized by AB 32 and recently extended by AB 398 to 2030, to reduce GHG emissions. The "cap" is an annual, declining limit on GHG emissions from covered sectors. These emissions are accounted for via allowances, each of which permit emissions for the equivalent of a metric ton of carbon dioxide emissions.[7] Allowances may be "traded" in the market, incentivizing entities to invest in the most economically efficient, or least-cost, means to reduce emissions.

To prevent rate shock to its customers, Roseville Electric receives an annually declining allocation of allowances. It purchases the balance of allowances needed for compliance in quarterly auctions. Finally, Roseville periodically surrenders a number of allowances equal to the GHG emissions from its resources, including the Roseville Energy Park (REP) and out of state imports.

2.6.1.2 Renewable Portfolio Standard

A second mechanism for reducing GHG emissions in the electricity sector is the RPS. The RPS program mandates a minimum percentage of load, increasing annually, to be served by qualifying renewable generation. Mandates were imposed on Roseville by SB X1-2[8] in 2011, and subsequently expanded by SB 350 in 2015. Currently, the major targets are 33 percent renewables by 2020, and 50 percent by 2030.

Roseville utilizes a diverse portfolio of qualifying renewable resources - geothermal, wind, solar, bioenergy, and small hydro[9]- to meet its RPS targets. Also, nearly one-fifth of Roseville's load is served by large hydro, a carbon-free resource which helps reduce its GHG emissions, yet is ineligible for RPS compliance. Figure 6 illustrates Roseville's forecasted power content for 2018 and 2030, assuming current portfolio conditions continue.

7 A metric ton of other greenhouse gases, such as methane, are more potent than a metric ton of carbon dioxide, and would require an accordingly greater amount of allowance.
8 http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.html
9 Hydroelectric generation resource less than 30 MW. Conversely, "large hydro" is greater than 30 MW.

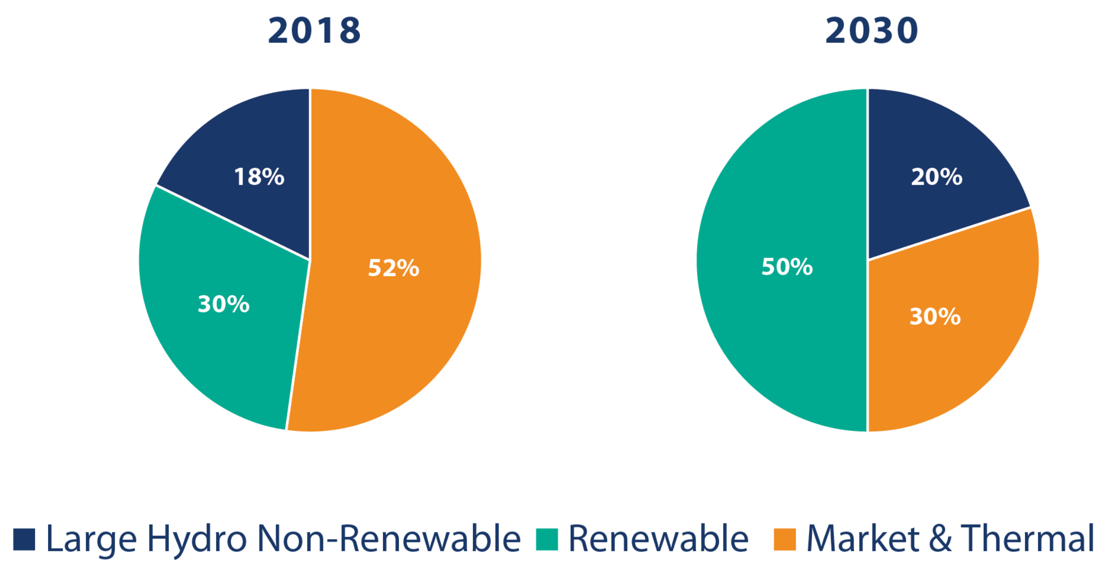


Figure 6 - Forecasted Power Content 2018 vs 2030

As noted in Figure 6, power content shifts towards more renewables, and fewer carbon emitting resources. Key questions this IRP will address regarding energy balance are:

- What is the optimal renewable resource mix to meet RPS compliance in 2025 and beyond?
- What are the optimal resources and energy procurement strategies to provide a cost effective, emissions limited portfolio to comply with state law and Roseville Electric's Risk Management policies?

2.6.1.3 Other GHG Assumptions

Roseville's IRP incorporates the overarching GHG reduction targets for the state of California, the role of utilities within these targets, and finally Roseville's role within the utility industry. The CARB Scoping Plan is an update of status and projections to meet California AB 32 and SB 32 GHG reduction targets. Figure 7 illustrates expected GHG reductions based on the 2017 Scoping Plan.[10]

10 Source: California's 2017 Climate Change Scoping Plan, November 2017, California Air Resources Board, page 30

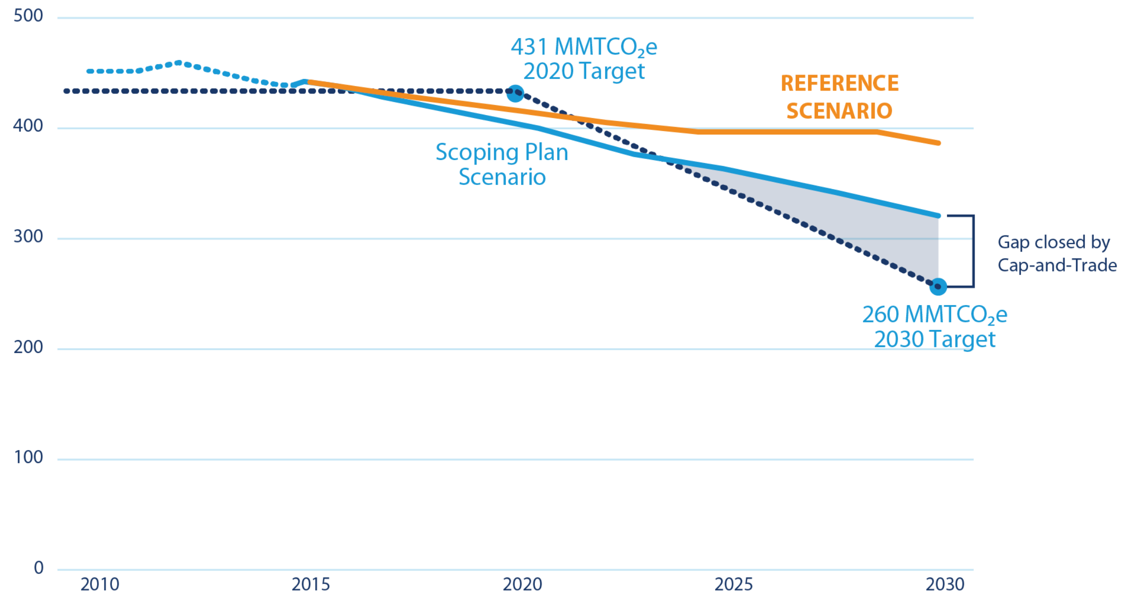


Figure 7 - Proposed Statewide Carbon Reductions

In order to achieve SB 32 targets, several sectors- including industry, transportation, and electricity- will need to reduce their carbon emissions. Figure 8[11] on the next page is an excerpt from the Scoping Plan that presents CARB's estimate of what each sector may be reasonably able to achieve. Although CARB has not finalized its goals, the utility sector is expected to achieve reductions down to a level of 53 million metric tons of carbon dioxide equivalents (MMT CO_2e), possibly as low as 30 MMT CO_2e in 2030. As shown, the electric sector GHG emissions in 1990 was 108 MMT CO_2e. Reducing this amount by 40 percent creates a target of around 64 MMT CO_2e, if estimating a proportionate reduction.

CARB's range of 30-53 MMT CO_2e for the electric utility sector is a 51% to 72% reduction, in excess of the sector's pro-rata share of the 40% reduction target. The two other major sectors in the market are the industrial and transportation sectors. In the Scoping Plan, CARB estimates the industrial sector can reduce GHG emissions between 8% and 15%, while the transportation sector can reduce GHG emissions between 27% and 32%. Much of the transportation sector's carbon burden will be shifted to the electricity sector via transportation electrification, which was not calculated in the Scoping Plan. This means the electricity sector's GHG emissions reduction burden will be even greater than it appears.

Although the electricity sector will exceed its pro-rata share to meet the overall target, as shown by the grey area in Figure 7, there is still an overall annual gap of 34 to 79 MMT CO_2e. This is where the Cap and Trade market creates an economic incentive for organizations to reduce additional emissions- if they can do so- to sell unneeded allowances for a net economic gain. This transition from prescriptive targets to Cap and Trade arises because there are less allowances than carbon produced. It appears this transition to market based changes will take place about 2023.

11 Source: California's 2017 Climate Change Scoping Plan, November 2017, California Air Resources Board, page 31

	1990	2030 Scoping Plan Ranges	% Change from 1990
Agriculture	26	24-25	-8 to -4
Residential and Commercial	44	38-40	-14 to -9
Electric Power	108	30-53	-72 to -51
High GWP	3	8-11	267 to 367
Industrial	98	83-90	-15 to -8
Recycling and Waste	7	8-9	14 to 29**
Transportation (Including TCU)	152	103-111	-32 to -27
Natural Working Lands Net Sink*	-7***	TBD	TBD
Sub Total	431	294-339	-32 to -21
Cap-and-Trade Program	n/a	34-79	n/a
Total	431	260	-40

* Work is underway through 2017 to estimate the range of potential sequestration benefits from the natural and working lands sector.

** The SLCP will reduce emissions in this sector by 40 percent from 2013 levels. However, the 2030 levels are still higher that the 1990 levels as emissions in this sector have grown between 1990 and 2013

*** This number reflects bet results and is different that the intervention targets discussed in Chapter 4.

Figure 8 - 2017 CARB Scoping Plan Reductions by Sector

The utility industry is expected to surpass its emission reduction share due primarily to the 50% RPS goal, and aggressive energy efficiency achievements. SB 350 requires that POU IRPs not only describe how they will meet their 2030 50% RPS target, but also how they will contribute to the electricity sector's share of GHG emissions reductions by 2030.[12] For benchmarking in this IRP and portfolio analysis, Roseville used the 53 MMT CO_2e figure as its 2030 target. These goals are for planning purposes and not compulsory; however, if changes to the regulations occur, Roseville will reflect those updates in its future resource planning efforts.

12 PU Code 9621(b): On or before January 1, 2019, the governing board of a local publicly owned electric utility shall adopt an integrated resource plan and a process for updating the plan at least once every five years to ensure the utility achieves all of the following: (1) Meets the greenhouse gas emissions reduction targets established by the State Air Resources Board, in coordination with the commission and the Energy Commission, for the electricity sector and each local publicly-owned electric utility that reflect the electricity sector's percentage in achieving the economy-wide greenhouse gas emissions reductions of 40 percent from 1990 levels by 2030. (2) Ensures procurement of at least 50 percent eligible renewable energy resources by 2030 consistent with Article 16 (commencing with Section 399.11) of Chapter 2.3.

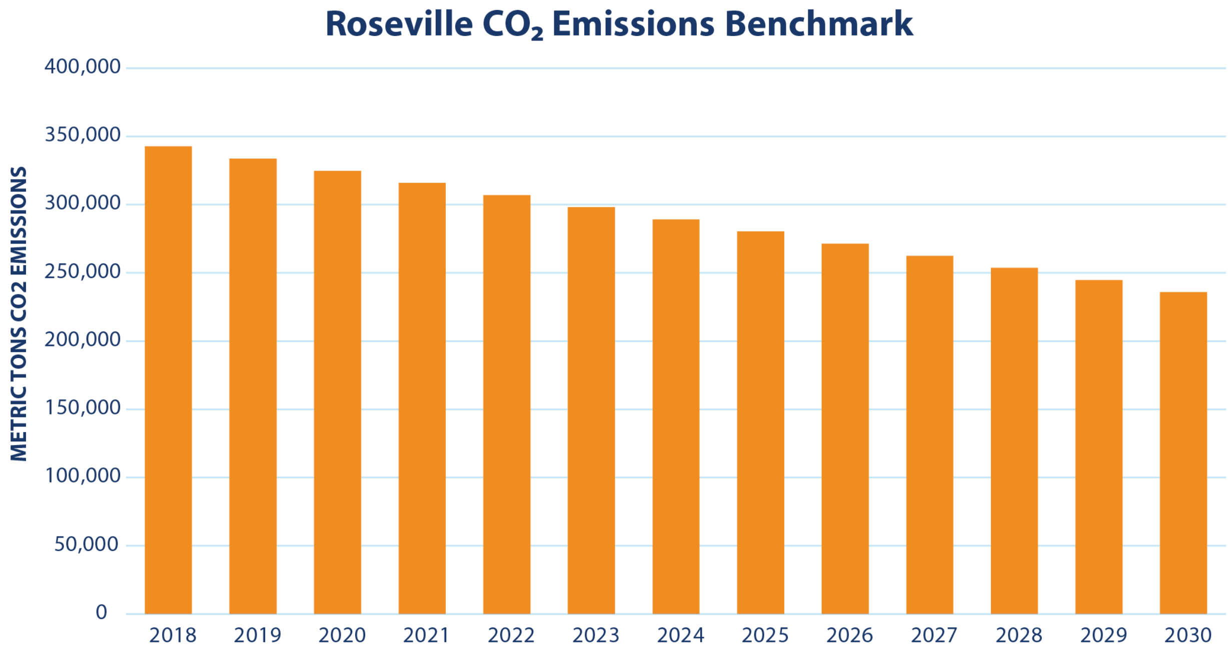


Figure 9 - Roseville Aspirational Share of MMT CO_2e Reduction Goal

Roseville's aspirational share of pro-rata GHG emissions reduction in Figure 9 is shown for illustrative and planning purposes, and not an enforceable target mandated by regulation or legislation. Mandatory RPS targets and the economic incentives of the Cap and Trade market mechanism are expected to ensure these aspirational goals are met.

2.6.2 Building Standards

California has continually increased the energy efficiency of new construction and appliances since the Warren Alquist Act of 1974. These efficiency standards (Title 24[13]) were updated to mandate Zero Net Energy (ZNE) residential new construction starting in 2020. ZNE homes require energy efficiency that will be achieved through implementing a high efficiency envelope (insulation, windows, etc.), and efficient Heating, Ventilation, and Air Conditioning (HVAC) units. The remaining energy consumption must be offset by distributed generation, predominantly rooftop solar generation, sized so that the annual building consumption (excluding natural gas) is approximately equal to building's electricity generation. Effective in 2030, all commercial new construction will also be required to meet the ZNE standard.

2.6.3 SB 338

SB 338[14] requires POUs to consider the role of distributed energy resources in meeting peak demand.[15] SB 338 further requires Council to consider distribution level, carbon-free resources such as demand response, energy efficiency, and energy storage to reduce the need for transmission level generation resources. Roseville's IRP meets the requirements of SB 338.

13 http://www.energy.ca.gov/title24/

14 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB338

15 PU Code 9621(c): In furtherance of the requirements of subdivision (b), the governing board of a local publicly owned electric utility shall consider the role of existing renewable generation, grid operational efficiencies, energy storage, and distributed energy resources, including energy efficiency, in helping to ensure each utility meets energy needs and reliability needs in hours to encompass the hour of peak demand of electricity, excluding demand met by variable renewable generation directly connected to a California balancing authority, as defined in Section 399.12, while reducing the need for new electricity generation resources and new transmission resources in achieving the state's energy goals at the least cost to customers.

2.6.4 Regulatory Uncertainty

Utilities currently face an unprecedented degree of legislative and regulatory change and uncertainty. This IRP, using the best information currently available, will chart a path leveraging proven technologies, including evaluation of pilot investments in promising experimental technologies, to ensure a "least regrets" path forward for Roseville while meeting its regulatory mandates and maintaining safe, affordable, and reliable service.

2.7 Reliability Challenges

California's resource mix has changed considerably as a result of its ambitious renewable mandates and the rapidly declining costs of solar and wind resources. The shift to renewables has led to lower market prices for energy at certain times of the day, but has changed the daily load shape which traditionally had a single peak lasting a couple hours each day. The changing load shape means new resources will be needed, and existing resources will need to be used differently, while maintaining affordability for customers.

2.7.1 Load and Resource Adequacy

Solar and wind resources are categorized as intermittent resources, where energy output is a function of fuel availability (e.g. wind and sunlight). Also, distributed generation (DG), such as customer rooftop solar, further contribute to intermittency on the system. Integral to successfully accommodating intermittent resources is providing sufficient resources to maintain capacity to follow this new demand profile, referred to as net load. Net load is electricity consumption minus wind and solar (both DG and utility-scale). Like load, intermittent resources must be followed with dispatchable supply. Recent resource additions for RPS compliance are largely solar, which is introducing a surplus of energy supply in the daytime hours. The challenges of net load are exacerbated in the spring and fall when renewable resources maintain higher levels of output and customer loads are at seasonal lows.

Figure 10 is a visual representation of the difference in load vs net load, highlighted by the orange area. This is commonly referred to in the industry as the "duck curve."

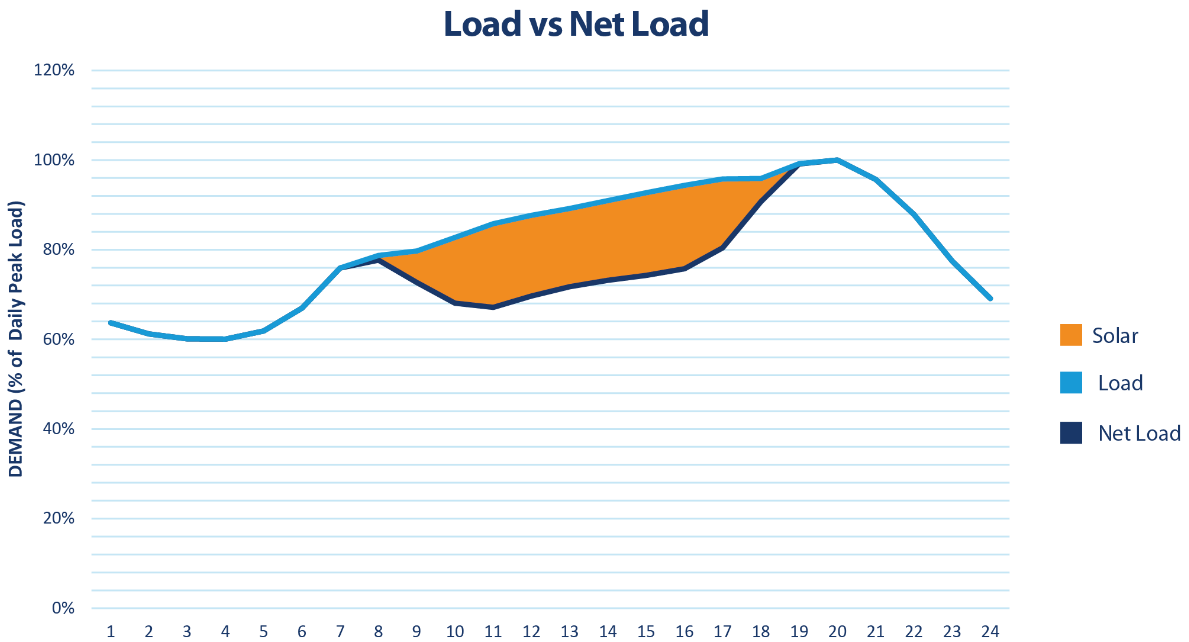


Figure 10 - Load vs Net Load

As seen in Figure 10, solar contributes to meeting load in the middle of the day, quickly ramping down while load is still at or near daily peak. For reliability, this creates the added capacity challenge of being able to meet the ramp, in addition to meeting peak demand. The resource fleet must be able to ramp down in the morning to accommodate solar generation, then ramp back up to meet peak demand needs as solar generation rapidly diminishes with the setting sun.

Figure 10 is an example of an hourly look at a cloudless, sunny day where actual output performed to expectation. Considering changing weather conditions can impact fuel availability (sunlight), solar output can be highly uncertain. Along with the duck curve hour-to-hour impacts, wind and solar output is highly variable minute-to-minute. Reliability will become more challenging as more intermittent wind and solar resources are connected to the grid, and more flexibility is needed to follow net load. Figure 11 below shows actual five-minute output from one of Roseville's solar plants on September 4, 2017:

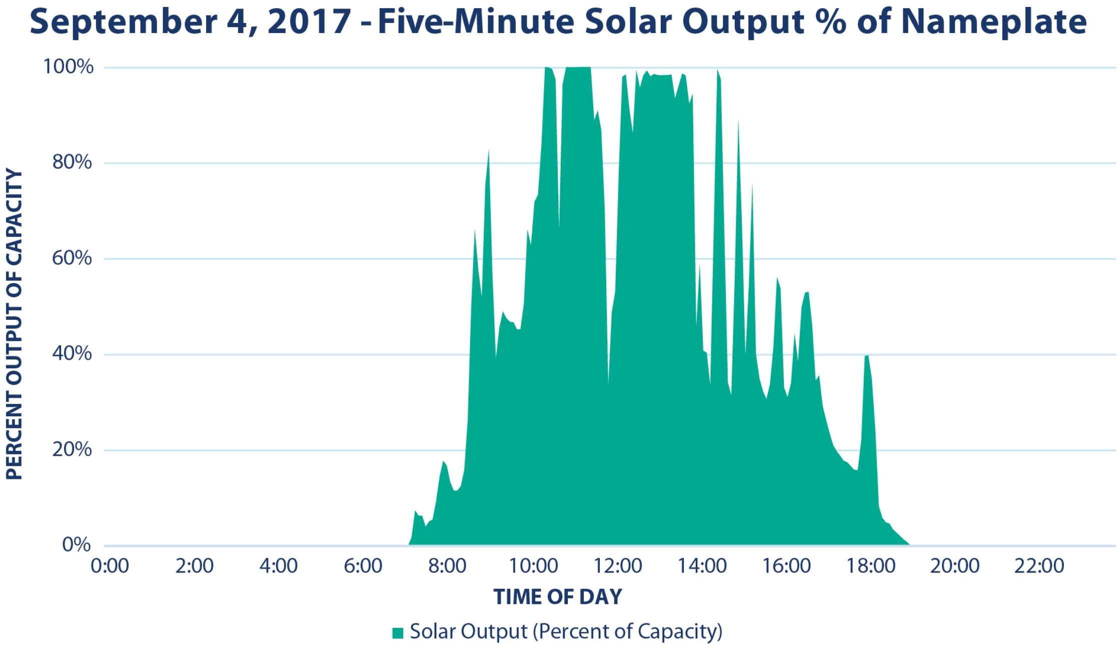


Figure 11 - Solar Variability

This profile is of a single resource, but representative of the short-term swings in generation that can be expected from this intermittent share of the grid's generation fleet, which is increasing significantly over time.

Similar to the growth in utility-scale solar additions, solar retrofits and new construction capacity installations have increased considerably in California. Roseville is no exception to the draw of customer investments in roof-top solar. Along with the retrofit market, ZNE post 2020 will bring considerable amount of solar as residential construction grows. Roseville anticipates an additional 30 MW from ZNE alone from 2020-2030. Adding the retrofit adoption forecast for both commercial and residential on top of the existing 14.35 MW of installed DG, Roseville forecasts high levels of cumulative DG solar installations by 2030, which will be a key driver in this IRP.

Thus, the IRP will investigate capacity needs through 2030 based on three categories:

1. Peak – Monthly peak load
2. Ramp – Largest 3-hour net load ramp by season
3. Flex – Load following reserve to meet five-minute energy imbalance

As load has evolved, so have resource adequacy needs. Thus, integrating renewables requires flexibility in the form of additional capacity that can handle future ramping and intermittency needs. Figure 12 summarizes Roseville's definition for resource adequacy sufficiency for each of the three defined capacity needs.

Capacity Need	Description	Resource Sufficiency Test
Peak	Monthly peak load need	Maintain sufficient resources and contracts to meet forecasted peak plus 15% planning reserve margin
Ramp	3-hour net load ramping need by season	Maintain sufficient resources and contracts to meet forecasted maximum 3-hour net load seasonally
Flex	Energy imbalance and regulation needs	Maintain sufficient resources and contracts to meet forecasted energy imbalance and regulation requirements

Figure 12 - Resource Adequacy metrics for IRP

2.7.2 Cost Stability

Critical to the balance of complying with state regulations while maintaining grid reliability is answering the question, "What is the cost to customers?" This IRP will evaluate portfolio scenarios and present the costs of the Preferred Plan. Portfolio scenarios will evaluate RPS compliance options and quantify reliability costs to determine an optimal resource mix and strategy for keeping customer rates competitive and stable.

Beyond costs, Roseville will evaluate a rate structure which aligns customer rates with costs to serve those customers' energy needs. Time-of-day generation is impacting wholesale market prices and will continue to change time-of-day pricing. The successful implementation of AMI will enable Roseville Electric to tailor programs, providing transparent price signals to benefit customers and the distribution system. As such, evaluation of rate incentives aligning with grid and supply conditions will be critical to success.

2.8 Other Challenges and IRP Considerations

Roseville Electric's 2018 IRP will address several other challenges throughout the report. These challenges arise from rapidly evolving state energy policies and include:

- Energy and Capacity Markets
    - Increasing RPS requirements will see more frequent instances of over-generation and depressed midday pricing.
    - Traditional energy price hedging instruments are becoming less effective at mitigating price risk, and may become less liquid as fewer counterparties are willing to make markets.
    - Additional intermittency will add volatility in real-time markets, and may require CAISO to add more segments to the day-ahead markets, like the recent Federal Energy Regulatory Commission (FERC) Order 764 implementation that added a fifteen-minute market (FMM) and five-minute settlement intervals.
    - Resource adequacy has been in an ongoing evolution to ensure the market has appropriate resources to meet the challenges of a rapidly changing generation fleet. Traditional dispatchable resources are facing challenges from lower market prices, higher operating costs, and emission regulations.
    - Changing rules to incentivize/dis-incentivize certain types of capacity and flexibility can have significant impacts on the capacity market.

- The natural gas market is long on supply, and prices and forecasted market volatility are low over the study period. Still, regional impacts, particularly in California (e.g. Aliso Canyon), may have basis impacts and resulting price volatility for Roseville's natural gas supply.
- Roseville has realized a significant increase in the cost to transport gas on PG&E's distribution system. This has had significant impacts on the utilization of efficient gas-fired generation in Northern California, and is a cost that cannot be hedged.

- Legislation and Regulation
  - The recent extension of the Cap and Trade market out to 2030 codified by AB 398 has several details that are yet to be defined by CARB.
  - Cap and Trade allowance pricing has traded near the floor for some time, but potential future changes to Cap and Trade regulations may tighten the market and cause allowances to become costly.
  - The California legislature is attempting to lay the groundwork to expand the CAISO into other states in the Western Interconnection, primarily to integrate renewables.
  - Uncertainty with the regional market structure, particularly transmission cost impacts, is a key risk to Roseville.
  - Doubling energy efficiency was codified in SB 350. The uncertainty here is the amount of control utilities like Roseville have in meeting this goal, as EE requires effective utility programs and customer adoption.
  - Legislative uncertainty makes long-term decision-making on new investments challenging for municipal utilities. Capital investments are made with thirty year time horizons to realize the projects' benefits. However, with regulations changing every few years, the risk is high for costly stranded investments.
  - Transportation electrification (TE) is paramount to successfully achieving the emission reduction goals of SB 32. Yet, there is no clearly defined formula for utilities to successfully promote TE. Increased load from TE may result in an uncovered GHG emission liability for utilities.
- Distribution Reliability
  - The grid was designed for uni-directional flow from generation to load. Increases in distributed generation have created a bi-directional network where reverse flow could stress or overload grid circuits.
  - Distribution planning has changed and will continue to change with the adoption of DG and EVs that may create clusters of high electricity demand in certain neighborhoods, challenging existing distribution circuits' ability to meet load at certain times of the day.

3 Existing Resources and System Description

A Balancing Authority Area (BAA) is an area in which electricity supply and demand/load is balanced. In California, the largest BAA is CAISO. BANC, which is short for Balancing Authority of Northern California, is a Joint Powers Authority consisting of the Sacramento Municipal Utility District ("SMUD"), Modesto Irrigation District, the City of Roseville, the City of Redding, the City of Shasta Lake, and the Trinity Public Utility District. BANC became operational on May 1, 2011. With a peak electricity demand of around 5,000 MW, BANC is the third largest balancing authority in California, serving 763,000 retail customers, and includes more than 1,700 miles of high voltage transmission lines. BANC's footprint currently extends from the Oregon border to Modesto and from Sacramento to the Sierra and includes the Western Area Power Administration (WAPA) transmission grid and the U.S. Bureau of Reclamations' generation resources in California. BANC includes the California-Oregon Transmission Project (COTP), as well as the systems of its members. The City of Roseville is about 7% of the total BANC member load.

WAPA operates as a contract-based sub-balancing authority within the BANC BAA. BAA responsibilities and costs are divided between BANC and WAPA passes their share of responsibilities and costs to their customers, including Roseville.

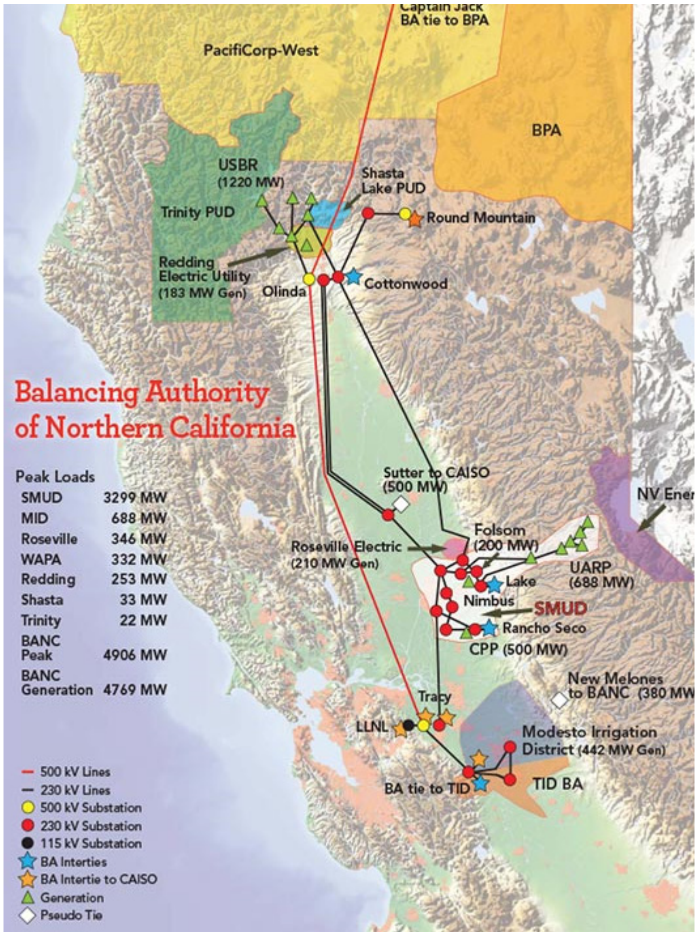


Figure 13[16] - BANC

3.1 Transmission Assets

Roseville does not own bulk electric system transmission (high voltage lines above 60kV). However, Roseville does have contractual rights to use high voltage transmission owned by WAPA, by the Transmission Agency of Northern California, and regularly procures short-term firm and non-firm transmission access to deliver generation to serve Roseville's load.

3.1.1 WAPA Network Integrated Transmission Service

Roseville's electrical system interconnects with the transmission system of WAPA. The WAPA transmission system is part of the BANC BAA and interconnects with the CAISO BAA. Roseville imports all of its electricity needs not met by internal generation over the WAPA transmission system through the Network Integrated Transmission Service (NITS) agreement. Roseville contracts for transmission service to meet its load under a NITS contract that expires on December 31, 2024. This contract provides for imports of electricity from various delivery points into the Roseville electric system. Roseville pays a proportionate load ratio share of WAPA's cost for operating and maintaining the system. Since 2012, the transmission rate has averaged $2.12/MWh.

16 www.thebanc.org

3.1.2 California Oregon Transmission Project

Fourteen Northern California cities and districts and one rural electric cooperative, including Roseville, are members or associate members of a California joint powers agency known as the Transmission Agency of Northern California (TANC). TANC, together with the City of Vernon, California, WAPA, two California water districts and Pacific Gas and Electric (PG&E) (collectively, the COTP Participants) own the COTP, a 339-mile long, 1,600 MW, 500 kV transmission power project between Southern Oregon and Central California. Roseville is entitled to 2.313% of TANC's share of COTP transfer capability (approximately 29.35 MW). In return, Roseville has agreed to pay 2.295% of the construction costs of the COTP, including debt service, and 2.313% of TANC's COTP operating and maintenance expenses. The City's share of annual debt service continues to the year 2039.

3.1.3 Elverta Transmission Right

Roseville's Interconnection Agreement with WAPA grants Roseville the right of 300 MW of transmission (import or export) through the Elverta 230 kV transformer. This is in recognition of Roseville's partial funding of the Roseville-Elverta transmission line under a predecessor agreement.

3.2 Power Supply

Roseville's generation supply is either owned by Roseville or purchased under bilateral or joint powers agreements. Roseville's owned generation, the Roseville Energy Park (REP) and Roseville Power Plant #2 (RPP2), are interconnected to its distribution system, providing energy as well as local and system reliability support. Also, Roseville is a participant in several generation projects which are licensed and operated by the Northern California Power Agency (NCPA) through joint powers agreements. These projects are jointly owned by NCPA members and include various projects located in the CAISO BAA.

In total, Roseville has approximately 300 MW of generating resources and long-term contracts. Remaining needs are purchased from the market bilaterally on a forward basis.

The power supply portfolio resources are located in both BANC and CAISO BAAs. These resources include:

- Thermal generation – Combined cycle and peaking
- Renewable generation – Geothermal, wind, solar, biomass/bio-waste, and small hydroelectric
- Large hydroelectric generation – Non-renewable carbon-free generation
- Market Purchases – Energy transactions for energy and capacity

3.2.1 Thermal Generation

Roseville owns and operates a combined cycle power plant, and two peaking units within the City, and has contract rights to a peaking unit owned and operated by NCPA that is located in the CAISO BAA.

3.2.1.1 Roseville Energy Park

The REP is owned and operated by Roseville Electric. REP is a Combined Cycle Generator Turbine (CCGT) capable of 120 MW base load, and up to 160 MW when duct fired. REP is a highly efficient natural gas plant with a 7,650 BTU/kWh optimal heat rate. The REP is comprised of two Siemens SGT 800 combustion turbine units and a Siemens STG 900 steam turbine. REP utilizes duct firing within the Heat Recovery Steam Generator. The plant has been in commercial operation since October 2007 and serves as an intermediate load resource for Roseville's power needs. REP is directly connected to Roseville's distribution system, which supports local reliability.

3.2.1.2 Roseville Power Plant 2

RRP2 consists of two simple cycle GE Frame-5 combustion turbines (CTs) that Roseville purchased from NCPA on September 1, 2010. On that date, Roseville took ownership of two of the five units in the NCPA Combustion Turbine No. 1 Project portfolio, in which Roseville had previously been a project participant. The CTs were purchased to provide local capacity and reserves for Roseville.

The two units each provide 24 MW of capacity for a total of 48 MW of capacity for the project. RPP2 is a 16,000 BTU/kWh heat rate plant. As such, the plant is primarily utilized as a peaking capacity resource, providing energy in times of peak load. RPP2 is constrained in the amount of hours it can run. The yearly cumulative combined-unit hours shall not exceed 900 hours and operations are limited to 25 combined-unit hours per day.

3.2.1.3 Combustion Turbine Project No. 2 (STIG)

NCPA Combustion Turbine Project No. 2 is a 49.9 MW steam injected natural gas turbine (STIG) generator located in Lodi, which is in the CAISO BAA. With rights to 36.5% of the output, Roseville receives 18.3 MW of capacity and varying amounts of energy annually from this project depending on natural gas and electric market prices.

The STIG operating range is from 35-49.9 MW, providing 14.9 MW of ramping capacity. Roseville's share of this results in approximately 6 MW of ramping capacity. The average plant heat rate is approximately 9,200 BTU/kWh. Additionally, STIG has a GHG allowance obligation which impacts the economics of its operations. Consequently, STIG primarily serves as a capacity resource and is dispatched against very high market prices.

3.2.2 Large Hydro Generation

Roseville has contract rights to large hydro generation for Central Valley Project (CVP) Base Resource power that is delivered by WAPA, and has contract rights to the Calaveras Hydroelectric project, an NCPA owned and operated resource that is located in the CAISO.

3.2.2.1 WAPA Base Resource Hydro

The CVP includes hydroelectric resources owned and operated by the United States Bureau of Reclamation (USBR). The majority of the project is considered large hydro, which are power plants with capacity rating greater than 30 MW and considered ineligible for California RPS compliance. WAPA markets the federal power, known as Base Resource, to qualifying agencies. Roseville is a Base Resource customer under the current contract from 2005 through 2024, and is currently entitled to 4.85333% of the CVP Base Resource output. In an average year, the Base Resource product provides Roseville with approximately 54 MW of capacity during peak summer months and 155 GWh of energy. The amount of capacity and energy supplied in a specific year depends on current year hydrology, carry over water storage conditions, environmental flow requirements, and energy consumption for CVP project uses such as water pumping.

Base Resource includes WAPA transmission service and is delivered at Roseville's Fiddyment substation. With the benefit of 4.85333% of the output of the project, Roseville pays 4.85333% of the Power Revenue Requirement (PRR). The PRR includes operations and maintenance (O&M) costs, capital repayment, and other costs for the operations of the CVP.

As party to the Base Resource contract, and in addition to the PRR, Roseville is required to pay 4.85333% of the power customer portion of the Restoration Fund obligation created by the Central Valley Project Improvement Act (CVPIA). The purpose of the CVPIA is to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California. Restoration charges are determined by the United States Bureau of Reclamation. The added cost of the Restoration Fund has raised significant concerns in the power community, which has borne disproportionate CVPIA costs.

3.2.2.2 Calaveras Hydro

NCPA's Calaveras project has total capacity of 252.8 MW. Roseville has a 12% share which provides 31 MW of capacity and 72 GWh of average-year energy. This project is located on the Stanislaus River in Calaveras County. The resources are interconnected to the CAISO BAA. The Calaveras project has two power plants- Collierville and New Spicer Meadow. Collierville is a 246 MW nameplate capacity plant and thus is classified as large hydro, making it ineligible as renewable resource under the California RPS. Roseville's share of Collierville is 29.6 MW. New Spicer Meadow is a small hydro plant eligible as a grandfathered renewable resource with a 6 MW nameplate capacity, of which Roseville receives 0.72 MW.

3.2.3 Renewable Generation

Roseville has a diverse renewable portfolio that includes geothermal, small hydro, solar, and wind. The resources are all contract resources, and are located within CAISO, or are firmed and shaped imports from out of state.

3.2.3.1 Geothermal Project

NCPA operates two geothermal plants in Sonoma and Lake Counties with a combined nameplate capacity of 165 MW. Roseville has purchased from NCPA, pursuant to power sales contracts, a 7.88% entitlement share in the NCPA Geothermal Project and is obligated to pay a like percentage of all of the debt service and operating costs. The plants have been experiencing declines in the steam field, which is gradually reducing both the capacity and energy from the project. Generation and capacity are both expected to decline at an approximate 2% annual rate. Currently, the total output of the both plants is about 101.3 MW, of which Roseville receives a total of about 9 MW of capacity and 61 GWh of energy annually in 2018, declining to 6 MW and 44 GWh in 2030. The capacity factor is about 85%. These plants are located in the CAISO BAA and Roseville can use this resource for exporting energy into BANC to meet Roseville's load. This resource is a qualifying renewable resource under the state's RPS standard.

3.2.3.2 Small Hydro Renewable Generation

While only 2% of the Calaveras project is eligible for California RPS compliance, the resource serves an important role in GHG reduction in Roseville's portfolio. Additionally, about 1% of CVP power is renewable eligible for generation off of Stampede, Nimbus, and Lewiston reservoirs. On average, small hydro-electric generation will contribute approximately 1% to the RPS energy needs out to 2030.

3.2.3.3 Long-term Renewable Power Purchase Agreements

In addition to the NCPA Geothermal projects and the portion of WAPA CVP qualifying renewables, Roseville has several contracts for renewable energy. These include contracts for geothermal, wind, biogas, and solar. Under its current retail sales forecast, Roseville has sufficient contracted RPS eligible energy for compliance through 2024. This IRP will demonstrate that Roseville Electric is well on the path to meet the 50% RPS by 2030 requirement.

3.2.4 Market Purchases for Capacity and Energy

Roseville utilizes market energy and capacity purchases to fill any forecasted deficits, or to take advantage of more economic energy opportunities. Roseville's portfolio approach includes utilization of the aforementioned 300 MW of owned and long-term contract resources, and mid-term firm energy purchases, and short-term market purchases for capacity and energy.

4 Load Forecast

Load forecasting is a foundational element of determining Roseville's future electricity needs. Roseville's long-term load forecast (Load Forecast) is necessary for long-term resource planning, rate design, and financial planning. Roseville employs advanced statistical techniques to develop accurate energy and peak demand forecasts to 2030.

4.1 Load Forecast Overview

Demand is the measurement of electricity usage at any given point in time. Historically, Roseville experiences its highest demand in the summer, when cooling demand (air conditioning utilization) is high. This highest demand period in time is referred to as peak demand. Demand (including peak) is measured in kilowatts (kW) or megawatts (MW), and is used in resource planning for capacity procurement needs. Energy is demand over time, or how many kW or MW are used over a certain amount of time. Energy is measured in kilowatt hours (kWh) or megawatt hours (MWh). The load forecast utilized for this IRP is a 2018 – 2030 forecast, including both peak demand and energy.

4.2 Load Forecast Methodology

Roseville applies a specific load forecasting methodology within each customer class, including the five outlined in Figure 14.

Class	Description
Residential	All residential customers
GS-1 Small General Service	Demand < 20 kW
GS-2 Medium General Service	20 kW < Demand <= 500 kW
GS-3 Large General Service	500 kW < Demand <= 1000kW
GS-4 Very Large General Service	Demand > 1000kW

Figure 14 - Rate Classes

Multivariate time series regression is used to forecast system energy, system peak demand, and retail energy sales to customer classes. Each of Roseville Electric's customer classes are forecasted using regression models and the individual results are used to forecast total energy and peak demand. Roseville's load forecasting team uses one of two approaches, depending on customer class: 1) Statistically Adjusted End-use (SAE) regression or 2) Econometric regression.

For residential, GS-1 and GS-2 customers, Roseville uses Itron's SAE model. The SAE model predicts end use assumptions for the main end uses driving energy demand such as heating and cooling saturation, efficiency, home size, appliances, and plug load, among several other end use variables. These variables utilize Energy Information Administration (EIA) energy assumptions for these various end uses.

Customers under GS-3 and GS-4 rate classes are forecasted using econometric regression models. The forecast uses historic growth combined with estimates of likely future growth from the City of Roseville Planning and Business Development Departments.

Since the previous IRP, Roseville has made significant changes to its load forecast prompted by growth in EVs and DG rooftop solar. Also, a significant contributor to the load forecast is the incorporation of Roseville's long-term EE targets into the end user assumptions. These demand-side impacts will be discussed in detail in sections 6.2 (EV), 6.1 (DG), and 5.1 (EE). Adjustments are made for future customers to reflect changes in EE, EV, and building standards.

4.3 Load Forecast Assumptions

4.3.1 Summary of Assumptions

Customer growth is a key driver of the load forecast. For the residential class, the near-term forecast includes the City of Roseville's Specific Plans, which account for new construction and customer demands. Additionally, Roseville specific population forecasts are used to develop forecasted residential customer counts. Figure 15 illustrates Roseville's historic and forecasted annual incremental customers (2009-2030).

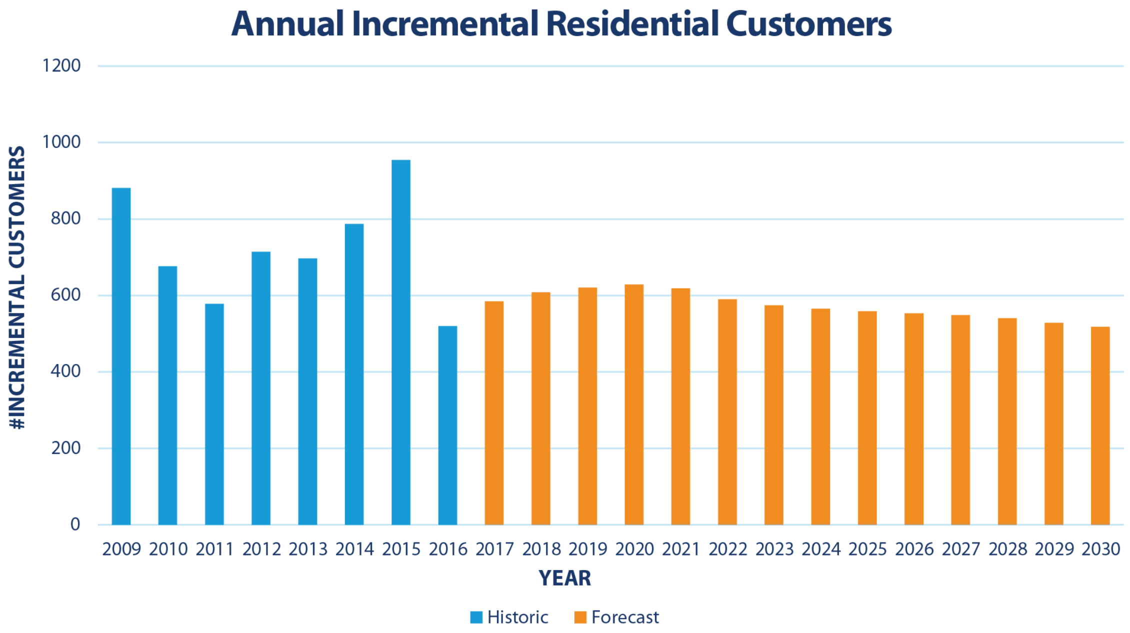


Figure 15 - Customer growth

The non-residential growth rate is based on a combination of internal expert knowledge of upcoming projects, external commercial development forecasts, and available land inventory. Customer additions have been forecasted using economic variables and allocations of square footage to commercial customer classes. There are several drivers in the creation of the load forecast.

Figure 16 summarizes the data sources used to develop the Load Forecast.

Data/Assumption	Definition
Historical Retail Sales	Historical billed sales to Roseville customers, in energy (MWh), after energy losses, energy efficiency, and onsite generation (e.g. rooftop solar).
Other Loads	Other loads include City "self" load, which is excluded from retail sales for the purposes of calculating the RPS obligation.
Interval Data	Random sample of medium commercial, small commercial, residential single-family, and residential multi-family classes that have meters that collect fifteen-minute interval data which is used to create an average profile for each type of customer class. All large and very large commercial classes have fifteen-minute interval meters.
Customer Growth	Data collected from Development Services Department and Economic Development Department, incorporating various City specific plans.
Demographics and End Use	Pacific Area residential and small commercial data inputs for energy assumptions[17]. Residential Appliance Saturation Study (RASS)[18] – PG&E study for Climate Zone 12 used to adjust certain EIA end use assumptions.
Economics	Unemployment data was taken from the State of California Economic Development Department. The forecasted unemployment takes into account the current City of Roseville unemployment rate and outside forecasts of unemployment.
Committed Energy Efficiency	SB 1037[19] annual reporting requirement of all committed EE programs.
Energy Efficiency	AB 2021 requirement, adopted by Roseville City Council in 2015.
Transportation Electrification (TE)	Forecasted TE aligned with Roseville's share of the CEC's 2017 mid-Integrated Energy Policy Report (IEPR) scenario.
Distributed Generation (DG)	Historical and forecasted behind the meter solar installations, both residential and commercial, including ZNE homes.

Figure 16 - Load forecast assumptions and sources

4.4 Load Forecast Results

In total, Roseville forecasts new customer growth of 0.4% annually. Roseville is growing, yet energy needs are declining. This is due in large part to forecast energy efficiency for both residential and commercial sectors, and the implementation of Zero Net Energy homes beginning in 2020. Figure 17 shows Roseville's retail sales energy forecast from 2018-2030, split between residential and non-residential classes.

17 https://www.eia.gov/outlooks/aeo/
18 http://www.energy.ca.gov/appliances/rass/
19 http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060SB1037

Figure 17 - Retail Sales Forecast

The added solar (detailed in section 6) contributes to energy reductions, while minimally contributing to peak demand reduction. This is illustrated in Figure 18.

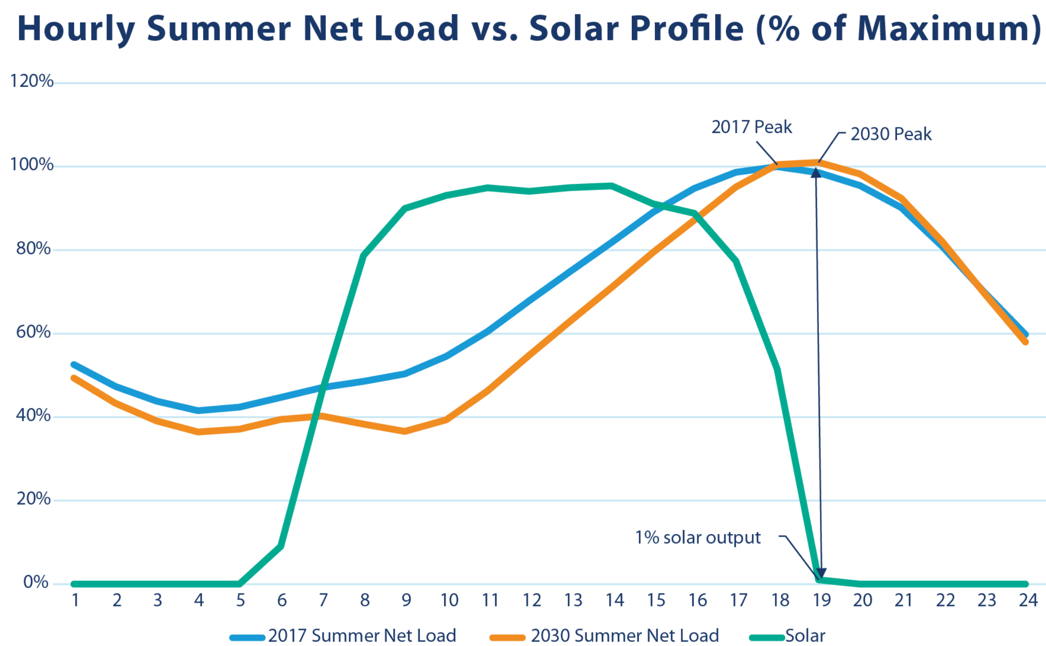


Figure 18 - Solar Coincident Load

Figure 18 contrasts the hourly net load shape of 2017, to the forecast 2030 net load shape. The average summer peak hour of 2017 and 2030 load are calculated as a percent of the 2017 peak. The summer net load shape is a composite of average summer load, combined with the solar shape provided by Roseville's utility-scale solar which has a better output profile due to its tracking capability. As more DG solar comes on Roseville's system, the average load shape will push the peak demand slightly later into the evening (5-6 PM in 2017, and 6-7 PM in 2030). The arrow illustrates the minimal contribution of solar energy towards meeting the peak demand needs, outputting at just 1% while system demand is high. This results in a reduction of overall energy needs, while the need for peak capacity increases.

Roseville's 1-in-2 peak demand and retail energy sales forecasts for 2018-2030 is shown in Figure 19. This peak demand forecast is used as the benchmark for peak resource adequacy sufficiency in Section 9 of this IRP.

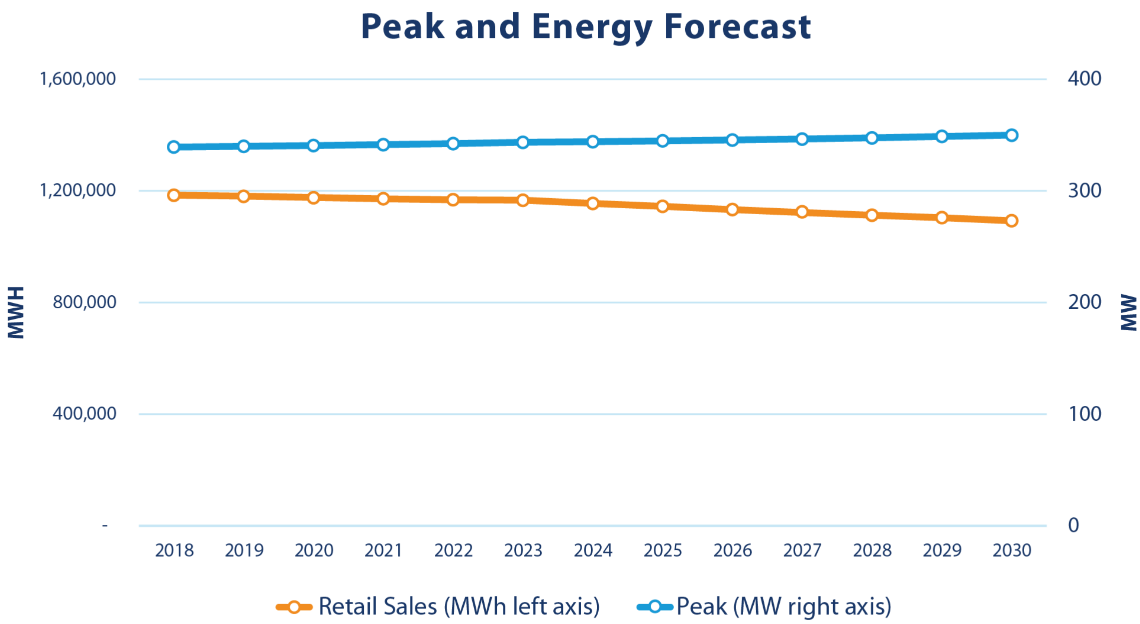


Figure 19 - Peak Demand and Retail Energy Sales Forecast

4.5 Demand Forecast-Other Regions

Electric demand in the Western Electricity Coordinating Council (WECC) fundamental electric market model is based on the electricity demand forecast developed by the CEC's 2016 Integrated Energy Policy Report (IEPR). The planning areas included in this report are in California and FERC 714 filings for WECC BAAs for the modeled zones outside of California. The California Energy Demand Updated Forecast for 2017-2027 in the 2016 IEPR filing contains projections for electricity consumption, sales, and peak demand for each of eight electricity planning areas and for the state as a whole. The forecast includes the mid-energy demand case that was used for the base case scenario for this study. Estimates of additional achievable energy efficiency (AAEE) at the mid-level were used in this analysis.

5 Energy Efficiency and Demand Response Resources

5.1 Energy Efficiency

As recently as 2015, California was ranked 49th in the nation for per capita energy consumption.[20] This is due in part to California's long-standing energy efficiency policy. In its 2003 Energy Action Plan, California's energy agencies established a "loading order" prioritizing conservation and energy efficiency, followed by renewable energy and distributed generation, and finally clean, fossil fuel, central-station generation as an interim resource. [21]

Roseville prioritizes EE, and is continuously analyzing its program offerings, and their cost effectiveness. Roseville's goal is to design and deliver programs that offer a range of cost effective EE measures that benefit Roseville's customers, contribute towards achieving EE goals, and educate customers on emerging technologies.

Two measurements of EE include:

- Committed Energy Efficiency (Committed EE): Committed 10 year potential EE from programs that have been, or are proposed to be, implemented by end-use customers.
- Additional Achievable Energy Efficiency (AAEE): Future potential savings from EE programs that are incremental to Committed EE and include savings from future updates of building codes, appliance standards, or new utility programs not modeled in the utility's 10 year potential study targets in 2016.[22]

5.1.1 Committed Energy Efficiency

SB 1037 (Kehoe, 2005) requires Roseville to report annual energy efficiency savings to its customers, and the CEC.[23] Figure 20 illustrates Roseville's actual annual EE savings by Roseville's customers from 2013-2017.

20 https://www.eia.gov/state/?sid=CA
21 http://www.energy.ca.gov/energy_action_plan/2003-05-08_ACTION_PLAN.PDF, Page 4. 2003.
22 Public Utility Potential Study Modeling performed by Navigant Consulting Inc. in 2016
23 "PU Code 9615(b) Each local publicly owned electric utility shall report annually to its customers and to the State Energy Resources Conservation and Development Commission, its investment in energy efficiency and demand reduction programs. A report shall contain a description of programs, expenditures, and expected and actual energy savings results."

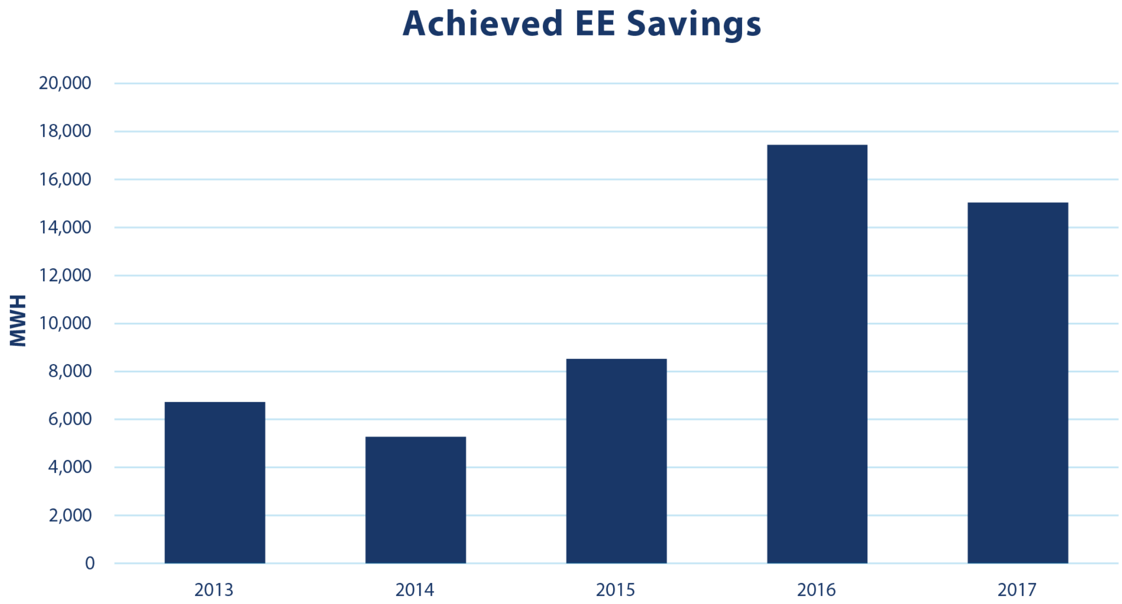


Figure 20[24] - Achieved Annual EE Savings

These EE savings resulted from Roseville's various EE programs[25] including:

- Residential Home Energy Reports: An industry-recognized, contractor-managed energy efficiency behavior program providing education, feedback and tips to residential customers.
- Residential Heating Ventilation and Air Conditioning (HVAC): Rebates to install higher efficiency HVAC systems upon retrofit.
- Residential Shade Trees: Rebate program designed to educate customers and promote the planting of drought-tolerant shade trees to cool their homes.
- Residential Pool Pump: Rebate program designed to help offset customer costs to upgrade from a single speed pool pump to a variable speed pool pump.
- Residential Sunscreens: Rebate program designed to incentivize customers to install permanent sunscreens on their windows to keep their home cool.
- Residential New Construction: The Roseville Advanced Home Program (RAHP) is designed to assist builders in achieving the State of California's goal of net zero energy homes by 2020 and beyond. The program is aligned with the larger California Advanced Home Program (CAHP) endorsed by the California Public Utilities Commission. RAHP provides a financial incentive to builders that exceed current building codes (Title 24) through energy efficient designs.
- Residential LED Lighting: Upstream, vendor-managed program providing discounted LED lamps through local retail outlets in Roseville.

24 http://www.ncpa.com/policy/reports/energy-efficiency/
25 As listed in Roseville's annual 1037 report

- Commercial LED and Other Lighting: Offers business customers a wide variety of energy efficient, interior and exterior LED lighting retrofits and control options for updating their facilities.
- Commercial Food Service Equipment: Program provides rebates to commercial restaurants to install energy efficient electric food service equipment listed on the PG&E food technology website.
- Commercial HVAC: Includes package and split system retrofits along with several measures to reduce heat gain in the facility, including shade trees, window film, and variable-frequency drive and variable-speed motor retrofits to existing HVAC supply and return fans.
- Commercial New Construction: Program that is based on current Title 24 requirements. The designed structure must exceed Title 24 specifications by at least 10%. The rebate is based on the kW reduced in the design.
- Commercial Custom: Customer driven rebate; targets projects that reduce peak loads and energy consumption, and offers unlimited energy efficiency technology opportunities for large and key account customers.

Figure 21 shows the EE achieved by program category from 2013-2017.

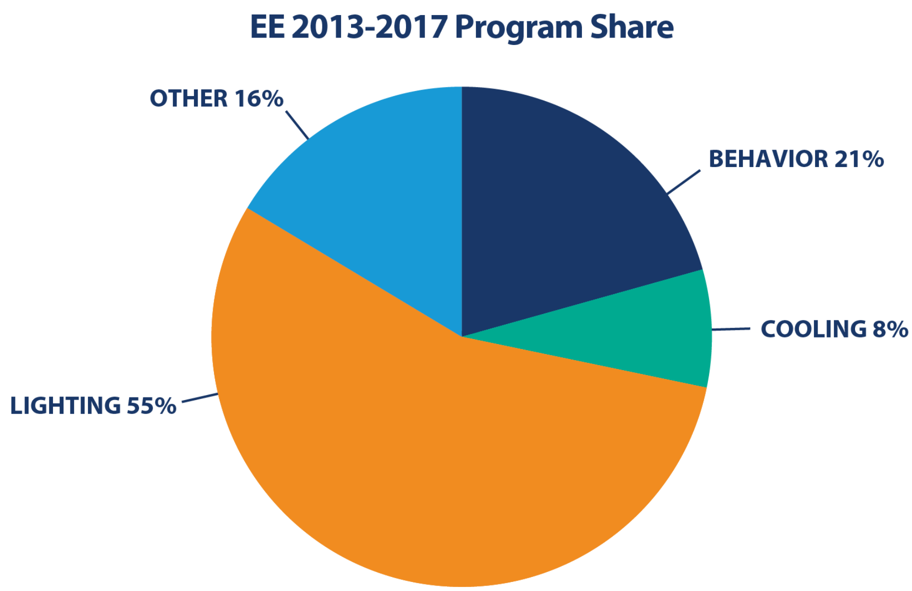


Figure 21 - EE Achieved By Program Category - 2013-2017

5.1.2 EE Potential Targets

AB 2021 (Levine, 2006) requires the CEC to consult with the CPUC and POUs, such as Roseville, in developing a statewide estimate of potential achievable energy efficiency savings as well as statewide annual targets for energy efficiency savings and demand reduction over 10 years.[26] AB 2227 (Bradford, 2012) updated the reporting frequency of the 10 year potential study to every 4 years, aligning with the CEC's biennial IEPR.[27]

Most recently, SB 350 (De Leon, 2015) required California to "double the energy efficiency savings in electricity"[28] by 2030.

26 http://www.energy.ca.gov/sb1/meetings/ab_2021_bill_20060929_chaptered.pdf
27 PU Code 9505(b). See also: http://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201120120AB2227
28 https://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201520160SB350

On March 15, 2017 and prior to the passage of SB 350, Roseville's City Council adopted Roseville's current 10 year AB 2021 energy efficiency targets. These targets are Roseville's annual potential energy efficiency savings for 10 years, as modeled in 2016, and are included in the SB 350 forecast as "committed" EE savings on a cumulative basis. Roseville anticipates these targets will be achieved through the continuation of programs described in the previous section, expansion of the residential behavioral program to all residents, new measures such as smart thermostats, and a city-wide LED street-lighting retrofit project. Figure 22 is a graphic from the study, illustrating: 1) the potential 2018-2027 incremental savings for the residential and non-residential sectors, and 2) the percent of forecasted retail sales reduction in each year.[29]

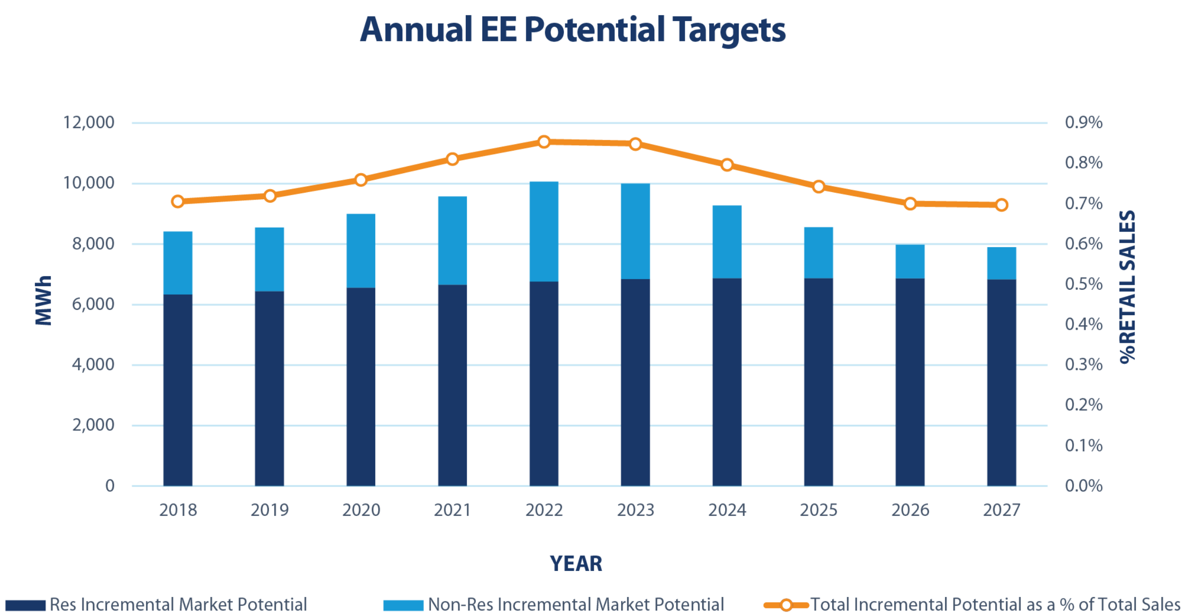


Figure 22 - Annual EE Potential Targets

The findings for Roseville include:

- A 10-year (2018-2027) average annual target of 0.76%/year of forecasted retail sales
- Roseville did not include energy savings from codes & standards in the 2016 potential study.
- The potential study is a 10 year forecast for EE savings. Public utilities report actual achieved energy efficiency in the annual 1037 report.

5.2 Demand Response

Roseville employs a demand response (DR), air conditioning (AC) cycling program which enrolls 3,700 customers with AC switches. This program provides Roseville with approximately 2.1 MW of interruptible load and is only utilized as a resource of last resort during critical load events. One topic of interest in this IRP is the potential for future expansion of Roseville's demand response portfolio, leveraging the latest technology to increase DR capacity and achieve energy efficiency goals.

Roseville is currently exploring options to update and expand its DR program, which is discussed in Section 9.

29 Public Utility Potential Study Modeling performed by Navigant Consulting Inc. in 2016.

6 Distributed Energy Resources

Roseville, like the rest of California, has seen a surge in customer installed distributed energy resources (DER) that are predominately rooftop solar, but also includes transportation electrification.

6.1 Distributed Generation

As of 2017, Roseville customers have installed approximately 14.35 MW of solar rooftop capacity "behind the meter", also referred to as distributed solar, rooftop PV, or customer sited solar. In the past 10 years, Roseville has provided more than $10 million in rebates for solar. This amount includes rebates to support Roseville Electric's BEST Homes program. Roseville Electric's BEST Homes program is part of the comprehensive statewide solar program created by SB 1[30] and the California Solar Initiative[31]. Qualifying new construction residential dwelling units are eligible for rebates from Roseville Electric, provided all program requirements are met. All homes in the BEST Homes program must achieve energy efficiency levels substantially greater than the requirements of the current California Building Energy Efficiency Standards, known as Title 24[32].

In addition, Roseville has informed its residential and business customers of their solar energy options through its "Your Trusted Solar Advisor" program[33]. This program provides customers with comprehensive information to support their rooftop solar decision including the general process, permitting and interconnections.

Behind the meter solar is a key driver in not only Roseville's load forecast, but also other system impacts discussed later in this IRP. Roseville has approximately 3,400 residential customers with rooftop solar, nearly 6% of all Roseville residents. Approximately 40 commercial customers also have systems ranging from 3 kW to 990 kW.

While Roseville has seen rapid growth from 2013 to 2016, 2017 saw considerable declines in rooftop solar installations. Figure 23 illustrates the number of annual residential solar installations (right axis) and the amount of capacity (in kW, left axis).

30 https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB1
31 http://www.gosolarcalifornia.ca.gov/csi/index.php
32 http://www.energy.ca.gov/title24/
33 https://www.roseville.ca.us/cms/One.aspx?portalId=7964922&pageId=8893146

Residential PV Systems and Capacity

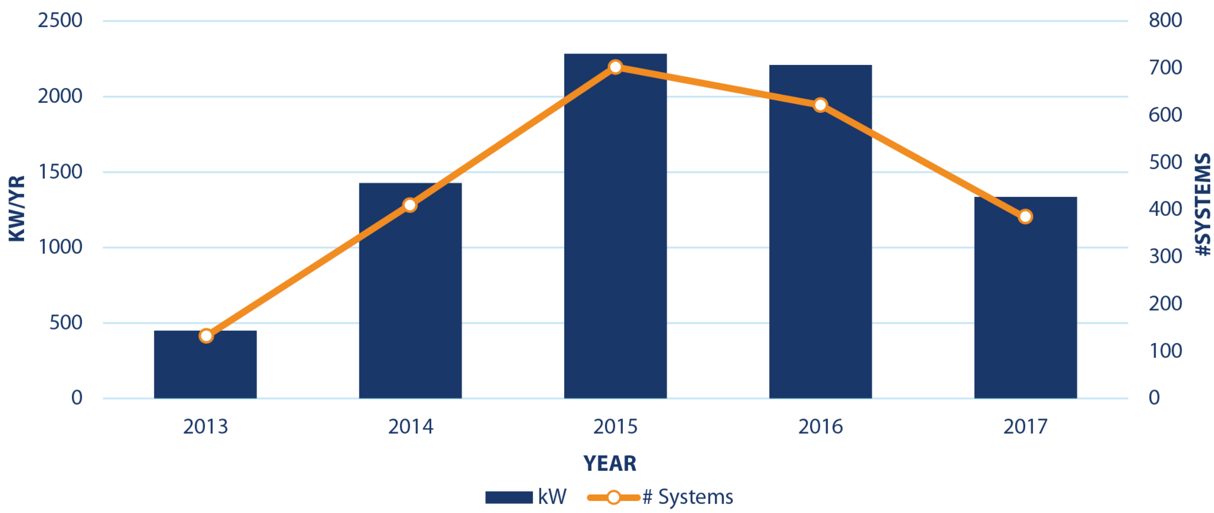


Figure 23 - Historic Residential Solar PV System Installations in Roseville

Commercial installations have historically been erratic year to year due to fewer, yet larger installations compared to residential. From 2013 through 2017, annual installations have ranged from 2 to 23. While the number of installations is low, the capacity per installation varies widely depending on the size of the customer's facilities. For example, in 2015, one of Roseville's larger customers installed 990 kW of solar in a single interconnection. In contrast, the average home installation is 2 to 3 kW. Figure 24 is Roseville's 5 year history of annual commercial solar installations (right axis) and the amount of capacity (in kW, left axis).

Commercial PV Systems and Capacity

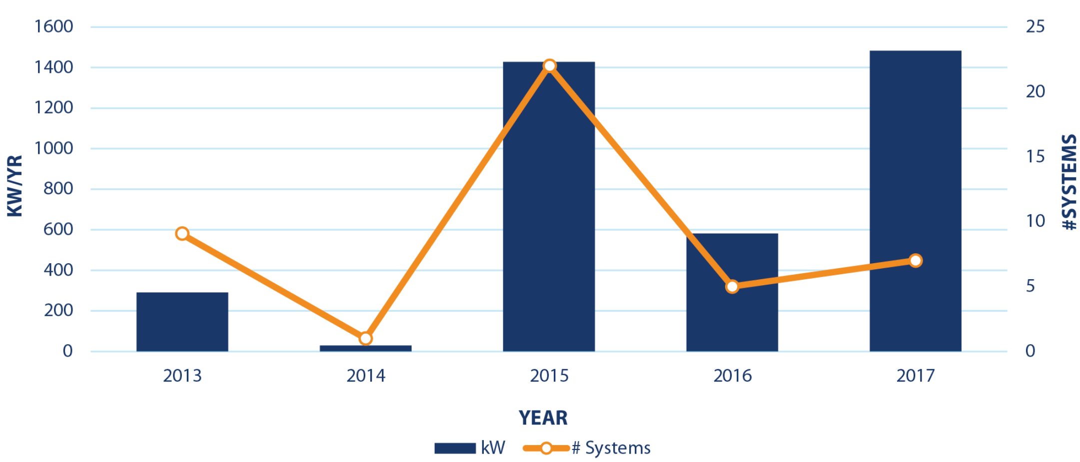


Figure 24 - Historic Commercial Solar PV System Installations in Roseville

Roseville developed a long-term forecast of distributed PV on system using this historical data for forecasted commercial and residential retrofits, and new construction installations due to ZNE. Figure 25 illustrates the resulting analysis and forecasted commercial and residential installations in incremental MW per year on Roseville's distribution system (stacked bars measured by left axis) and the cumulative installations (dotted line measured by right axis).

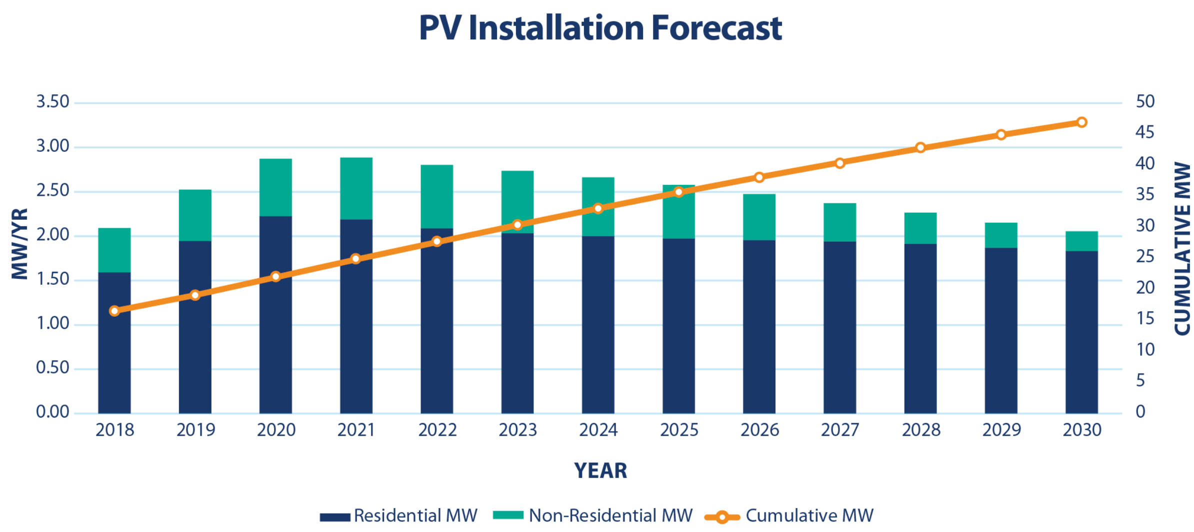


Figure 25 - PV Forecast

6.2 Transportation Electrification

Electrification of the transportation system is a key element of California's GHG reduction efforts. CARB's 2017 Scoping Plan provides a framework for sectors to achieve California's GHG reduction targets. While the transportation industry, as seen in Figure 26 is the largest source of GHG emissions, success in transitioning to zero emission forms of transportation is dependent on the electric utility sector.

California's transportation system consists of a vast network of more than 175,000 miles of roads and highways. Roseville is ideally located at the intersection of Interstate 80 and State Route 65, enabling its residents' access to metropolitan job centers, and outlying rural communities' access to Roseville's premium shopping, services, and other amenities. Additionally, Roseville is mid-way between the San Francisco Bay Area and Lake Tahoe. Roseville is a central shopping and commuting hub, as well as an ideal location for tourists to layover, eat and charge their EV's on their way to other destinations.

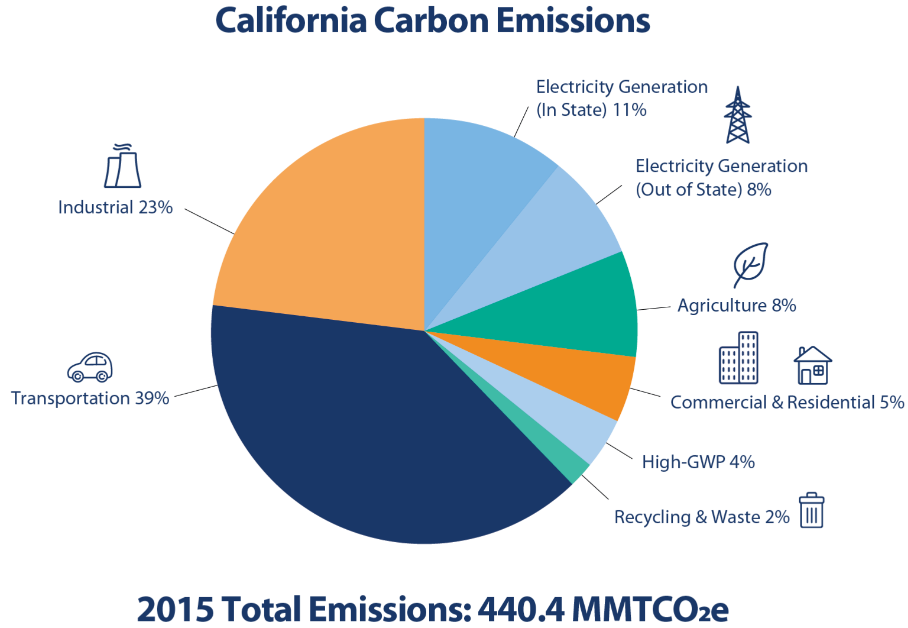


Figure 26 - California Emissions by Sector[34]

EVs could prove to be an opportunity to leverage Roseville's infrastructure by expanding the rate base, redistributing load, and lowering customer costs. The implementation of ZNE homes in 2020 will place Roseville in the position of managing the seasonal and diurnal output and consumption imbalance of its customers, while seeing declines in overall annual household energy consumption. However, customer AMI data may enable Roseville to design EV charging rates that optimize charging times and reduce variability in Roseville's load profile, benefiting both customers and the grid.

6.2.1 Transportation Electrification Impacts

California Department of Motor Vehicles (DMV) data from 2011-2015 shows rapid growth in Roseville's electric vehicle (EV) population with an increase from 10 to 496. For this IRP, Roseville forecasted the expected growth in EVs by utilizing the CEC's EV calculator for light-duty plug-in EVs. The CEC calculator was developed in consultation with CARB, the CPUC, and California's investor owned utilities (IOU). Roseville assumed an adoption rate of Moderate[35] - which is in line with CEC 2017 Mid-Case forecast. For the IRP, a single growth scenario was selected which results in approximately 1.8 million EVs statewide by 2030.

To estimate Roseville's "share" of total EV stock, a percentage allocation from the CEC provided annual DMV sales showed Roseville was 0.28% of total state EV registrations. Using this percentage methodology and applying it to the scenarios, Roseville's pro-rata amount of EVs resulted in nearly 5,500 EVs forecast to be adopted by Roseville residents by 2030. This level of adoption will add more than 18,000 MWh of load to Roseville. This incremental load will help mitigate the decline in energy consumption from ZNE homes. The forecast energy impact and associated stock are represented in Figure 27.

34 https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf, page ES1

35 Note the Aggressive CEC forecast would create results approximately double the results below and be in line with CARB's goal of four million EV's by 2030.

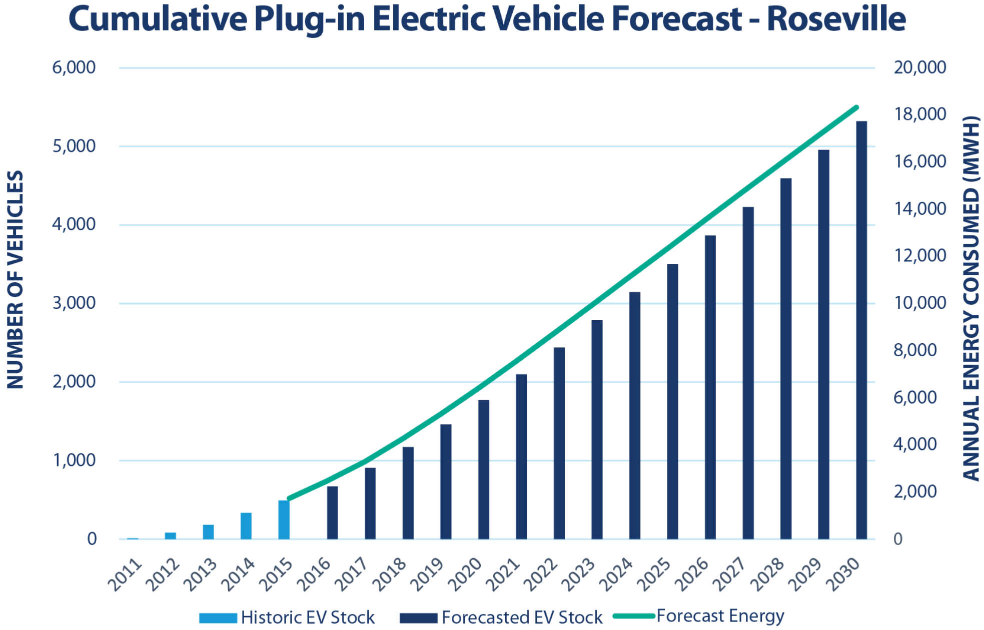


Figure 27 - Cumulative EV Penetration and Energy Consumption

This incremental load will increase Roseville's direct GHG emissions, and result in an added compliance cost to the Utility of $0.2M to $1.1M per year in 2030. However, the transportation sector will see a larger incremental emissions drop than the Utility's emission increase, creating a community wide reduction in GHG emissions for the City of Roseville. It is not clear if Roseville Electric will receive any benefit or compliance credit from CARB for its contributions to supporting EV's. Figure 28 below shows Roseville's increase in Utility emissions, and the net decline within the City of GHG emissions.

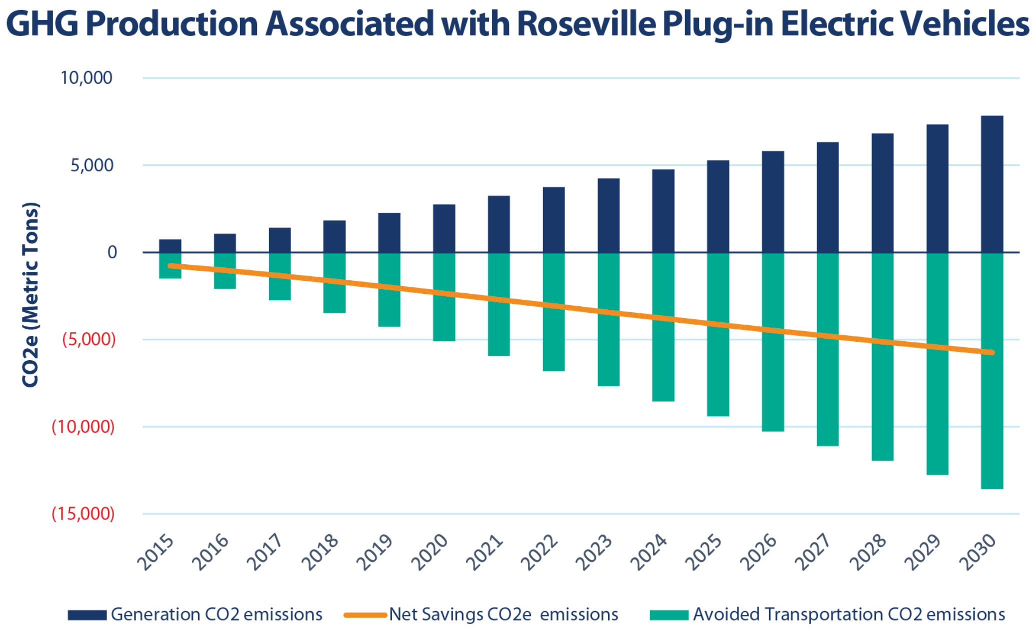


Figure 28 - GHG Generation, Transportation and Net CO_2 Emissions Impacts

Figure 28 illustrates net GHG savings is due to reduction in gasoline production is a greater benefit than the burden of increased electric generation.

The load impacts will vary widely, due to the underlying uncertainty of the depth and details of EV adoption in Roseville, and California as a whole.

Roseville has hired AECOM to help develop an EV business plan to focus on several areas of EV impact in parallel with the IRP:

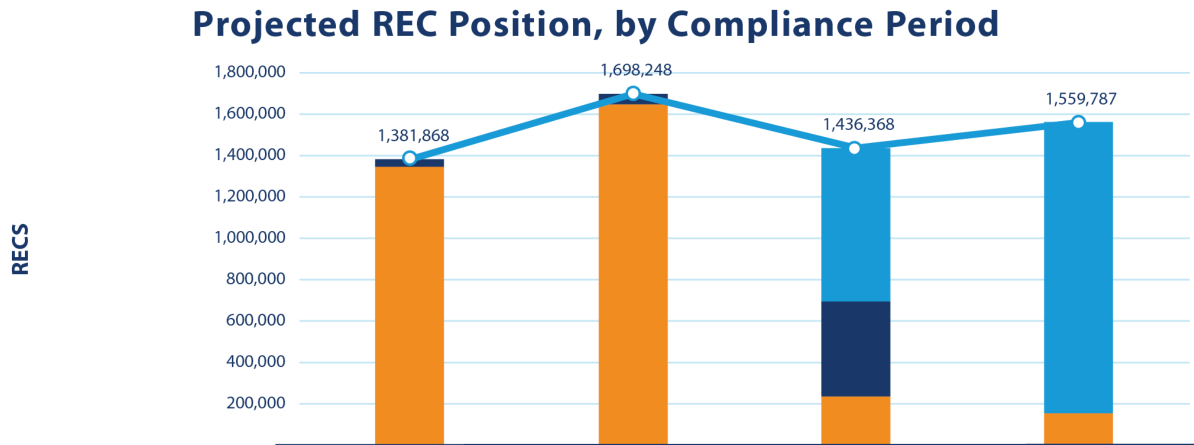
- A forecast of EV penetrations and charging technologies, and how they will affect Roseville Electric and its customers
- Scenarios of how EV charging will affect Roseville Electric
- Model how EVs will impact Roseville's distribution grid along with potential solutions and opportunities
- Forecast EV impacts on Roseville Electric generation resources and load

7 Demonstration of Need

Roseville's key challenge over the IRP planning horizon is meeting its RPS requirements, having sufficient and appropriate reliable capacity to meet its peak, ramping, and flexibility needs, while not assuming a large carbon compliance challenge or cost. In choosing solutions, Roseville must consider the regulatory uncertainties to ensure long-term resourcing decisions are durable and without regrets.

7.1 Renewable Energy Requirements

California increased its goal for renewable energy with the passage of SB 350 in 2015, from 33% by 2030, to 50% by 2030. Roseville's IRP will ensure that it is on track to plan for and procure "at least 50 percent eligible renewable energy resources by 2030." As requested by the Guidelines, Figure 29 projects Roseville's renewable energy obligation, procurement and need over the four compliance periods.



	CP 3 (2017-2020)	CP 4 (2021-2024)	CP 5 (2025-2027)	CP 6 (2028-2030)
RECs Requiring Purchase/Contract	0	0	753,380	1,406,081
Banked RECs Applied	38,140	42,021	445,272	0
Contracted RECs Applied	1,343,728	1,656,227	237,716	153,706
RPS Procurement Obligation	1,381,868	1,698,248	1,436,368	1,559,787

COMPLIANCE PERIOD (CP)

Contracted RECs Applied · Banked RECs Applied · RECs Requiring Purchase/Contract · RPS Procurement Obligation

Figure 29 - Projected REC Position, by Compliance Period

Figure 29 illustrates that Roseville has contracted for sufficient RPS eligible resources to meet its projected RPS obligation through Compliance Period (CP) 4 (through 2024). The majority of Roseville's current RPS contracts end in 2022-2025. Therefore, while a number of previously procured, or banked, renewable energy credits (REC)[36] will be applied towards the CP 5 obligation, the majority of Roseville's RPS compliance obligation for CP 5 and CP 6 will need to be procured. The RPS requirement appears to dip between CP 4 and CP 5, but this is an artifact of CP 3 and CP 4 consisting of 4 years, while CP 5 and CP 6 are 3 years each. In accordance with the regulations, Roseville will initiate new procurements to maintain compliance with future period requirements, as presented in Section 9.4.4.

36 Each REC represents the green and environmental attributes of 1 MWh of renewable energy.

7.1.1 Forecasted RPS Procurement Targets

The forecasted RPS procurement obligation previously illustrated in Figure 29 is the minimum procurement needed to meet the procurement requirements[37] for each compliance period. Calculation of the forecasted procurement target for each compliance period is based on annual retail sales and the POU's established RPS annual soft targets.

Roseville's procurement targets for each compliance period was adjusted to reflect a RPS provision which omits self-generation from a utility's RPS requirement. Specifically, PUC Section 3201(cc) defines retail sales as "sales of electricity by a POU… This does not include energy consumption by a POU, electricity used by a POU for water pumping, or electricity produced for onsite consumption (self-generation)." In contrast, for power source disclosure, PUC Section 1394(2)(B) defines retail sales as… "total retail sales."

7.1.2 Renewable Procurement

A forecast of future procurements by Roseville to meet its projected RPS compliance obligations is included in Figure 29, based on its current RPS eligible resource contracts and excess procurements. As explained previously, Roseville's procurement targets for each compliance period was adjusted to reflect an RPS provision which omits self-generation from a utility's RPS requirement.

Roseville has no historical pre-2011 procurement carryover, but Figure 29 does include excess procurement from recent compliance periods ("Banked RECs applied"), and Utility-owned and contracted resources ("Contracted RECs applied").

7.1.3 RPS Procurement Plan

Roseville has included its RPS Procurement Plan (Exhibit C), in accordance with PUC Section 399.30(a)(2) which requires that Filing POUs incorporate their RPS procurement plan. Section 9.4.4 provides further detail on Roseville's RPS analysis and long-term plan.

7.2 System and Local Reliability Criteria

The reliability finding of this IRP is that growing intermittency from distributed resources drives increasing needs for flexible resources. California's AB 32 was a landmark shift in state energy policy, resulting in rapid implementation of large quantities of grid scale renewable energy technologies. The rapid adoption of grid scale solar, and policies subsidizing solar, has helped drive cost reductions in solar equipment and made residential solar more attractive to Roseville's customers, further accelerating solar energy growth. Wind and solar resources have provided significant environmental and air quality benefits, but have created ramping and flexibility challenges due to their intermittent nature.

7.2.1 Reliability Criteria

Roseville's distribution system has a sizable number of rooftop solar systems that will see further growth with the implementation of ZNE home standards in 2020. To quantify the intermittency and flexibility challenge, Roseville looked to the CAISO. The CAISO market has a much greater proportion of intermittent resources than Roseville or BANC, and is presently dealing with significant ramping and intermittency challenges. Accordingly, CAISO has

37 See Public Utilities Code (PUC) Section 399.30(c)(2).

performed extensive work in defining and measuring intermittency, and building a framework for the resource attributes and requirements to manage intermittency. The CAISO framework is the model Roseville utilized to not only forecast Roseville's ramping and intermittency challenge, but also assess the resources needed to meet it.

In 2014, CAISO implemented the first flexible capacity obligation in an independent system operator (ISO)[38] market, known as Flexible Resource Adequacy Criteria – Must Offer Obligation (FRACMOO)[39]. These are flexible resource obligations assigned to utilities to procure their portion of what CAISO identified as the critical metric, the daily three-hour maximum ramping (change in net load level). This is a starting point for Roseville in defining the magnitude of ramping Roseville will see in its net-City loads as more rooftop solar systems are installed, and new homes in 2020 come equipped with solar to meet ZNE standards.

As renewables and distributed resources increase, CAISO has initiated the next phase of FRACMOO: FRACMOO-2 an ongoing initiative as of early 2018. FRACMOO-2 will include smaller fifteen-minute and five-minute segments so that resource commitments will better align with changes in net load, primarily early in the day and late in the day when solar output is predictably ramping up and down quickly. Instead of the current requirement of meeting the 3-hour ramp with some contingency reserves to address uncertainty, CAISO has proposed a resource stack that can align unit capabilities with predicted and unpredicted energy deviations. These proposed new approaches in FRACMOO-2 include:

- A day-ahead shaping product based on the current flexibility criteria. CAISO has proposed a need to introduce an integrated forward market with fifteen-minute increments.
- A fifteen-minute flexible resource adequacy[40] product would have similar characteristics to the five-minute product, but the qualification would be its movement capability over fifteen minutes. The fifteen-minute product would allow intertie resources that are tied to a specific resources outside CAISO, such as those in BANC or electrically connected system of resources outside CAISO. The fifteen-minute product could also be considered toward meeting five-minute product need.
- A five-minute flexible RA capability to address uncertainty between the fifteen-minute market and real-time dispatch. A resource in this category would qualify for the actual movement it could achieve in five minutes, e.g. a resource that could move 10 MW/min may qualify for 50 MW of five-minute ramping product.

This new flexible capacity paradigm would commit the least flexible units and technologies in the day-ahead at the bottom of the resource stack, and the most flexible at the top.

The CAISO approach is instructive for Roseville, as Roseville has forecast its current resource mix to be sufficient in meeting its growing intermittency until around 2025. However, for planning purposes, it provides insight into the characteristics Roseville will investigate to ensure it has sufficient resource capabilities well ahead of when reliability challenges are forecast. Specifically, Roseville's portfolio will maintain and enhance its flexibility to meet:

- Peak Capacity: Meet expected peak capacity requirements plus a 15% reserve margin
- Day-Ahead Ramp: Meets the ramp magnitude of Roseville's maximum daily one-hour and three-hour ramps

38 "Independent system operator" means an entity authorized by the Federal Energy Regulatory Commission to control a regional transmission grid.
39 http://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleResourceAdequacyCriteria-MustOfferObligations.aspx
40 "Flexible Resource Adequacy" means the capacity of a resource that is operationally able to respond to Dispatch Instructions to manage variations in load and variable energy resource output

- Five-minute Flexibility: Meet the variable energy resource intermittency needs utilizing Roseville's 10MW regulation and imbalance energy deviation band and other portfolio assets

7.2.1.1 Roseville Peak Capacity

Figure 30 shows Roseville's capacity and reserve capacity requirements for 2018-2030. Roseville will procure an additional 15% reserve margin, resulting in a capacity procurement target ranging from 387 MW to 398 MW over the study period.

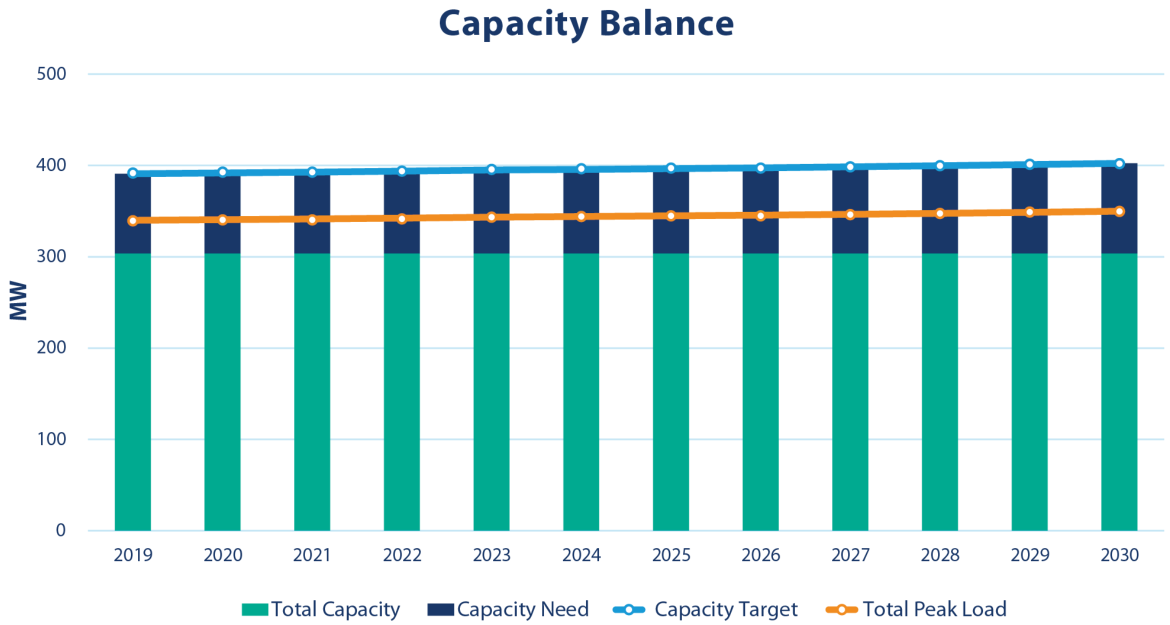


Figure 30 - Roseville's Peak Capacity Requirement for the Study Period

As illustrated in Figure 30, Roseville is 90-100 MW short of capacity over the study period. Section 9 will outline portfolio options and analysis to meet this need.

7.2.1.2 Roseville Ramping Requirement

The maximum annual ramp in 2030 is anticipated to see modest growth compared to the 2017 net load ramp. The maximum three-hour net load ramp will grow about 9% from 110 MW in 2017 to 120 MW in 2030. Figure 31 illustrates the maximum three-hour ramp from 2017 to 2030.

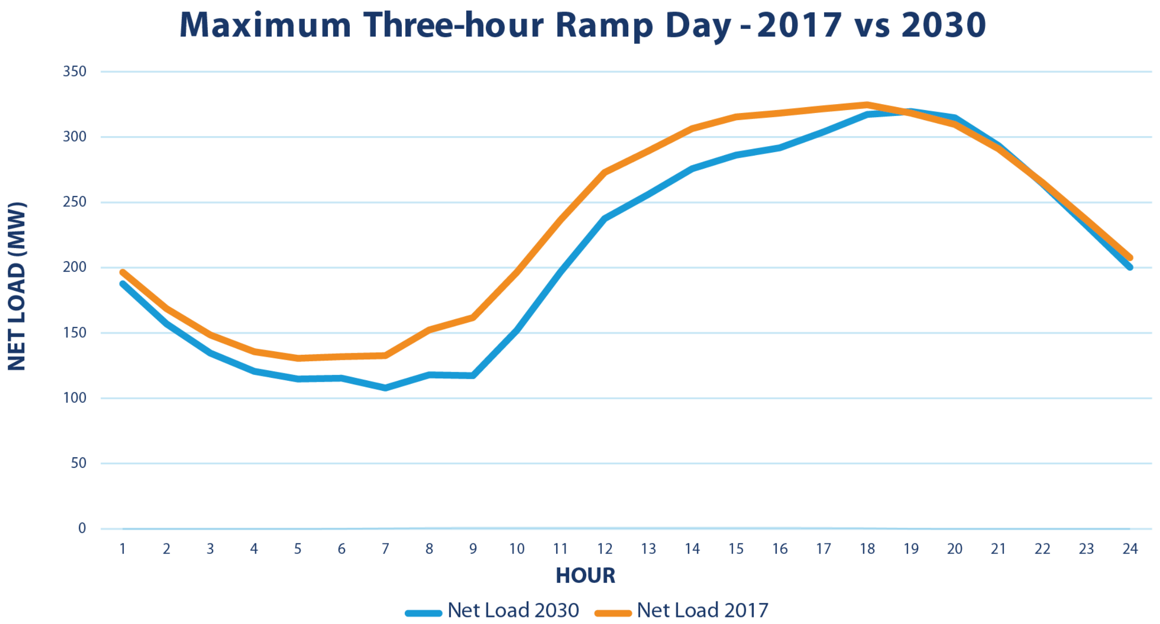


Figure 31 - 2030 Maximum Three-hour Ramp Day – Load and Net Load

Roseville's one-hour ramp has the same basic pattern as the three-hour ramp. Figure 32 shows the annual maximum one-hour and three-hour ramp rates.

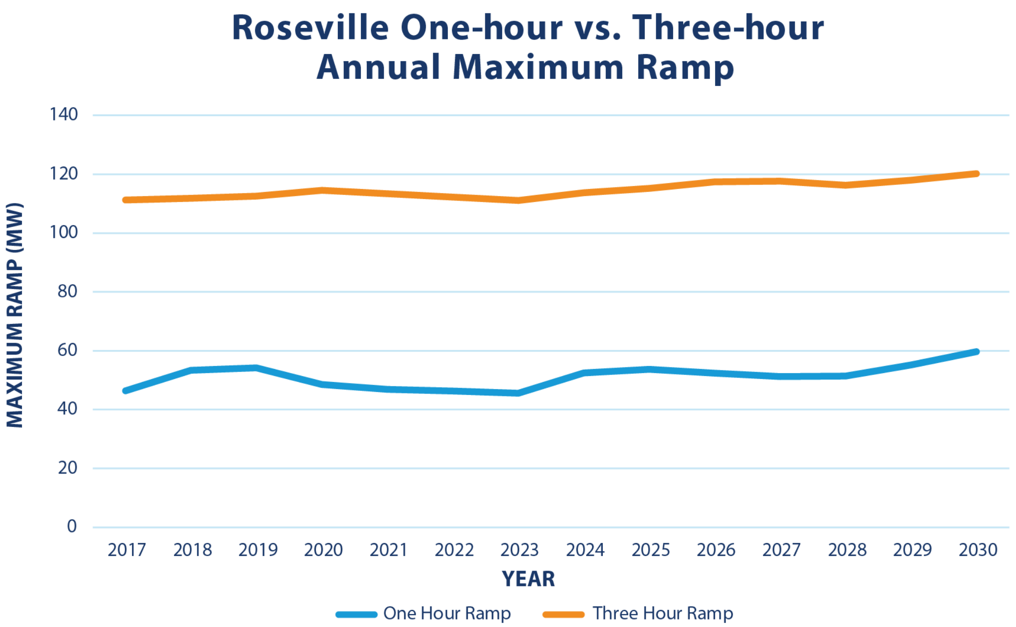


Figure 32 - Roseville one-hour and three-hour largest annual net load ramp

The one-hour and three-hour ramp relationships in the Figure 32 are similar. One-hour ramps are forty to fifty percent of the three-hour ramp; in other words, half of the movement occurs in a third of the three-hour interval. This is consistent with the framework for flexible ramping the CAISO is developing. The one-hour and three-hour average ramp chart are changing proportionally.

Overall, the ramping impact is modestly increasing over time and Roseville does not forecast a multi-hour ramping capacity need over the study period.

7.2.1.3 Roseville Intra-Hour Flexibility Requirement

Roseville's Interconnected Operations Agreement (IOA) with WAPA provides for an intra-hour deviation band of +/-10 MW. Deviations within the band are calculated on an integrated hour, corrected through an after-the-fact energy exchange during like on/off peak periods of the same day. To the extent that the Utility purchases from WAPA in excess of the 10 MW band, WAPA supplies energy at 150% of the cost to replace. If the Utility oversupplies its electricity needs beyond the 10 MW band, the energy is delivered to WAPA with no payment to Roseville.

This band serves as a regulating capacity for Roseville and other WAPA interconnected customers. A challenge into the future is the impact of larger and more frequent intra-hourly changes driven by distributed generation growth on the both Roseville's system, as well as the greater WAPA system. There is currently no formal definition in the IOA with WAPA for problematic intra-hourly excursions, but there exists general terms for Significant Operational Change[41]. For the purpose of this section, Roseville assumes problematic deviations would risk a Significant Operational Change.

In developing an assumption of problematic deviations, Roseville first assumes that the stress occurs when the WAPA system is stressed, as deviation band capacity is not regulating Roseville's deviations alone, but the entire WAPA system. The data accessible to Roseville for this study includes five-minute historical utility-scale solar data, five-minute historical load data, forecasted solar installations (Section 6.1), and forecasted hourly load (Section 4.4). Since Roseville does not have the data to model the WAPA system, Roseville developed a net load profile and made assumptions that 1) diversity of the WAPA system will mitigate system impact and 2) diversity of small scale, largely rooftop, installations will dampen the solar movement.

With a five-minute net load profile to 2030, Roseville developed its more relevant definition of problematic deviations to manage given the changing characteristics of load with higher levels of rooftop solar. In this case, the boundary is a five-minute excursion from the deviation band boundary occurring more than 5% of the days in a season, accounting for diversity benefit. The assumption is, therefore, if five-minute deviations exceed 10 MW more than five-percent of the days in a season, additional portfolio assets are needed to manage deviations.

Roseville's intermittency challenge can be seen in Figure 33, a box and whisker chart with the box showing the 95th percentile upward and downward maximum five-minute daily deviation and the whisker showing the maximum daily five-minute deviation expected. There are lines showing the deviation threshold (for reference) and the threshold as a boundary to graphically show when net load deviations exceed the threshold.

41 Significant Operational Change is defined as '"any operational change proposed by a party that could reasonably be expected to significantly affect the other party's electric power system or control area or any action taken by the control area operator which may cause a significant change in the way a party operates or must operate its electric power system or control area or the points of interconnection between the parties."

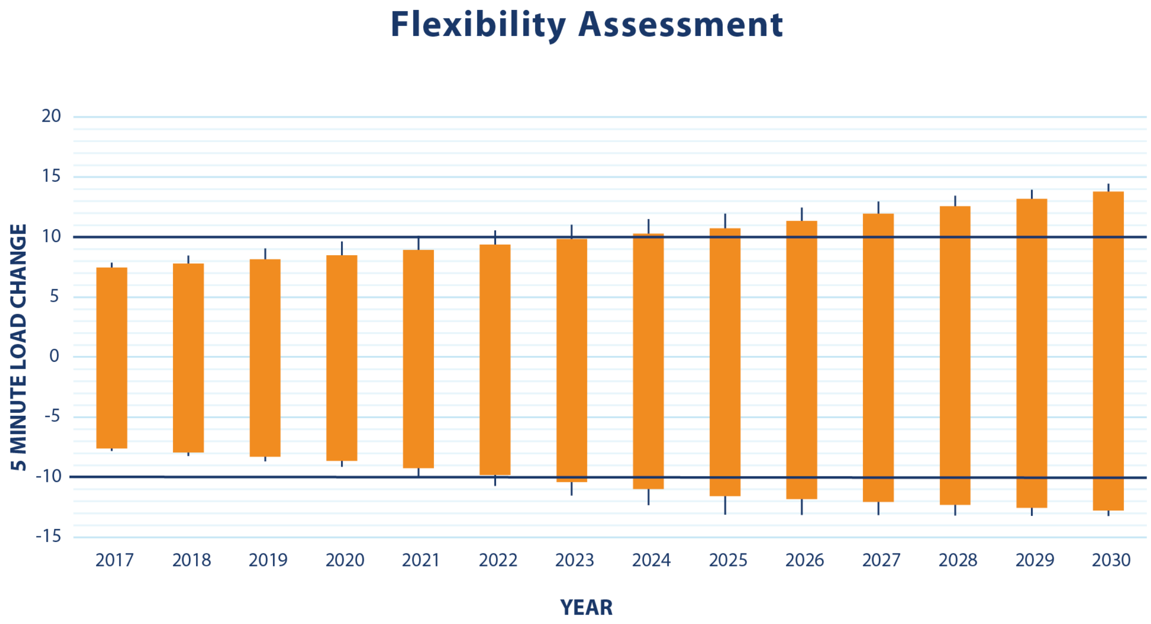


Figure 33 - Roseville Five Minute Deviations vs. a Five-Minute Deviation Threshold

Figure 33 indicates that Roseville has a flexibility challenge when the orange boxes get outside the area bounded within the two blue lines, and should implement technologies to supplement its deviation band to actively manage five-minute deviations. The deviations are forecast to grow over time as solar resources are added to the system. The threshold is exceeded in late 2024 or 2025. After this time, Roseville portfolio assets will need to manage five-minute deviations beyond the 10 MW deviation range. The challenge is manageable, but may require some portfolio additions in the future.

7.2.1.4 Summary

Roseville's deviation band provides adequate flexible capacity for managing intermittency, and it is forecast to be sufficient for some time. There is no over generation challenge within the study period, although there are some challenges in intra-hour load following. Roseville's capacity challenges over the study period can be summarized as:

- Peak: Roseville's portfolio is short 90-100 MW peak capacity of its 15 percent reserve margin over the study period. Peak resource options and analysis is presented in Section 9.
- Three and One-Hour Ramping: Roseville's portfolio meets the maximum daily three-hour ramp and the maximum daily one-hour ramp over the study period.
- Intra-hour Five-Minute Flexibility: Roseville meets the expected intermittency requirements until 2024 to 2025. Flexible resource options and analysis is presented in Section 9.

8 Transmission and Distribution Systems

Roseville owns and operates a robust distribution system, serving most customers through underground lines. The high incidence of underground lines has helped Roseville maintain high customer reliability, and low forced outage rates and duration.

Roseville does not own or operate any bulk electric transmission. However, Roseville does have long-term transmission service contracts that provide access to high voltage transmission for wheeling energy to Roseville's loads, and access to other markets and counterparties for the output of Roseville's generating assets.

8.1 Bulk Transmission System

Roseville is party to transmission contracts with WAPA, and the Transmission Authority of Northern California (TANC) which operates the California Oregon Transmission Project (COTP). Roseville is engaged in the governing boards of these transmission facilities and reviews the studies performed by the particular Transmission Path Operator for transmission concerns. Roseville also is engaged in the Sacramento Valley Study Group, which performs annual contingency analysis of transmission assets. There are no transmission level concerns for Roseville's assets during the study period.

8.2 Distribution System

Roseville's distribution system is directly connected to the WAPA transmission system. WAPA's 230-kV system serves much of the western United States. The Interconnection Agreement (IA) defines the points of interconnection between WAPA transmission assets (230-kV) and Roseville's distribution assets (60-kV and below) at two receiving stations. Roseville owns three power transformers at the two receiving stations, two at Berry receiving station and one at the Fiddyment receiving station. Power is then transmitted to distribution substations through the city's 60-kV network. At the distribution substations, the voltage is further reduced to 12-kV by the substation transformers. From the distribution substations, 12-kV main feeders are installed to supply load. The 12-kV feeders are mainly installed in underground duct banks. The voltage is then further reduced to the normal application voltages by distribution transformers located near the customer's premises.

Roseville has a robust distribution system. Approximately 85 percent of Roseville's distribution feeders are underground, relatively short in length, and highly resistant to voltage and harmonic fluctuations. Compared to other utilities in similar territories, a Roseville outage frequency and duration is low. Two industry accepted benchmarks for outage reporting include:

- System Average Interruption Frequency Index[42] (SAIFI) – Index of frequency of outages calculated as total number of customer interruptions divided by total number of customers served
- System Average Interruption Duration Index[43] (SAIDI) – Measurement of duration of outages calculated as sum of all customer interruption durations divided by total number of customers served

Roseville's 5 year average (2012-2016) SAIFI and SAIDI indexes are shown in Figure 34.

42 https://en.wikipedia.org/wiki/SAIFI
43 https://en.wikipedia.org/wiki/SAIDI

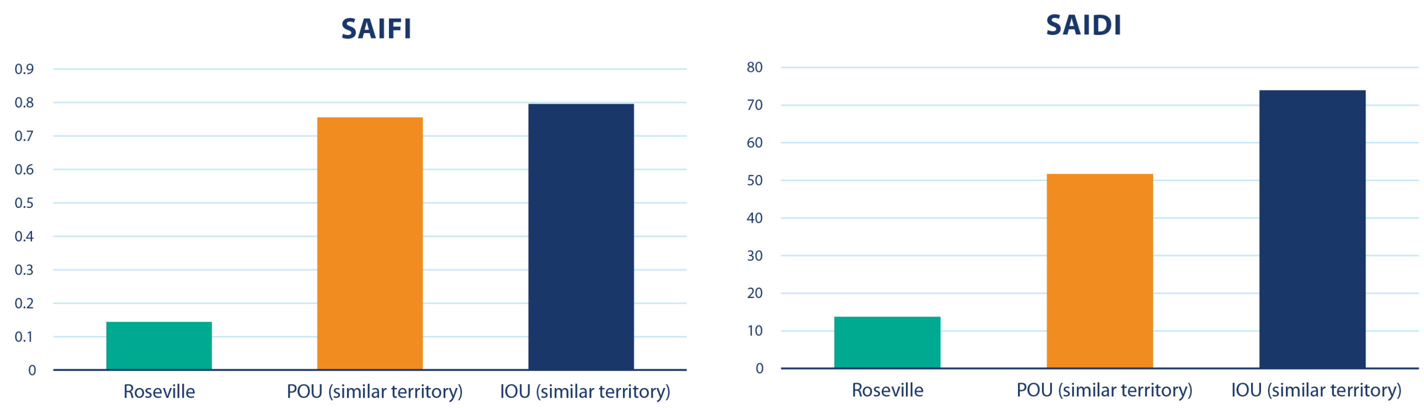


Figure 34 – SAIFI and SAIDI Indices

Roseville's five-year average SAIFI is 0.14, meaning an average Roseville customer experiences an outage 0.14 days per year, or once in every 6.9 years. Roseville's 5 year average SAIDI is 13.7, meaning total outage duration divided total customers, results in average outage duration of 13.7 minutes.

8.2.1 Distribution Planning Study Process

Roseville's distribution engineers annually perform a comprehensive distribution planning study. This plan is the culmination of a variety of efforts aimed to best serve Roseville's customers by balancing safe and reliable operation of the power delivery system with affordable rates. Activities feeding into the development of this plan are:

- 60 kV Transformer loss contingency analysis: This study simulates the systematic removal of each of the system's twenty-one 60/12 kV transformers – one at a time – and determines if customer load can be readily transferred to other transformers in the system. Projects are put in the plan for those instances where load cannot be readily transferred, or where moving the load results in system overloads. These projects may include cable upgrades / replacements and other 12 kV system changes (new lines, switches, transformers, etc.). Each year, this comprehensive system-wide analysis is updated to reflect any changes and load growth within the past year.
- 230 kV transformer loss contingency analysis: This analysis uses network simulation tools to investigate the impact of the loss of the system's main sources of power: the three 230/60 kV transformers and generation at the Roseville Energy Park (REP). Instances where a loss overloads lines or transformers are used as input for 230 and 60 kV upgrade plans (adding lines, new transformers).
- 60 kV line and breaker loss contingency analysis: This simulation determines the effect of the loss of any single line or associated hardware. In those cases where two 60 kV lines are run on the same set of poles (double circuit line), the effect of the simultaneous loss of both lines is investigated. Results of this study are used to determine 60 kV system expansions.
- 60 and 12 kV fault studies: These studies determine the amount of fault current (current flowing when a line is down or equipment fails) available at various locations throughout the system. This information is used to determine the rating of circuit breakers throughout the system. Over the past few years, due to increases in the capacity of WAPA's network, some fault current levels have risen significantly. Fault studies are run on an as-needed basis, triggered by significant system changes.

- Asset condition assessment: Historical failure rates, failure trends, field observations, manufacturer data, along with equipment loading and age are combined to determine the condition of assets and likely end-of-life.
- Light Detection and Ranging (LIDAR) survey: This survey determines overhead line spacing and conductor separation. Increased loads (causing line sag) and changing conditions can cause conductor separation and/or clearance to ground and other objects to drop below acceptable minimums – triggering the need to rebuild lines.
- Load growth projection: Data from the city's Planning Department, along with information and historical experience developed by Roseville Electric's New Services team, is combined to project likely load growth trends in various parts of the city.
- Distributed generation impact analysis: Data pertaining to distributed generation – predominantly solar – is examined to determine how distributed generation affects system peak loading and how it impacts feeder voltage control.

8.2.2 Plan Results

By combining information from the various simulations and study efforts outlined above, Roseville engineers determine the new construction and rehabilitation work that must be completed in order to provide service to new customers and maintain system reliability. This planning methodology provides high reliability, balancing infrastructure costs to best meet the customer's needs.

As presented in Section 6 of this IRP, high levels of distributed energy resource (DER) penetration are expected on Roseville's system, particularly DG solar. Roseville has employed a systematic interconnection process to ensure that customer-owned DERs behind the meter do not cause adverse impacts on the distribution system. For commercial DG solar systems larger than 10 kW, distribution engineers review single-line diagrams; for commercial systems under 10 kW, no engineering review is required and the interconnection application is processed by administrative staff.

To date, distribution engineers have not identified any notable impacts or concerns from photovoltaic (PV) or EV on Roseville's distribution system, or substantial reduction in distribution line losses or improvements in power quality. Roseville does not anticipate feeder-level impacts until DG solar penetration reaches at least 40-50 percent of feeder peak load. This is due to the robust design of Roseville's distribution feeders. As DER penetration increases in the future, Roseville engineers will continue to utilize complex modelling for distribution system impact studies for incremental installations. Additionally, Roseville's new AMI system will provide increased visibility into the performance of the distribution system and localized DER impacts and enable technology to mitigate the distribution system impacts of DERs. This is further discussed in Section 9.4.

In summary, the main impacts from DERs may occur at the bulk generation level rather than at the distribution level, as EV and DG will impact flexibility needs as presented in section 7.2. Roseville's engineers will continue to evaluate EV and DG system impacts to maintain high reliability for Roseville's customers

9 Portfolio Evaluation and Results

Roseville considered a diverse set of existing and new resources in its portfolio analysis. The key need in the near term is a portfolio of peaking assets; in the longer term, more flexibility is needed, all while providing reliable and affordable energy. The evaluation process utilized a model of western energy markets that incorporated the resource changes necessary to meet the key energy policy objectives (i.e. RPS and GHG compliance). That model produced market prices for natural gas, electricity, and GHG emission allowances against which current and potential future resources could be tested to determine if they cost effectively met Roseville's future portfolio needs for peaking and flexible capacity. The outcome of the model simulations were checked against emission reduction objectives and assessed for cost and risk. The resultant recommendations are for some minor changes to Roseville's existing portfolio, as well as to embrace new future smart grid technologies.

9.1 Methodology

A long-term energy market price forecast was developed by Black and Veatch (B&V) to serve as the basis for analysis of the Roseville portfolio. The price outlook was derived on a combination legislative and regulatory requirements, and B&V's long-term economic assumptions, to develop a fundamentals-driven framework for long-term market pricing models.

An essential element in the energy price forecasting process is the use of a structural market model, namely the Fundamental Energy Market Model (FEMM), to simulate electric energy market behavior and establish the fundamental-based economic assumptions which drive market behavior. The electrical grid in the U.S. is operated as a synchronized system across regions. A FEMM is therefore constructed for each region, as applicable, and simulates energy prices for market zones across this region.

The FEMM utilized by B&V is a chronological dispatch economic modeling platform which seeks to minimize costs to produce electricity to meet customer demand while simultaneously adhering to a wide variety of operating constraints, including generating unit characteristics, variable O&M costs, variable and fixed startup costs, unit minimum down time and minimum run times, maintenance schedules, transmission limits, fuel and environmental considerations, and transactions. For each hour of the forecast period, the model first clears the local electric supply and demand within each market zone, then optimizes electricity transfers between zones to optimize total system production costs. The model captures grid interfaces and key grid parameters in and between zones, including transfer capacity, congestion, and losses. This process is repeated for each hour of the simulation period, while capturing the chronological constraints and limitations of each generation asset. The model produces a forecast of hourly prices for electricity across multiple zones or locations under economic and operating constraints.

9.2 Modeling Assumptions and Market Results

The modeling accounted for all known state and federal policy regulations and statutes, as well as expected commodity supply and price trends. The western grid will be in constant evolution over the next couple decades to achieve the emission reduction requirements, responding to increasing intermittency, and EE and EV goals.

9.2.1 Statewide Assumptions

The Base Case SB 32 Compliance Scenario (SB 32) assumes California GHG emissions are on a trajectory that allows it to meet the 40% GHG reduction by 2030 from 1990 levels. The Base Case scenario uses the 2017 IEPR demand forecast developed by the CEC. Electric vehicle charging energy provided in the CEC 2017 IEPR demand forecast was used to estimate electric load required to support California electric vehicle charging. Key assumptions used to define the Base Case Market Scenario are summarized in Figure 35.

Key Electric Generation Assumption	Methodology & Approach	Source(s)
Electric Load	CEC IEPR for Consumption and Peak Demand Projection – Mid-Case	2017 IEPR Projection
Generation Capacity Additions & Retirements	Included publicly announced capacity retirements and additions. Usage based criteria to determine future retirements. Economic based capacity additions based on reserve margin requirements	WECC, CAISO, B&V Analysis
Energy Storage	Compliance with AB 2514 target of 1.3 GW requirements by 2022. Beyond 2022, assumed additional 6 GW may be procured by 2030 to support growth in renewable energy.	AB 2514 B&V Analysis beyond 2022
Behind the Meter and Wholesale Solar PV	Use 2017 IEPR Mid-Demand projections for 2017 – 2027; consistent with CARB 2017 Proposed Scoping Scenario	2017 IEPR Mid Demand Projection
Greenhouse Gas Emissions & RPS Targets	Compliance with SB 32 targets of 40% GHG reduction from 1990 levels and SB 350 targets of 50% RPS by 2030	SB 32 SB 350
Electric Vehicle Growth	Use 2017 CARB Proposed Scoping Scenario – Consistent with Vehicle count in 2016 IEPR Demand through 2030	2017 CARB Proposed Scoping Scenario

Figure 35 - Key Assumptions

9.2.2 Price Assumptions

9.2.2.1 Natural Gas Prices

Roseville used B&V's gas price forecasting methodology, a fundamental analysis of natural gas supply, demand, and the interconnecting pipeline grid. B&V's modeling process incorporates views on fundamental drivers that influence the natural gas market and projections of supply, demand, and prices across North America. B&V monitors the development of such resources and undertakes in-depth analyses to understand North American natural gas supply potential. In addition, B&V considers issues relevant to the future of the natural gas industry including future demand for natural gas and coal from the power sector, ongoing exploration and development cost trends, and exports of liquefied natural gas (LNG) exports.

The B&V natural gas spot price forecast at Henry Hub then extended to the other major natural gas pricing points, including PG&E Citygate, the natural gas hub for Roseville. From 2017 to 2021, the forecast shows price increases due to moderate demand growth in LNG exports and pipeline exports to Mexico. Prices continue to rise moderately as natural gas becomes more expensive to extract from shale basins, and new pipeline capacity must be built to move gas production to serve demand. Improving technology moderates these expenses and maintains prices below $5/MMBtu through 2030. Figure 36 below shows the PG&E Citygate Hub price and the range of other major California natural gas hub prices. This is the price of natural gas for Roseville and Northern California.

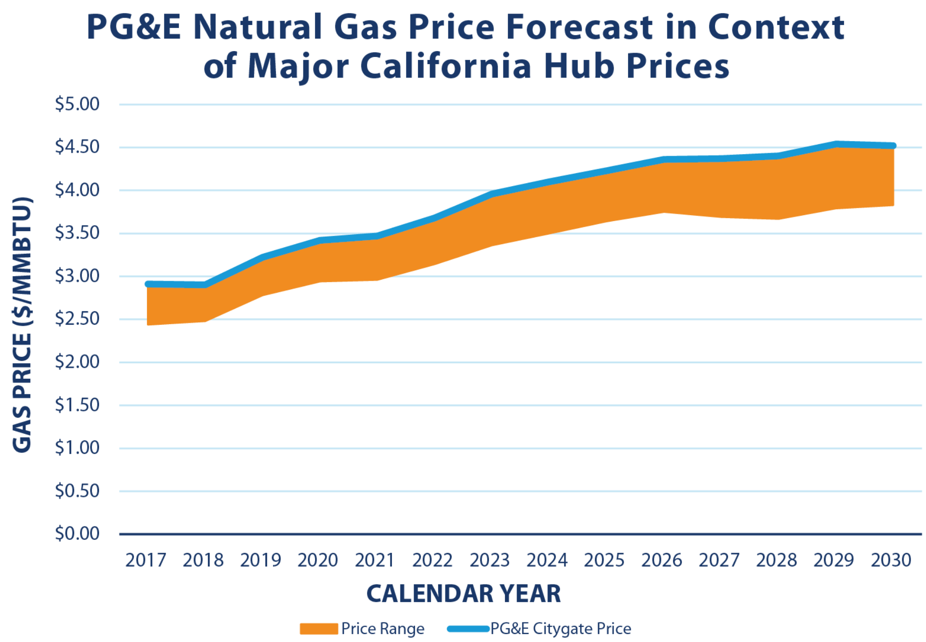


Figure 36 - B&V Price Forecast PG&E Citygate Natural Gas Price Forecast and Its Competitive Position with Other California Hub prices.

9.2.2.2 Electricity Market Prices

The FEMM model forecasts that environmental regulations will fundamentally change the California power market. RPS, met largely with solar resources, will cause over-supply in daylight hours. Figure 37 represents the average hourly prices (nominal) modelled in 2018 compared to 2030 for the Northern California region. An interesting observation is that the midday hours are becoming less economic for natural gas units, and therefore, those units will serve fewer operating hours in the future.

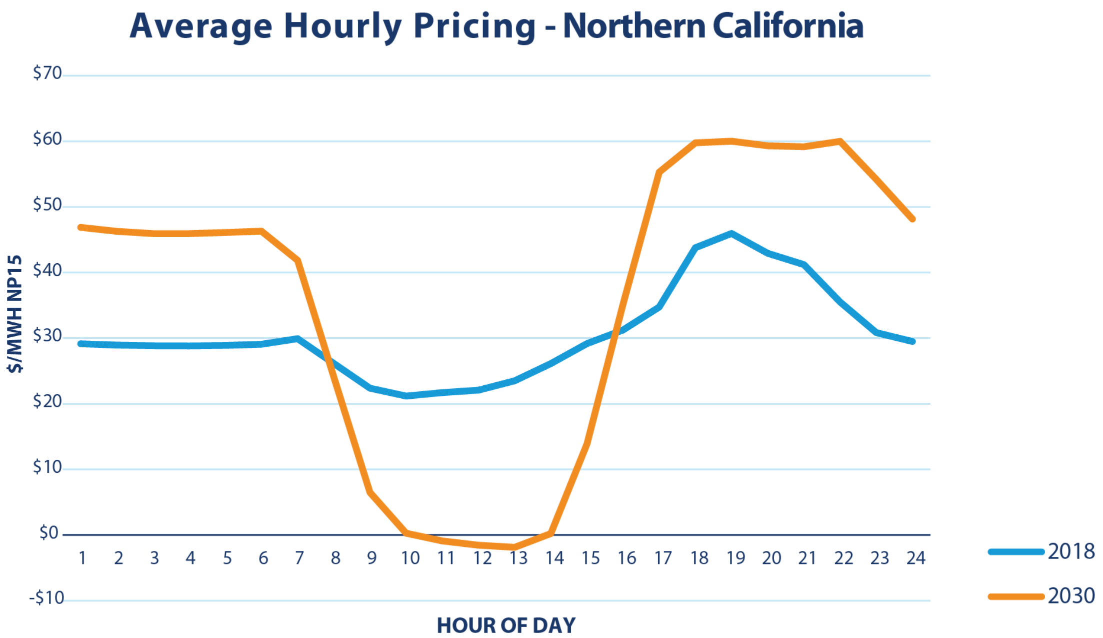


Figure 37 - Average Hourly Price Shape

Overall, the FEMM model forecasts increasing average electricity market prices over time. The primary driver for increasing energy prices is the nominal projected increase in natural gas prices. Figure 38 illustrates the wholesale energy price forecasts produced for Northern California for standard trading periods. These periods include the On-Peak[44] period, the Off-Peak[45] period and average all hours. These periods are commonly traded industry accepted periods for transacting electricity.

During the On-Peak shoulder hours, natural gas generation is forecasted to be online as the marginal resource (the resource setting the market clearing price). Forecasted on-peak average prices decrease over the forecast period. This projected decrease is due to the decrease in mid-day prices. Traditionally, On-Peak periods are a premium to Off-Peak periods due to higher demand during the On-Peak. Because solar generation is not available to serve demand beyond daylight hours, natural gas remains the marginal fuel during Off-Peak hours. This price spread[46] between On-Peak and Off-Peak power is forecast to narrow and eventually cross, with Off-Peak power more expensive than On-Peak power. The increased penetration of higher levels of renewables does depress the market clearing price but not enough to overcome the increase in natural gas prices given the number of hours natural gas resources will still be the marginal resource.

44 On Peak refers to the hours ending 7 through 22, Monday through Saturday (except NERC holidays)
45 Off Peak refers to all hours ending 1 through 6, hours ending 23-24, Sundays and NERC holidays
46 Spread is the difference of one price to another, in this case the difference of On-Peak to Off-Peak

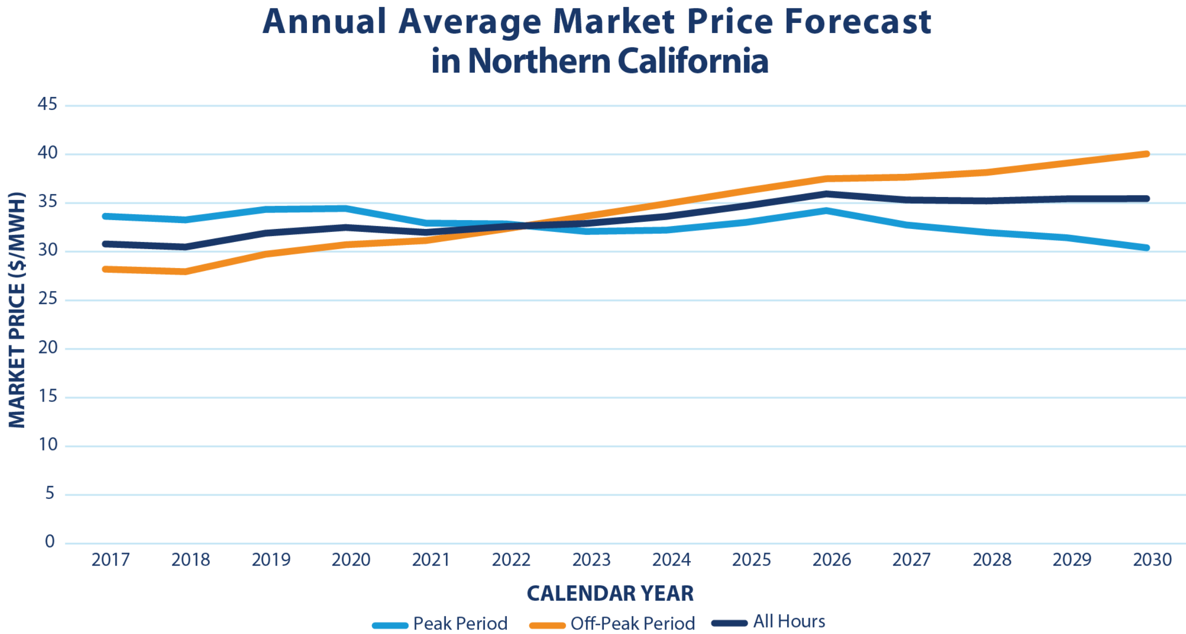


Figure 38 - Average Annual Electricity Market Prices for Northern California

9.2.3 Model Limitations

The FEMM model is a forecast of hourly energy market prices, an industry accepted approach for forecasting the energy value of resources. Section 9.2.2 illustrates the forecasted decrease in market prices during mid-day hours. These prices are for energy, and do not capture the increase in capacity costs, as these intermittent resources require additional resources for integration. As presented in Section 7.2, the system and reliability criteria are changing grid requirements, and increasing the need for flexibility. Increased intermittency will impact real-time market volatility and require reserves to regulate these resources.

9.3 Existing Resource Evaluation

Roseville's portfolio of existing resources was evaluated based on forecasted needs and portfolio fit in the future environment. Some of Roseville's resources and contracts will face critical decisions during this study period, including resource retirement and contract extension.

9.3.1 Roseville Energy Park (REP)

REP is an important resource for Roseville to support local reliability, capacity needs, and serves as an economic hedge of market prices. Roseville primarily schedules and dispatches the plant economically to meet its peak capacity and energy requirements versus market opportunities. REP is also used for reliability needs (e.g. voltage support, transformer contingencies) and operating reserves (ancillary services). Model results forecast REP will run an estimated 250 GWh/Year from 2018-2030, serving 20-25% of Roseville's energy needs. This forecast is based on an economic dispatch of REP.

REP is a flexible generation asset, capable of ramping up and down quickly to support renewable integration. The market need for greater flexibility will lead Roseville to investigate cost effective upgrades to REP to lower its minimum generation levels, and increase its ramping capability. A challenge will be containing the cost and GHG impacts from REP operating to support renewable integration, which is presented in section 9.5.2.

9.3.2 Roseville Power Plant 2 (RPP2)

RPP2 serves as a peaking resource. Similar to historical operations, model results show that RPP2 will be run infrequently. While RPP2's energy value is low, its capacity value is high. RPP2 has no debt service and low O&M costs, resulting in a lower capacity cost than the market replacement. RPP2 is interconnected to Roseville's distribution system which supports local reliability. Its ability to quickly start (within 8 minutes) and generate at full load (less than 10 minutes) provides support in contingency events.

One of the key risks considered in this IRP is RPP2's age and reliability state. RPP2's two CT's have legacy components that Roseville has been replacing and upgrading to increase the plants' start reliability. One of RPP2's two 24 MW Combustion Turbine units has had generator damage. Roseville has procured sufficient capacity to backfill its need during a low priced capacity market environment. With forecasted increasing market capacity costs, RPP2 is undergoing a comprehensive reliability study to determine cost effective upgrades to improve the reliability of these older units. Roseville plans to have the evaluation completed in summer 2018. Roseville expects to continue to invest in RPP2 due to its importance for meeting peak demands, and assisting with BAA reliability and stability.

9.3.3 Combustion Turbine Project No. 2 (STIG)

STIG serves as a peaking resource. The STIG plant is located in CAISO, and is a capacity resource for Roseville to export from CAISO to load in BANC.

The STIG unit is LMS 5000 technology, a unit with low market penetration, few spare parts available, and with increasing risk of maintenance support due to lack of service providers. NCPA participating members, including Roseville, are evaluating STIG as it nears the end of its debt service in 2026. NCPA will be performing an investigation into the benefits, costs, and risks of decommission the current unit, upgrading the unit to extend its useful life, or a complete repowering with a state of the art unit. An initial feasibility study is expected to be completed in 2019.

9.3.4 WAPA Base Resource

Roseville's Base Resource share is forecasted to provide 155 GWh/Year, serving an estimated 14% of Roseville's energy needs. This carbon-free resource displaces an estimated 66,000 MT CO_2 emissions annually from Roseville's portfolio, a hedge against carbon allowance costs. Since Roseville's 2012 IRP, Base Resource costs have been above market alternatives in several years due to escalating Central Valley Project Improvement Act (CVPIA) Restoration Fund costs.

WAPA's marketing plan for the new Base Resource contract is to present a pro-forma contract in late 2019 for execution in 2020. The new Base Resource contract is a 30 year contract effective January 1, 2025. Roseville has the right to continue its Base Resource share. In this IRP, Roseville has included the continuation of this contract due to its rights. Alternatively, under the current contract, Roseville can elect to terminate its contract following the next rate implementation which is targeted for October 1, 2019. Within 90 days of the new rate, Roseville can state its intent to terminate which would take effect by 2021. Future Roseville contract negotiations with WAPA will consider progress by Reclamation in controlling CVPIA Restoration Fund costs and the economic competitiveness of Base Resource compared to market alternatives, including renewable resources.

9.3.5 Calaveras Hydro

Calaveras supports Roseville's peak capacity needs, and is a carbon-free hedge against market energy. Additionally, Calaveras is a highly flexible hydro project with several benefits to Roseville. The fast start, fast ramping capability enables the resource to provide ancillary services, including regulation. While very flexible, this unit is in the CAISO BAA and does not serve Roseville's system flexibility needs; however, it can function as a hedge of Roseville's ancillary service requirements. Roseville may also use the capacity of this resource by exporting into BANC for serving Roseville's load. Model results show Calaveras will operate at an estimated 66 GWh/Year from 2018-2030, serving 6% of Roseville's energy needs. Calaveras displaces an estimated 28,000 MT CO_2 emissions annually from Roseville's portfolio.

Calaveras debt service is paid off in 2032, when its FERC license expires. The re-licensing process will begin in the early 2020s. Re-licensing costs and requirements will be the key consideration moving forward with Calaveras.

9.3.6 Geothermal Project

The NCPA Geothermal Project is located in the CAISO BAA and serves Roseville in both peak capacity and RPS energy needs. The Geothermal Project is forecasted to provide 5% of Roseville's energy needs from 2018-2030.

A risk to geothermal generation is the fuel. Steamfield production is expected to decline over time, which will result in declining generation. A second risk is the future duck curve pricing impacts, including negative pricing, on the economics of the plant. NCPA members are evaluating the impact and alternatives to economically optimize the resource in the future price environment.

9.3.7 Existing Resource Portfolio Summary

Roseville's existing resources provide several benefits and should continue to serve Roseville's energy and capacity needs. The NCPA Calaveras and geothermal resources provide a mix of clean renewable and large hydro energy. STIG will undergo a study to determine whether it is repaired, repowered, or de-commissioned.

Base Resource provides benefits including carbon-free energy delivered to Roseville's system. However, Base Resource cost is highly variable and uncertain due to CVPIA Restoration Fund costs. Roseville should continue with the Base Resource contract as long as it is affordable and the energy is market competitive.

Resource Strategy-1 (RS1): Maintain Existing NCPA and Base Resource Contracts.

REP and RPP2 are critical resources providing local capacity and support local reliability needs such as voltage support. Continue investing in these resources to achieve high reliability, and more flexible operating characteristics. These assets should be investigated for opportunities to improve reliability and operating characteristics such as lower minimum operation levels.

Resource Strategy-2 (RS2): Improve Operating Reliability of Roseville Power Plant 2 (RPP2).

Resource Strategy-3 (RS3): Study Cost Effective Upgrades to REP to Increase Flexibility.

9.4 Resources and Market Options

Roseville considered a number of different technologies when developing the resource options. Technologies considered included renewable resources, thermal resources, market capacity, demand-side resources, and energy storage. Roseville selected resources for detailed evaluation based on those which met reliability requirements presented in Section 7, including both peak and flexible capacity needs, and RPS needs to develop candidate portfolios. The resource technology options carried forward for detailed analysis are summarized in Figure 39.

Need Category	Resource
Peak Capacity	Demand-side Management Thermal Energy Storage Market
Flexible Capacity	Energy Storage Thermal
RPS	Solar Wind Geothermal Biomass

Figure 39 – Resources

Each of the different resource technologies considered for analysis have different advantages and disadvantages, including tradeoffs in facility size, capital or installed costs, operating efficiencies, and environmental impacts. While larger power plant facilities tend to be more economical, Roseville's overall demand is relatively small. In these cases, the evaluation considered that Roseville could pursue an option jointly with another entity through a partial ownership share in the future. These resource options assumptions are summarized in Sections 9.4.1 – 9.4.4. Supply side options were provided by B&V[47] and are detailed in Exhibit B, while Demand-side Management options were developed internally by Roseville.

9.4.1 Energy Storage

Energy storage has become an important grid resource in recent years at both transmission and distribution levels. While it is not considered a generation resource (since charging requires energy from a generation resource), energy storage has the capability to perform a variety of grid-beneficial applications including peaking supply and flexible capacity.

Applications can often be characterized by the primary use for meeting flexible energy needs, or peak energy needs. Flexibility applications include regulation to integrate renewables and results in short duration (approximately five minutes to one hour) charging and discharging that may involve many cycles per day. Peak energy applications generally require longer duration (approximately three hours or more). Peak capacity, energy time-shift, capacity firming, and transmission upgrade deferral are examples of peak energy applications. Costs, and revenues, vary widely among applications and energy storage system configurations. For the purpose of this IRP, Roseville evaluated lithium ion battery storage, as it is the lowest cost battery technology, and has been proven in grid level applications.

47 For renewables, wind and solar resource cost assumptions were provided by B&V per Exhibit B, geothermal and biomass were provided by the Lazard Levelized Cost of Energy study: https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-100/

9.4.2 DSM

Roseville will continue to implement its existing energy efficiency and demand response programs. This IRP evaluated smart thermostats as an additional DSM option to provide peak capacity for Roseville and EE savings for the customer (via AC load reduction technology). This technology enables two way communication to the thermostat device for customers opting into the program. Smart thermostats could be utilized by Roseville peaking resource, by pre-cooling the house ahead of an event. In addition to DR, the customer realizes EE benefits in bill reduction, and Roseville would see overall GHG reductions.

9.4.3 Natural Gas Fueled Generation

Although natural gas fueled generation technologies produce greenhouse gas emissions, these resources provide firm capacity and have dispatchable characteristics, which can be used meet peak and flexible capacity needs. Thermal resources evaluated include: simple cycle, combined cycle, reciprocating internal combustion engines, and aero-derivative.

Each of the different resource technologies considered for analysis has different advantages and disadvantages, including tradeoffs in facility size, capital or installed costs, operating efficiencies and environmental impacts. The projected costs and operating characteristics for gas turbine-based and reciprocating engine technologies was levelized to a Net Cost of New Entry (NCONE) approach. The NCONE is a measurement (in $/kW-Yr) of the net cost of capacity after all other market revenues (e.g. energy market revenue).

9.4.4 Renewable Resources

Renewable energy technologies considered in the analysis included geothermal, biomass, solar and wind. There are currently federal tax incentive programs available to third-party developers, which can reduce the net effective cost of renewable energy to power purchasers such as Roseville. The analysis was therefore based on the assumption that Roseville would obtain energy from renewable facilities through a power purchase agreement (PPA) structure with a third-party independent power producer (IPP). To obtain indicative pricing for a PPA, a levelized cost of energy (LCOE) was developed. Each technology was modeled assuming the representative project would come online in 2020 and 2030. For facilities coming online in 2030, it was assumed that cost reductions and performance improvements would continue to occur, consistent with observed trends over the past decade.

9.5 Portfolio Analysis and Results

Section 7 of the IRP demonstrated Roseville's forecast needs for capacity and resources to meet compliance obligations. The needs include:

- Peak capacity
- Flexible capacity by 2025
- RPS procurement by 2025

Resource options were presented in Section 9.3 including both demand-side and supply-side resources. Among these options, Roseville considered the best fit for its needs.

9.5.1 Peak

Roseville has a portfolio of peak resources that include owned and long-term contracted assets in both CAISO and BANC. At times, Roseville makes short-term market purchases to manage its year-to-year capacity needs due to market opportunities, plant derates, or outages.

Roseville utilizes generation assets in CAISO to meet its peak needs. Roseville has rights to a number of NCPA assets located in CAISO, providing 56.6 MW of peak capacity. Roseville utilizes these CAISO resources as a supporting resource to Roseville's energy exports for meeting peak needs. A supporting resource is valuable for providing higher reliability and deliverability during a contingency event. Similar to these NCPA asset backed exports, Roseville may enter into transactions in the CAISO for resource backed capacity to fill any remaining peak needs that may arise due to planned or forced outages, drought driven hydro shortfalls or other peak capacity issues. Alternatively, Roseville may solicit and procure capacity within the BANC BAA as well.

Roseville forecasts peak demand to continue to rise over the planning period, while annual energy demand is in gradual decline, even with the added load from electric vehicles. Figure 40 below shows Roseville's resource stack for meeting its one-in-two peak, and meeting its fifteen-percent planning reserve margin.

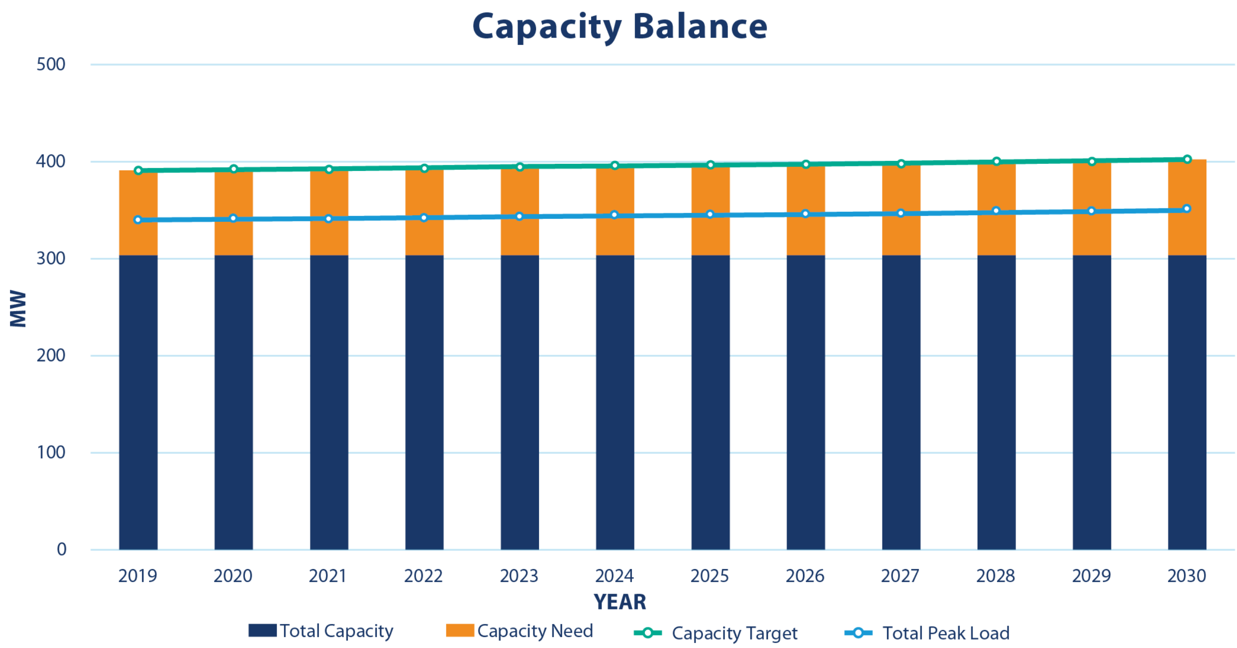


Figure 40 - Peak Capacity Balance

New capacity investment analysis included a NCONE approach of new supply and demand resources, compared to market forecast. Figure 41 illustrates the 2018 NCONE of peaking resource options.

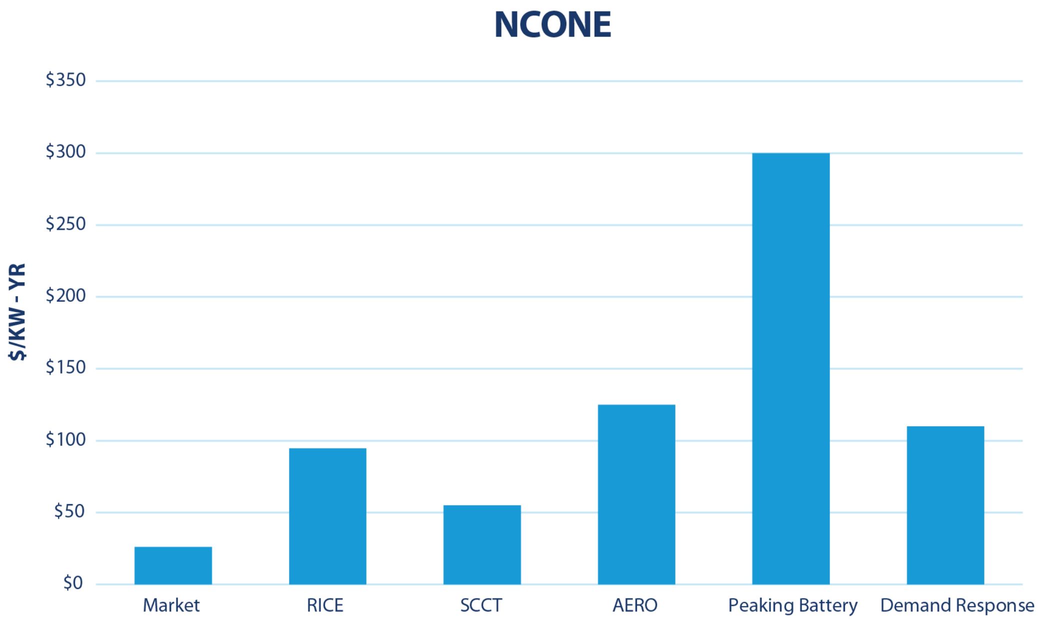


Figure 41 – 2018 Peak NCONE

Market capacity is the lowest cost option due to excess supply in California. B&V's forecast is that the excess supply tightens in 2023, which is expected to cause price increases in market capacity, which could create upward pressure on prices.

Resource investment decisions must weigh some key risks, including long-term capital commitment in an uncertain market, and uncertain long-term GHG allowance prices. Thirty year asset investments are high risk in a market facing unprecedented market upheaval with rapidly changing environmental regulations, and the decision to recommend a long-dated capital intensive asset must meet a high level of need to justify the investment uncertainty.

Roseville's peak capacity portfolio will meet reliability needs by diversifying low cost market options, and increasing access to low carbon markets. Therefore, to meet peak needs, Roseville will take the following actions:

- Procure additional transmission to access low emission energy markets
- Perform an evaluation of its Demand Response program, and review opportunities to upgrade it to advanced smart-grid solutions

In January 2018, Roseville entered into a transmission service contract with PacifiCorp. Roseville is expected to begin taking service in March 2018 under a long-term transmission contract for 50 MW of firm transmission, increasing Roseville's existing Northwest transmission (Roseville has 29 MW of the COTP). This is a five year contract, where Roseville has the first right to extend at the end of the contract term. This will accomplish two objectives: 1) increase reliability and 2) access lower carbon emitting resources. Roseville will enter into energy and capacity transactions with COB counterparties to utilize the firm transmission for delivery to Roseville's system. These imports will position Roseville's local generation assets for greater use towards load following and ramping needs. Additionally, this transmission contract increases Roseville's transmission capability to transact with counterparties for specified resources with low and zero emission resources. The COB market is largely hydro-electric generation. Roseville actively transacts specified resources on existing COTP transmission capacity and will continue to solicit specified source transactions on this increased capacity to reduce portfolio emissions.

Resource Strategy-4 (RS4): Procure Transmission to Pacific Northwest.

9.5.1.1 Demand-side Management

Roseville analyzed EE and DR resources in its IRP. The existing DR program is aging, and new technologies provide both utility and customer benefits through smart thermostat technology. Smart thermostats provide two value streams in both energy efficiency benefits for the customer and peaking capacity to the Utility.

The current DR program is 2.1 MW of peaking capacity. Roseville forecasts market potential of 5-10 MW of DR capacity through a smart thermostat program. Considering the stacking value of both EE and capacity, smart thermostats are a cost competitive demand-side option to reduce capacity need, and reduce carbon emissions. Roseville's DR strategy is under evaluation including a transition plan from existing to new devices, and customer engagement though current smart thermostat incentives to determine customer appetite for this technology. Roseville will prepare a business case for transitioning the existing demand response (DR) program to improved technology, which will provide capacity for Roseville and energy efficiency savings for Roseville's customers

Resource Strategy-5 (RS5): Investigate Demand Response Program Enhancement.

9.5.2 Flex

Roseville forecasts its existing portfolio capable of managing Roseville's five-minute net-load variation and flexible capacity needs until around 2025, when additional flexible capacity may be needed. The primary driver of Roseville's flexibility needs is rooftop solar or distributed generation which to date has consisted of a steady rate of home owner retrofits that is expected to decline over the next few years. However, in 2020, all new construction will be ZNE and likely will require rooftop solar systems, adding more intermittency for Roseville to manage. Roseville will continue to track the actual rooftop solar installations, and refine forecasts for when flexibility may exceed current resource capabilities.

There are a number of options available to Roseville for adding flexibility. REP is the key piece of infrastructure in Roseville's generation portfolio. It is a modern combined cycle plant that is designed to be efficient, quick starting and ramping. REP can provide flexibility, but at a cost of added carbon and uneconomical dispatch.

To provide flexibility, REP would need to be utilized as a must-run resource at a level where it could increment up or decrement down as needed to offset deviations from roof-top solar. The penalty for operating REP for flexibility would be needing it to follow net-load as solar ramps up in the morning, running most of the day at low efficiency, at a high unit energy cost, and at a high carbon emission level. The higher carbon emissions would push up Roseville's portfolio emissions to a level that may challenge Roseville's soft 2030 carbon emissions target (see Figure 40 below).

Internal combustion engines (ICE) are highly scalable and a proven technology for adding peak, ramp, and flexible capacity. Power stations can be readily assembled with independent engines that often increment in 10MW. ICE units can be dispatched within a couple of minutes, and their output can be readily throttled up or down to meet flexibility challenges. An ICE power station's modular design allows it to turn on additional units, stepping up to meet ramping needs, and throttling engines down to meet flexibility demands. The modular design does not have the same minimum generation level drawbacks that a combined cycle plant like REP has, so its emission costs and impacts to Roseville's 2030 emission's target (see Figure 40 below) are less significant than REP.

Storage, such as lithium-ion batteries are non-generating resources (NGR) that can provide peak, ramp and flexibility benefits, and respond faster than any traditional power generation technology. As an NGR, batteries are typically sized to provide ramping and flexibility benefits for an hour, or peaking benefits over a four hour period. In a carbon constrained world, batteries can provide grid flexibility benefits, with a modest carbon impact from the roundtrip losses associated with the charging and discharging cycle. Batteries scale from small household systems of around 5 kW (13.5 kWh) to utility level modular systems as large as Southern California Edison's 20 MW (80 MWh) Mira Loma Project. For the IRP analysis, the added carbon emissions of battery storage were negligible, as shown below in Figure 42. In the long-term, NGR has the potential to be a key element of a broader DSM strategy that coupled with AMI, may enable Roseville to promote or incentivize customers to consider battery storage coupled with their rooftop solar to control the flexibility issues such systems place on the Utility.

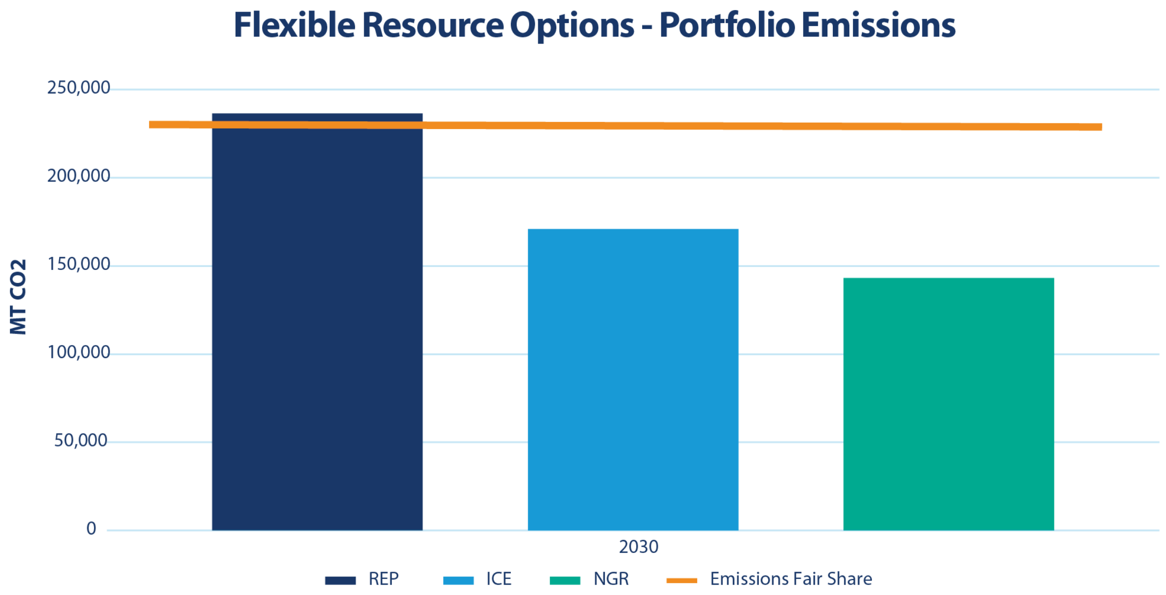


Figure 42 - Flexible Resource Options Portfolio Emissions

Roseville performed a detailed analysis to estimate the NCONE to compare existing resources like REP to future investments in new resources like ICE or NGR's like batteries. The analysis (see Figure 43 below) considered life-cycle costs including siting, capital investment, fuel, fixed and variable operations and maintenance costs, and carbon emission compliance costs.

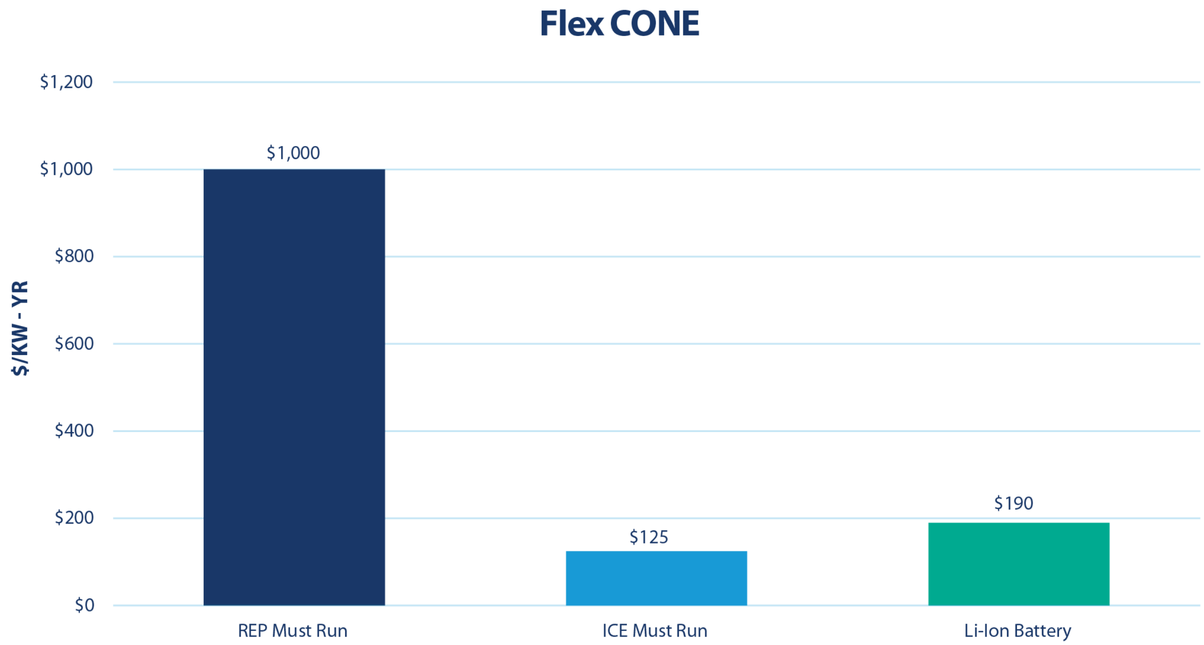


Figure 43 - NCONE for Flexibility Options

REP in a must-run state is not cost effective and challenges Roseville's ability to meet the State's 2030 portfolio emission targets. The key challenge for REP is for it to meet flexibility needs, it must run near its minimum level where its efficiency is lowest, resulting in high fuel costs and high emission compliance costs.

ICE was shown to be very effective at providing peak, ramp, and flexibility benefits that align and scale well with forecast needs. ICE had the lowest NCONE, and had a lower overall emissions profile compared to REP. ICE does increase emissions when it is needed for flexibility, and it would require Roseville to commit to a thirty-year capital investment decision. The long-term investment risk of ICE is considered to be very high since much of California's energy policy has been changing at an unprecedented pace and recent legislative efforts are aimed at even lower GHG emission targets, possibly a 100% clean energy target. The likelihood of a stranded investment is too high to pursue a sizable ICE power station.

Battery storage has low exposure to carbon emission prices, is nearly as cost effective as ICE in this baseline analysis. However, battery price assumptions, particularly value analysis, range widely when evaluating NCONE. A recent study by the Brattle Group[48] performed a stacked benefits[49] analysis of batteries. That analysis resulted in a NCONE of $113/kW-yr. Battery storage demand and manufacturing scale has seen exponential growth in the last decade driven by personal electronics, electric utilities, and the proliferation of electric cars. Unlike other flexibility alternatives, battery storage has the highest potential for further cost improvements, and is capable of being part of a utility-scale project, or part of a DSM effort. Battery storage gives Roseville many scalable options to design supply and demand-side programs. Roseville will perform a battery storage study and may execute a pilot project to deploy battery storage as a flexible resource.

Resource Strategy-6 (RS6) – Evaluate Energy Storage Pilot Project as Flexibility Solution.

48 Hledik, Ryan, et al., "Stacked Benefits: Comprehensively Valuing Battery Storage in California", The Brattle Group, September 2017
49 Stacked benefits is a detailed analysis of both the operational characteristics of the battery and the nature of the value streams it cap

9.5.3 DERs and Grid Modernization

In 2015, Roseville worked with Leidos on a Smart Grid feasibility study. The study assessed Roseville's existing system technology and data collection, and performed a cost-benefit analysis of modernized Smart Grid solutions. AMI proved to be a benefit for Roseville by providing enhanced data capabilities of the grid for both utility and customer benefits. Current residential meters in Roseville are read monthly, whereas AMI will enable meter's to be read intra-hourly.

In December, 2017, Roseville's City Council took the first major step toward modernizing the electricity system by approving an AMI project with Itron Incorporated. AMI deployment is scheduled to complete in 2020.

Moving forward, Roseville plans to leverage AMI capabilities to enhance the efficiency, security, reliability, and resiliency of Roseville's distribution systems and enhance customer services by:

- Equitable rates – AMI enables Roseville to develop efficient and equitable rate structures
- Customer empowerment – AMI enables technology to communicate to customers, that may incent energy efficiency and demand reduction for grid and customer benefits
- Renewable integration - AMI provides the system granularity to integrate significant amounts of distributed energy resources into utility transmission and distribution systems

Roseville, driven by changing grid characteristics is engaging solutions that can integrate grid information from various platforms. This effort includes the development of a technology roadmap to leverage the AMI capabilities for the benefit of Roseville's customers. These capabilities include the following reliability supporting functions:

- Remote monitoring and control of distribution equipment (switches, reclosers, regulators, capacitor banks, dynamic VAR compensators, and faulted circuit indicators)
- Asset health monitoring (transformers in particular, but also circuit breakers and protection and control systems)
- Network modeling and analysis (typically power flow, voltage, and faulted circuit analysis)
- Outage management (including automatic outage notification, fault locating, restoration, and verification)
- Dispatch and control of distributed resources (especially solar, emergency back-up generators, onsite customer generation, and in some cases micro wind and battery storage)
- Voltage optimization (optimizing service entrance voltage to improve system efficiency)
- Real-time/dynamic equipment rating (especially circuits, substation getaways, and transformers)
- Failure prediction (especially in substation and distribution transformers)
- Fault analysis (especially the identification of momentary outages and high-impedance faults)

AMI is expected to provide an opportunity to evaluate non-conventional resources. This will enable Roseville to expand DSM offerings in areas of EVs, distributed solar, and advance EE and DR programs. This approach will enable Roseville to implement diverse solutions for flexibility needs. Roseville's technology roadmap will include a comprehensive and proactive strategy to enable solutions for customer to grid benefits.

Resource Strategy-7 (RS7): Develop Comprehensive Distributed Energy Resource Strategy Including Flexibility Options.

9.5.4 RPS

Roseville is on target to meet the 40% RPS target through 2024 with its existing renewable portfolio. As presented in Section 7.1, new renewable energy needs begin in Compliance Period 5 (2025-2027). Roseville will comply with RPS by procuring additional renewables in advance of Compliance Period needs. The IRP evaluated renewable technologies discussed in Exhibit C (Resource Options).

Renewable resource cost assumptions were derived from a combination of the Lazard LCOE 11.0 report, and B&V market quotes for renewable energy in California. The Lazard report is an annual update of LCOE analysis presented in terms of levelized cost of output in $/MWh for various technologies based on forecast fuel costs, capital costs, tax credits and several other factors. In the renewable sector, the most notable changes include cost declines in wind and solar. This is due largely to the high saturation of manufacturing capacity, low cost of capital, and increases in efficiencies of solar panels and wind turbines. Renewable resources evaluated in Roseville's IRP include wind, solar, geothermal, and biomass.

Particularly important to renewable resource evaluation is the expected market revenue. For geothermal and biomass, these resources operate at all hours in a relatively flat generation profile. The energy value or these resources is the average electricity price. Conversely, wind and solar resources have highly variable time-of-day output which requires a time-of-day analysis for expected resource revenue. The duck curve impact will result in lower market revenue during the midday hours. Figure 44 illustrates the 2030 price B&V's model results with the following characteristics:

- Average 24 hour solar output profile in blue (measured by left axis as % of max capacity)
- Average 24 hour wind output profile in orange (measured by left axis as % of max capacity)
- Average 24 hour price shape in navy blue (measured by right axis in $/MWh)

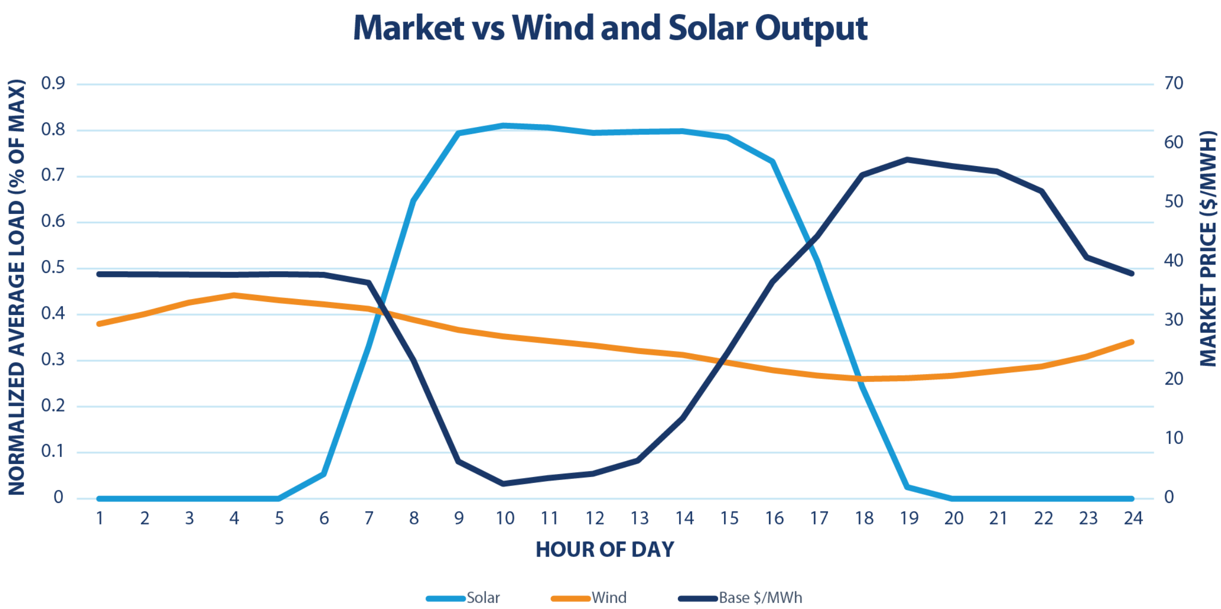


Figure 44 - 2030 Market vs wind and solar output

Clearly, the duck curve effect devalues energy for mid-day generation, and provides an energy premium for HE 19-22 energy. In 2025-2030, solar averages $13.90/MWh in revenue, while wind averages $32.54/MWh. Also, beyond the average, it is important to note the average $/MWh revenue trend of these resources, as more renewable resources come online.

Modelling the expected market revenue is important due to time-of-day generation coincident market conditions. The model results indicate that year-over-year, solar revenue declines as more solar generation is added. Figure 45 illustrates the average $/MWh market value of solar compared to wind from 2020-2030.

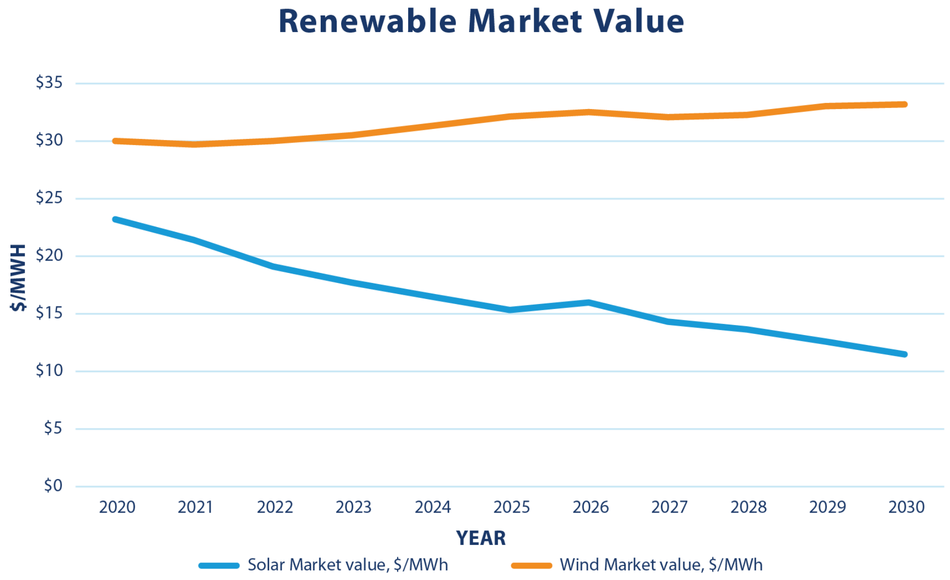


Figure 45 – Renewable Market Value by Resource

The chart above displays the model results for average annual market revenue for solar and wind. The forecast indicates solar revenue declining over time, while wind is slightly increasing. This is the result of time-of-day generation for solar being coincident with lower priced energy, whereas wind is generating during higher priced hours, as illustrated in Figure 44. Figure 45 shows that solar market value is $7/MWh less than wind in 2020, growing to $21/MWh in 2030.

For a comparison of relative renewable attribute cost, Roseville utilized the metric implied REC cost. Implied REC cost is the LCOE, plus integration costs if applicable, less the market revenue for energy to establish the forecast net cost. Figure 46 illustrates this calculation and presents the implied REC costs of the four resources considered in Roseville's analysis.

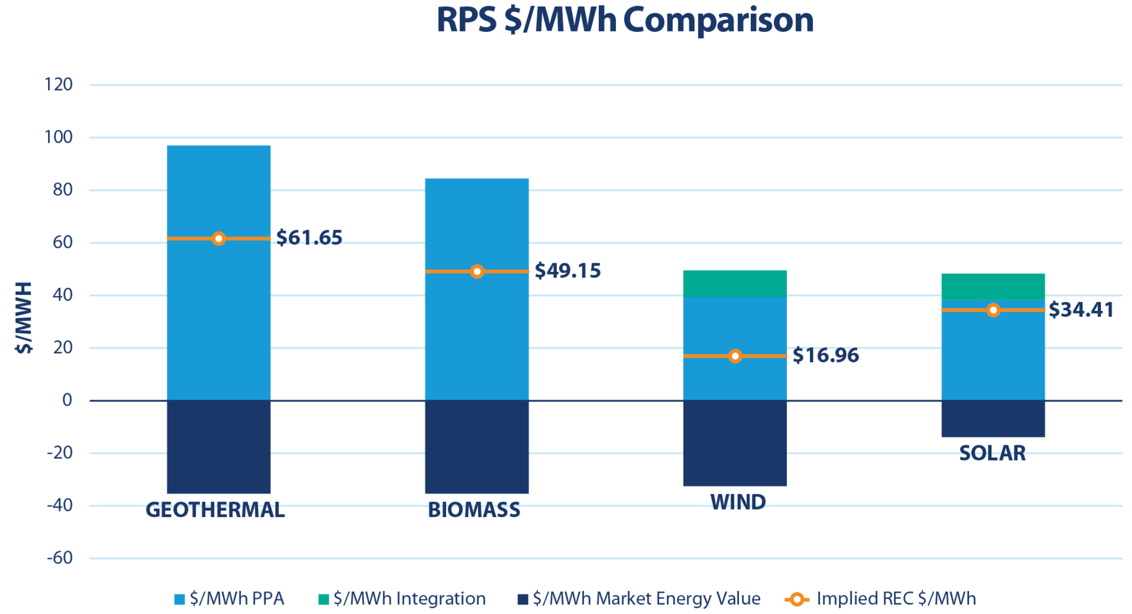


Figure 46 - Implied REC Cost

Wind and solar are the lowest net cost. As presented in Section 9.2.3, there are limitations to the model, including the forecasted integration cost of renewables. Roseville used B&V's integration cost assumption of $10/MWh for both wind and solar. Geothermal and Biomass do not have the same variable characteristics, and thus have no integration cost. The challenge to this assumption will be how integration requirements change over time, as more renewables are interconnected to the grid. Also, integration requirements may vary, depending on fuel, which could impact the implied REC analysis.

While wind is the lowest cost resource, investing solely in one technology limits portfolio diversity, which can mitigate cost exposure as cost assumptions change over time. Therefore, Roseville chose a low cost, diversified renewable portfolio, where 50% of the need is met with solar and 50% by wind. Existing geothermal and small hydro-electric resources are assumed to continue to be part of Roseville's portfolio. Roseville will issue future requests for proposals, and evaluate offers on a case-by-case basis to recommend to Roseville City Council.

Resource Strategy-8 (RS8): Prepare RPS Execution Plan For RPS Need.

9.6 Results Summary and Preferred Plan

Roseville's IRP identified customer needs through 2030 and analyzed resource portfolios to meet those needs. Roseville's Preferred Plan is the recommended long-term plan to achieve its IRP priorities. The Preferred Plan forecasts new resources will not be required until 2025, when renewable energy resources will need to be procured to meet state RPS compliance, and flexible resources may be required to help integrate rooftop solar.

Through 2030, Roseville anticipates customer growth driven by ZNE homes (as presented in Section 2.6.2), yet retail energy sales are forecast to decline. The net decline is due to reductions in customer energy consumption driven by energy efficiency, as well as more homes with rooftop solar. From 2018 to 2030, the amount of rooftop solar is forecasted to triple, due largely to strict environmental building standards. While this will reduce energy supply needs, solar output is limited due to intermittent seasonal weather changes, any every day there is sudden decrease in output in the early evening hours, requiring other portfolio resources to ramp up to meet peak demand.

Peak capacity needs will be met with existing resources and market purchases, with an action plan to evaluate layering in demand-side options. This includes increasing the reliability of Roseville's peaker plant known as Roseville Power Plant #2, purchasing long-term transmission to access Northwest energy trading hubs, and evaluating an expanded demand response program to diversify portfolio capacity.

To date, Roseville has taken early action to ensure long-term RPS compliance with a diversified portfolio of solar, wind, small hydro-electric, and geothermal resources. Renewable energy under contract will keep Roseville in RPS compliance through 2024, when additional renewable energy will need to be procured. Solar and wind resources are the lowest cost renewable resources, due to significant cost declines in recent years, and are expected to be the post-2024 sources Roseville will use to meet its RPS needs.

Renewable integration, or managing the intermittency caused by intermittent renewable resources (rooftop and utility-scale solar), will be an operational challenge in the future. Beginning in 2025, Roseville may require additional flexible capacity to preserve grid reliability. Roseville will evaluate a low risk, scalable, energy storage pilot project to help integrate renewables. Additionally, Roseville is implementing advanced metering infrastructure (AMI), which will enable evaluation of non-conventional resources, including the aggregation of customer sited resources which could serve as a flexibility option.

10 Portfolio Costs and Risks

Roseville's 2018 IRP priorities include providing competitive prices to customers. The 2018 IRP Preferred Plan will meet compliance requirements, maintain high reliability, and will ensure Roseville maintains affordable electric service to its customers.

10.1 Preferred Plan Costs

Roseville forecasts power portfolio costs for the Preferred Plan to incrementally increase over the planning period. The causes of the increase have been segmented into three categories, to better understand the causal driver of the cost change, and the forecast impact. These increases are an industry wide phenomenon among California utilities given the changes in state energy policy and utility requirements. The categories, drivers, and impacts include:

Category	Driver	Impact
Direct Environmental (49% of cost impacts)	Increased RPS requirements	RPS resource cost is higher than market replacement
	Extension of Cap and Trade (GHG cost)	GHG obligation for generation and market purchases
Indirect Environmental (12% of cost impacts)	New system intermittency, CAISO intermittency obligations	Integration costs due to intermittent resources
Other Power Supply (39% of cost impacts)	Growing system peak	Adding capacity with increasing prices
	Natural gas market and PG&E transportation costs	Forward market prices forecasted to increase

Figure 47 - Cost Drivers

Environmental compliance is the key cost driver in the IRP. Environmental compliance includes increasing RPS requirements, and carbon emissions costs that are embedded in market purchases and Roseville's thermal generation. Increases in RPS requirements and GHG market prices will increase direct environmental costs, and require assets to integrate renewables resulting in indirect environmental costs. Roseville forecasts costs to increase $22 million (nominal) from 2018-2030, or 2.75% annually (less than 1% when adjusted for inflation).

Roseville has estimated the impacts to its customers to achieve these policy mandates while maintaining reliability of the Preferred Plan in total portfolio cost. Total annual power portfolio costs (fixed and variable) in Figure 48 are expressed in nominal million-dollars per year. While portfolio costs are increasing modestly above inflation, rates will be pressured by the compounded effect of higher costs over lower retail energy sales. Changes in rate design after AMI is in place could potentially mitigate this. Forecasted increasing supply costs and decreasing retail energy sales are illustrated in Figure 48.

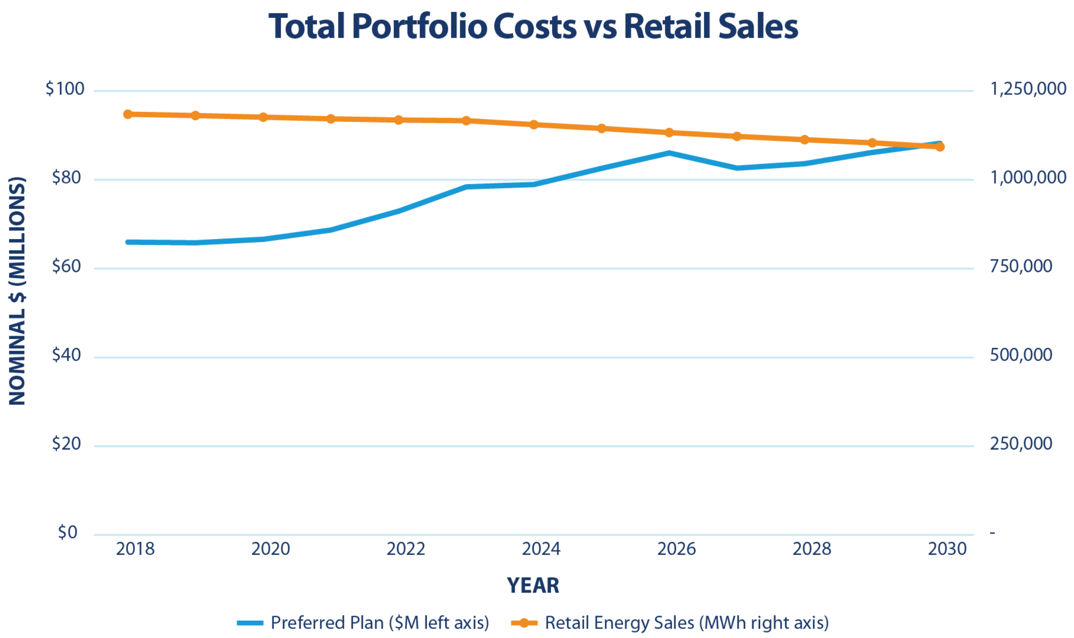


Figure 48 - Power Supply Portfolio Costs and Retail Sales

The Preferred Plan forecasts the power supply component of retail rates increasing by 3.45% annually from 2018-2030.

10.2 Risks

Portfolio costs are subject to risk. Roseville analyzed cost risks to the Preferred Plan and identified three key risks. First, environmental compliance is not only a key cost driver in the Preferred Plan, but also the leading risk with the potential for RPS compliance to increase, along with GHG allowance prices. Second, transmission costs could increase substantially pending proposals that would impact the WAPA transmission system. Third, bilateral counterparty liquidity is declining due to the expansion of structured markets such as the Energy Imbalance Market (EIM), which may expand to a day-ahead market, and further erode bilateral energy market liquidity.

10.2.1 High Environmental Compliance Cost Risk

Environmental compliance is expected to be the largest cost risk to Roseville over the planning period. The carbon allowance market has the potential to increase considerably from the base case market scenario. Figure 49 illustrates the projected range of the Cap and Trade market emissions allowances. The base case carbon prices from B&V trend at the floor. Roseville tested the portfolio against a higher environmental compliance scenario where CO_2 prices escalate according to Figure 49.

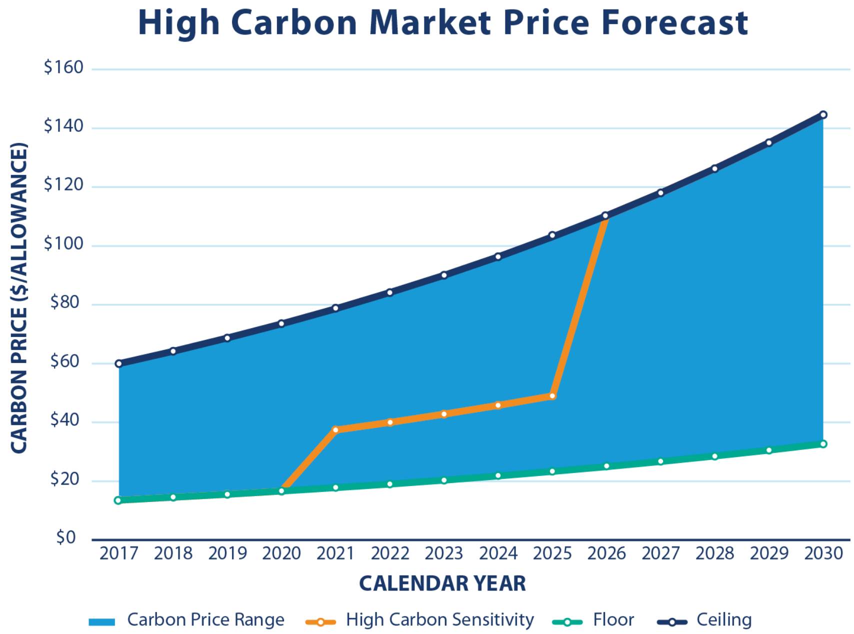


Figure 49 - CO_2 Market Price Range

As of the drafting of this report, there are pending regulations from CARB that will impact the price range assumed in this IRP (Figure 49). Roseville's high carbon scenario is in line with some of the current discussions regarding implementation of updated GHG market design elements and provides one view of how portfolio costs are impacted under a feasible carbon market scenario.

California has continued to move to stricter RPS measures from SB X1-2 (2011), SB 350 (2015), and recently proposed legislation for increasing the RPS target to 60% by 2030. Along with higher carbon allowance prices, Roseville included stricter RPS regulations of 60% RPS by 2030 in the high environmental compliance scenario. Figure 50 illustrates the impact on total portfolio cost due to higher environmental regulations.

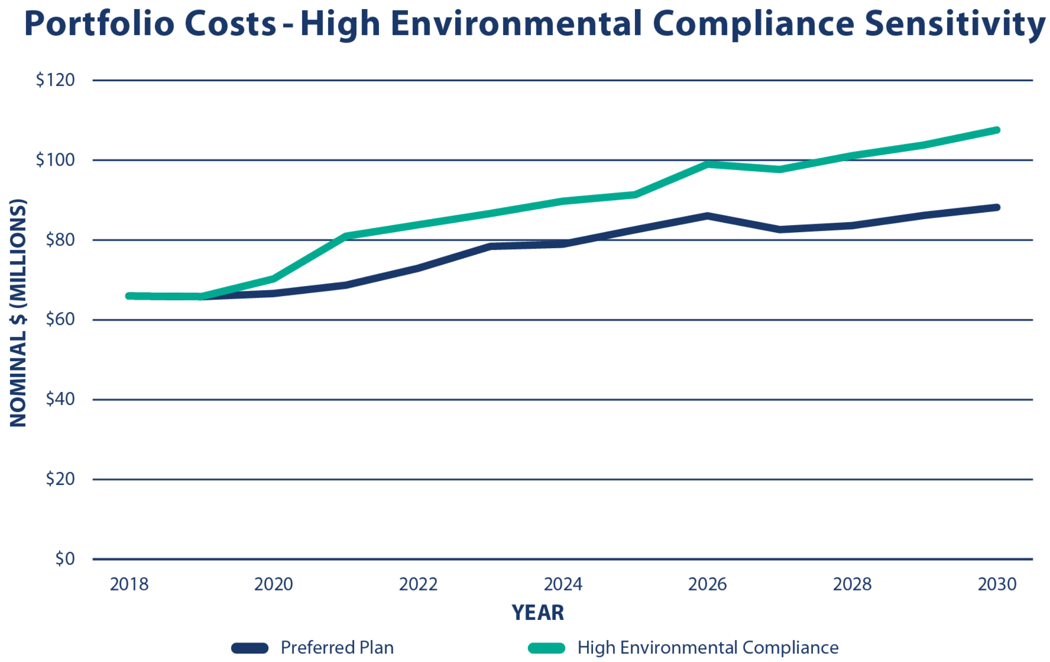


Figure 50 - Portfolio Rate Impact: High Environmental Sensitivity

The impacts to total portfolio costs from the high environmental compliance case are significant. Costs would see significant increases, including a 16% increase in 2021, and a 9.9% increase in 2026. When combined with lower net load, it will adversely impact Roseville's customers.

Roseville's portfolio has the benefit of hydro resources and transmission access to the hydro rich Pacific Northwest, which will help shield Roseville's customers from added GHG compliance burdens versus many other California utilities. When CARB completes the long-term regulations impacting Cap and Trade allowances, Roseville will develop a strategy to mitigate cost risks due to carbon.

Risk Mitigation -1 (RM1): Develop a strategy to mitigate carbon market cost exposure.

10.2.2 Transmission Cost Risk

Roseville has low transmission service costs with WAPA compared to the majority of California load serving entities in the CAISO territory. This low transmission cost is threatened by two scenarios: 1) the recurring proposal to privatize the Federal Power Marketing Agencies (PMA); and 2) regionalization of the CAISO.

Roseville gets network high voltage transmission service from WAPA, a PMA. Roseville's high voltage transmission service is nearly one-third the cost of transmission service in CAISO, and is escalating at a lower rate. Privatizing the PMAs is expected to result in an auction style sale of the assets, and would likely transfer control of WAPA transmission lines to the CAISO control area and become part of the PG&E area high-voltage transmission access charge (TAC) revenue requirement. Transitioning from the current PMA transmission service to the CAISO is expected to triple Roseville's annual transmission costs, and increase power portfolio costs by over 15%. This is illustrated in total cost in Figure 51.

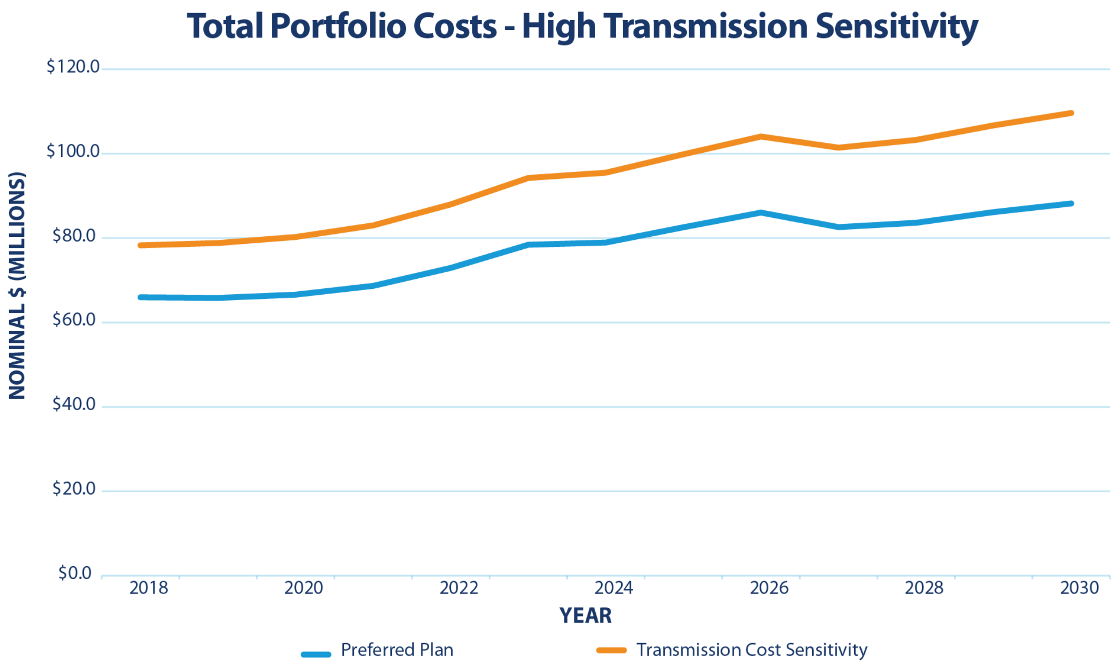


Figure 51 – High Transmission Costs Sensitivity

Transmission cost risk is significant, increasing power supply costs by approximately $10-$20/MWh over the study period. Roseville will work with its BANC partners to maintain the PMA's and its affordable transmission service for Roseville's customers.

10.2.3 Liquidity Risk

The Preferred Plan includes an evaluation of market opportunities for Roseville to lower power supply costs. The Western Energy Imbalance Market (EIM) is a real-time energy market with the opportunity to optimize Roseville's portfolio in both cost and emissions reductions. Several of Roseville's bilateral trading parties have joined the EIM, or are in the process of joining. This in turn will impact Roseville Electric's trading opportunities.

The California ISO's EIM is a real-time market launched in 2014. The EIM is expected to enhance grid reliability, improve the integration of renewables, and provide cost savings by dispatching the lowest cost resources across participating balancing authorities. Utilities that participate maintain their existing balancing authority reliability obligations, and are free to offer as much or as little of their assets into the real-time optimized market dispatch.

EIM has levels of participation, with a participating balancing authority contracted with CAISO as a "Balancing Authority Entity" and its transmission contracted as an "Entity Scheduling Coordinator." For Roseville, the BA Entity would be BANC. Currently for BANC members, only SMUD is joining EIM and is scheduled to go live in 2019. Roseville, connected to the WAPA SBA, is evaluating EIM participation and addressing any barriers for future EIM participation as part of the BANC BAA. For Roseville to consider joining EIM, Roseville would need to contract its Generation resources within BANC as "Participating Resources for the SC," while Roseville would contract with CAISO as a "Participating Resource Owner Agreement." Joining EIM is estimated to be an 18-month process that includes: planning and project management; policy, legal and contracts; EIM network model and energy management changes; system integration and testing; metering and settlements; and operations readiness and training. Entities that are part of EIM indicate that it is a large investment in people and capital to join, as well as new scheduling and communication protocols.

EIM is an opportunity for Roseville and other BANC members. BANC has diverse resources including long-term transmission rights to the Pacific Northwest. However, as much diversity as BANC has, CAISO and its EIM participants have a lot more. The EIM benefit for Roseville is to more economically deploy its resource stack. This benefit is not without cost. CAISO has many stakeholder processes that Roseville would be compelled to engage in. New EIM scheduling and settlement platforms would need to be implemented, as well as technical upgrades to Roseville's metering, and automatic dispatch capabilities at its power plants. The benefits of the EIM would need to be weighed with the increase in staffing and system costs as well as complexity in operating the Utility. Roseville is engaged in an EIM evaluation, and anticipates a final decision by April 2019.

Risk Mitigation -2 (RM2) – Roseville will study and evaluate the efficacy and financial viability of participating in the EIM to mitigate decreasing real-time market opportunities.

11 Greenhouse Gas Emissions

The California Air Resources Board 2017 Scoping Plan (reference Section 2.6.1) outlined the GHG emission targets for the state, and various economic sectors including the electric utility sector. The electric sector is responsible for implementing efforts to achieve a sector total in 2030 of 53 MMT CO_2e. Roseville's share of the electricity sector's 2030 target was estimated at 0.445%[50], or approximately 236,000 MT CO_2e by 2030.

Roseville's Preferred Plan provides an energy mix on trajectory to meet its share of utility GHG emission reductions. Over the IRP planning period, Roseville's addition of renewable resources, Northwest transmission and specified hydro resources, and demand-side resources, are expected to keep Roseville well below its emission target. Figure 52 illustrates Roseville's projected portfolio emissions through 2030, measured against the benchmark of Roseville's fair share target of utility sector-wide emissions reaching 53 MMT CO_2e by 2030.

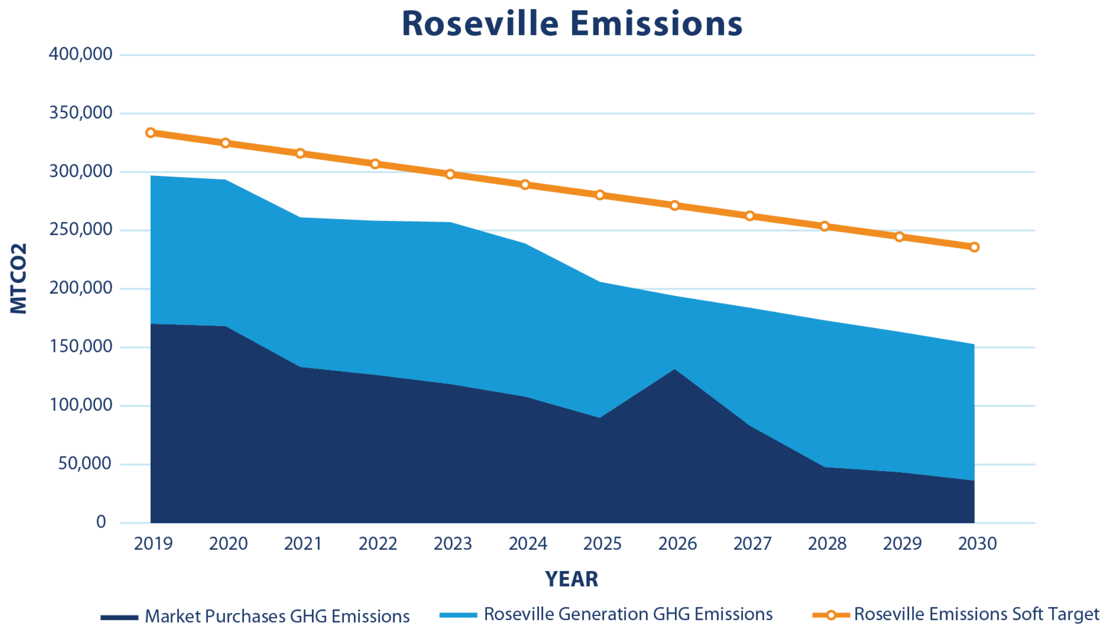


Figure 52 - Roseville GHG Emissions

Roseville's Preferred Plan is below the current target, and has some headroom to accommodate modest reductions to the electric sector's 53 MMT CO_2e. Future changes by CARB to the electric sector targets will be analyzed and addressed in future Roseville IRPs.

11.1 Localized Air Pollutants and Disadvantaged Communities

Roseville does not serve areas which are identified in CalEnviroScreen as disadvantaged communities. However, a portion of its customers are low-income. Roseville is focused on ensuring that those customers are not unduly burdened by rising energy costs.

Roseville provides its residents a number of programs designed to reduce their energy bills, such as shade tree, fan, sunscreen, and window replacement rebate programs. Roseville also provides a wealth of resources for customers to

50 Roseville used value from CEC presentation in December 2017. This value will be finalized by CARB in 2018, and is used in this IRP as best available information at time of report.

further reduce their energy bills, including energy efficiency workshops, energy consumption audits, and information guides for saving energy.

In addition, some proceeds from Roseville's sales of its directly allocated GHG allowances have been allocated for the benefit of low-income customers. Specifically, proceeds have been used to fund increased bill credits, no-cost retrofits for low-income homeowners, and no-cost retrofits for multi-family housing such as apartments.

Roseville has targeted programs for its low-income customers. These programs provide energy efficiency benefits, reduce GHG emissions, and contribute to lower electricity bills.

12 Conclusion

Roseville's IRP identified customer needs through 2030 and analyzed resource portfolios to meet those needs. Roseville's Preferred Plan is a resource portfolio that achieves the IRP priorities of providing service that is affordable, reliable and compliant with regulations. Roseville's energy portfolio mix from 2018-2030 will include higher proportions of renewable resources, carbon-free large hydro-electric, demand-side reductions, and thermal and market options.

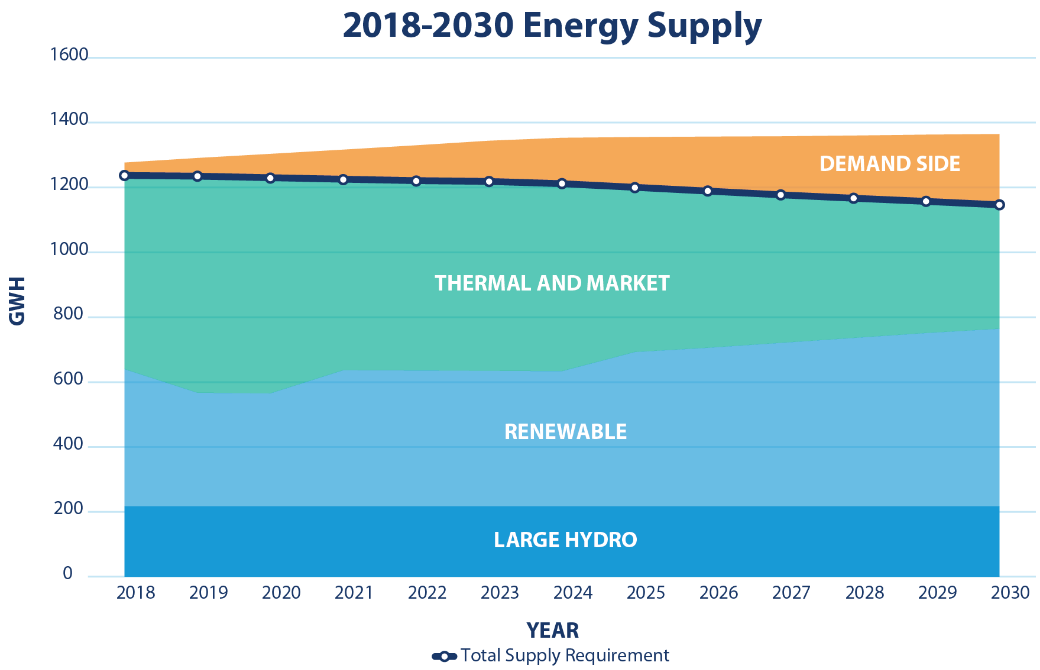


Figure 53 - Roseville 2018-2030 Energy Mix

In addition to the energy supply mix, Roseville's peak and flexible capacity needs will require action. The Preferred Plan presents an action plan for existing resource reliability, future resource evaluation, and leveraging available market capacity options. Roseville will take steps to evaluate options for portfolio costs reductions through the Energy Imbalance Market. Finally, the Preferred Plan identifies leading risks and actions to mitigate those risks. The following figure provides a summary of Roseville's Preferred Plan with actions for Resource Strategies (RS) and Risk Mitigation (RM) Strategies, with the forecasted timeline.

Peak Capacity Portfolio

Portfolio Forecast to be Short 90-100 MW of Planning Reserve Margin by 2030

RS-1: Maintain existing NCPA and Base Resource Contracts	2018
RS-2: Improve operating reliability of Roseville Power Plant 2	2018
RS-3: Study cost effective upgrades to REP to increase flexibility	2019
RS-4: Procure transmission to Pacific Northwest	2018
RS-5: Investigate demand response program enhancement	2018

Flexible Capacity Portfolio

Added Flexible Capacity Needed in 2025 and Beyond, Driven by Growth in Local Intermittent Resources

RS-6: Evaluate Energy Storage Pilot Project as flexibility solution	2019
RS-7: Develop comprehensive Distributed Energy Resource strategy including flexibility options	2020

Renewable Portfolio Standard

New Renewable Resources are Needed After 2024

RS-8: Prepare RPS Execution Plan for RPS need	2019

Risk Mitigation

Cap and Trade Prices Have Potential to Increase Significantly

RM-1: Develop Strategy to mitigate Carbon Market cost exposure	2018

Real Time Market Counterparties are Decreasing Due to Energy Imbalance Market

RM-2: Evaluate the efficacy and financial viability of participating in the EIM to mitigate decreasing real-time market opportunities	2019

Figure 54 - Roseville Portfolio Challenges and IRP Action

Roseville Electric will provide public updates on the progress, successes, and new challenges over the implementation period of this IRP that may impact the Preferred Plan.

Exhibit A - Acronyms

AAEE	Additional Achievable Energy Efficiency
AB	Assembly Bill
AC	Air Conditioning
B&V	Black and Veatch
BAA	Balancing Authority Area
BANC	Balancing Authority of Northern California
BEST	Blueprint for Energy and Solar Technology
BTU	British Thermal Unit
AMI	Advanced Metering Infrastructure
CAISO	California Independent System Operator
CARB	California Air Resources Board
CCGT	Combined Cycle Generator Turbine
COB	California Oregon Border
COTP	California Oregon Transmission Project
CEC	California Energy Commission, or Commission
CP	Compliance Period
CT	Combustion Turbine
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DER	Distributed Energy Resource
DG	Distributed Generation
DMV	Department of Motor Vehicles
DR	Demand Response
DSM	Demand-side Management
EE	Energy Efficiency
EIA	*Energy Information Administration*
EIM	Energy Imbalance Market
EV	Electric Vehicle
FEMM	Fundamental Energy Market Model
FERC	Federal Energy Regulatory Commission
FMM	Fifteen-Minute Market
FRACMOO	Flexible Resource Adequacy Criteria – Must Offer Obligation
GHG	Greenhouse Gas
GS	General Service
GW	Gigawatt
GWh	Gigawatt Hour
HE	Hour Ending
HVAC	Heating, Ventilation, and Air Conditioning
IEPR	Integrated Energy Policy Report
IA	Interconnection Agreement
ICE	Internal Combustion Engine
IOU	Investor Owned Utility
IPP	Independent Power Producer
IRP	Integrated Resource Plan
ISO	Independent System Operator
kW	Kilowatt
kWh	Kilowatt Hours
kV	Kilovolt
LCOE	Levelized Cost of Energy
LIDAR	Light Detection and Ranging
LNG	Liquid Natural Gas
MMBTU	Million BTUs
MW	Megawatt
MWh	Megawatt Hour
NCPA	Northern California Power Agency
NEL	Net Energy for Load
NERC	North American Electric Reliability Corporation
Net CONE	Net Cost of New Entry
NGR	Non-Generating Resources
NITS	Network Integrated Transmission Service
NP15	Northern California Path 15
O&M	Operations and Maintenance
PG&E	Pacific Gas and Electric
POU	Publicly Owned Utility
PMA	Power Marketing Administration
PPA	Power Purchase Agreement
PRR	Power Revenue Requirement
PUC	Public Utilities Code
PV	Photovoltaic
RASS	Residential Appliance Saturation Study
REC	Renewable Energy Credits/Certificates
REP	Roseville Energy Park
RPP2	Roseville Power Plant 2
RPS	Renewable Portfolio Standard
SAE	Statistically Adjusted End-use
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SB	Senate Bill
SMUD	Sacramento Municipal Utility District
STIG	Steam Injected Natural Gas Turbine
TAC	Transmission Access Charge
TANC	Transmission Agency of Northern California
TE	Transportation Electrification
U.S.	United States
USBR	United States Bureau of Reclamation
VAR	Volt-Ampere Reactive
VER	Variable Energy Resource
WAPA	Western Area Power Administration, or Western
WECC	Western Electricity Coordinating Council
ZNE	Zero Net Energy

Exhibit B – Black and Veatch Resource Options and Assumptions

Roseville considered a number of different technologies when developing preferred resource plans to evaluate. Technologies considered ranged from renewable resources, conventional technologies (which includes those fired by natural gas) and purchases from the market. Current conservation and energy efficiency programs, as outlined in this document, were assumed to continue, and are incorporated into the demand forecast. Roseville selected resources for detailed evaluation based on those which achieved reliability requirements, RPS goals, and cost goals, while balancing environmental policy goals and regulatory requirements as discussed further below. The resource technology options carried forward for detailed analysis are summarized in Table B-1.

Table B1 Resource Technology Options

Conventional Technologies
• GE 7FA based Simple and Combined Cycle • Advanced Class Combined Cycle • Aero-derivative GE LMS100 • Aero-derivative GE LM6000 • Wartsila Internal Combustion Reciprocating Engines

Renewable Technologies
• Utility-scale Solar • Utility-scale Wind

1.1 Natural Gas Fueled Generation Technologies

Although natural gas fueled generation technologies produce greenhouse gas emissions, these resources can provide firm capacity and have dispatchable characteristics, which can be used to offset the intermittent operating profiles of renewable resources and to meet Roseville's energy needs when renewable resources are not capable of producing energy (as with a solar plant which produces no energy after the sun goes down).

Each of the different resource technologies considered for analysis have different advantages and disadvantages, including tradeoffs in facility size, capital or installed costs, operating efficiencies and environmental impacts. The projected costs and operating characteristics for representative gas turbine-based and reciprocating engine technologies considered are summarized in Table B-2.

As shown, the GE 7FA simple cycle option is projected to have the lowest installed cost on a $/kW basis although the lower capital cost is offset by a lower efficiency and higher operating costs over the life of the unit. Combined cycle options tend to achieve the highest operating efficiencies but also typically have higher initial investment requirements and greater environmental impacts. The aero derivative units (GE LM6000 and LMS100 technologies) and reciprocating engines tend to have both good operating efficiencies and high operational flexibility.

While larger power plant facilities tend to be more economical, Roseville's overall demand is relatively small. In these cases, the evaluation considered that Roseville could pursue this option jointly with another entity through a partial ownership share.

Table B2 Combustion Turbine-Based New Generation Resource Cost and Characteristics

Asset Type	Combined Cycle Combustion Turbine (CCCT) Technologies			Simple Cycle Combustion Turbine (SCCT) Technologies			Reciprocating Internal Combustion Engine
MODEL DESIGNATION	1 X 1 GE 7FA	2 X 1 GE 7FA	2 X 1 ADVANCED CLASS	GE 7 FA	LM6000	LMS100	WÄRTSILÄ 20V31SG
Fuel	Gas	Gas	Gas	Gas	Gas	Gas	Gas
Installed Cost ($/kW)[1]	1,454	1,333	1,010	565	1,418	1,101	1575
Summer Ratings (June – August)							
Capacity (MW)	315	650	950	225	40	98	11.12
Heat Rate (HHV_2, Btu/kWh)	6,625	6,600	6,400	9,800	9,800	9,400	8,023
Winter Ratings (September – May)							
Capacity (MW)	350	715	1,025	245	52	103	11.12
Heat Rate (HHV, Btu/kWh [2])	6,575	6,550	6,300	9,500	9,200	8,800	8,023
Variable O&M ($/MWh)[3, 4]	3.83	3.83	3.83	16.34	8.60	3.37	7.00
Fixed O&M ($/kW-year)	12.74	8.50	6.56	8.37	15.39	22.78	0
Ramp Rate (%/minute)	5	5	5	18	18	1	100
Emission Rates (with controls) (lb/MMBtu)							
CO2	115	115	115	115	115	115	115
SO2	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
NOx	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075

1 Includes owner's costs and interest during construction (IDC).

2 HHV = Higher heating value.

3 O&M = Operations and maintenance.

4 Includes allocation for combustion inspections, minor maintenance, and major maintenance costs assuming hours based maintenance.

1.2 Renewable Energy Technologies

Renewable energy technologies considered in the analysis included solar and wind technologies. Described below are the cost and performance assumptions utilized in the analysis.

There are currently federal tax incentive programs available to third-party developers, which can reduce the net effective cost of renewable energy to power purchasers such as Roseville. The analysis was therefore based on the assumption that Roseville would obtain energy from renewable facilities through a through a power purchase agreement (PPA) structure with a third-party independent power producer (IPP). To obtain indicative pricing for a PPA, a levelized cost of energy (LCOE) was developed. Each technology was modeled assuming the representative project would come online in 2020 and 2030. For facilities coming online in 2030, it was assumed that cost reductions and performance improvements would continue to occur, as consistent with cost and performance trends for wind and solar technologies over the past decade.

Pricing was developed for solar projects and wind projects of different potential project sizes and in different regions. Modern wind projects tend to be 100 MW or more, so smaller wind farms were not modeled. The project locations, sizes and performance characteristics for the four solar projects and two wind projects modeled are summarized in Table B-3 and Table B-4, respectively.

Table B3 Solar Systems and Modeled Performance

Site	Location	Project Capacity [MWac]	Module Capacity [MWdc]	Capacity Factor (ac)	Degradation (annual %)
1	North CA	10	13	27.9%	0.7%
2	Arizona	100	130	33.1%	0.7%
3	Central Valley	20	26	30.6%	0.7%
4	Central Valley	100	130	29.8%	0.7%

Table B4 Wind Systems and Modeled Performance

Site	Location	Project Capacity [MWac]	Capacity Factor (ac)	Degradation (annual %)
5	North CA	100	30.0%	0.0%
6	Arizona	200	30.0%	0.0%

All of the solar projects were assumed to be single axis tracking systems (SAT). SAT tend to have higher output in the late afternoon when generation is needed most. The solar production for each location was modeled using the Solar Advisory Model's (SAM) detailed PV module using weather files for each representative location. The inverter loading ratio (ratio of module capacity to inverter capacity) was assumed to be 1.3. The capacity factor was calculated based on the AC project capacity. Additionally, the long-term degradation of the systems was assumed to be 0.7 percent per year.

Wind capacity factors were derived from analysis performed for various energy zones as part of the California Public Utility Commission's Renewable Portfolio Standard (RPS) Calculator effort, which Black & Veatch contributed to. No degradation was assumed for wind farms.

1.2.1 Cost Assumptions

Renewable project costs will vary based on system size and location costs. The capital costs developed are intended to be representative for a generic site and reflect estimated engineering, procurement and construction (EPC) costs[51], and owner's costs (which typically includes permitting costs, developer fees, interconnection costs, financing fees, and interest during construction).

51 Additional trade tariffs were imposed on imported solar cells in January of 2018, resulting in increases in module costs. However, the new tariffs are set to decline over the next four years, and module costs are expected to continue to fall. Thus, module costs are assumed to be similar to 2017 levels by 2020.

Actual costs vary by size, developer and region. Assumptions used to develop estimated interconnection costs for each project are summarized in Table B-5 and Table B-6. Total operating expenses, including O&M, property taxes, equipment replacement and other administrative costs, are generic.

Table B5 2020 Cost Assumptions for Solar SAT Systems (Nominal $)

Site	Location	Project Capacity [MWac]	Inter-connec-tion Cost ($m)	Capital Cost [$/kWac]	Capital Cost [$/kWdc]	Fixed O&M Costs [$/kWac]	Fixed O&M Escalation (annual)
1	North CA	10	$0.5	$1,770	$1,362	26	2.5%
2	Arizona	100	$5	$1,380	$1,062	26	2.5%
3	Central Valley	20	$1	$1,730	$1,331	26	2.5%
4	Central Valley	100	$5	$1,580	$1,215	26	2.5%

Table B6 2020 Cost Assumptions for Wind Systems (Nominal $)

Site	Location	Project Capacity [MWac]	Capital Cost [$/kWac]	Fixed O&M Costs [$/kWac]	Fixed O&M Escalation (annual)
5	North CA	100	$1,700	35	2.5%
6	Arizona	200	$1,550	35	2.5%

To determine the estimated costs in 2030 for the same indicative projects, it was assumed that capital costs would decline by one percent per year in real dollars for both wind and solar technologies with an inflation rate estimated at 2.5 percent per year. The resulting costs in nominal dollars for 2030 are shown in the tables below.

Table B7 2030 Cost Assumptions for Solar SAT Systems (Nominal$)

Site	Location	Project Capacity [MWac]	Capital Cost [$/kWac]	Capital Cost [$/kWdc]	Fixed O&M Costs [$/kWac]	Fixed O&M Escalation (annual)
1	North CA	10	$2,049	$1,576	30	2.5%
2	Arizona	100	$1,598	$1,229	30	2.5%
3	Central Valley	20	$2,003	$1,541	30	2.5%
4	Central Valley	100	$1,829	$1,407	30	2.5%

Table B8 2030 Cost Assumptions for Wind Systems (Nominal$)

Site	Location	Project Capacity [MWac]	Capital Cost [$/kWac]	Fixed O&M Costs [$/kWac]	Fixed O&M Escalation (annual)
5	North CA	100	$1,968	45	2.5%
6	Arizona	200	$1,794	45	2.5%

1.3 Market Purchase Options

Other alternatives to meeting capacity or energy needs through direct ownership of a physical plant or through a long-term PPA or contract structure exist. Options include obtaining resource adequacy contracts through the bilateral (direct negotiation) market or entering into energy procurement contracts. Either option allows the ability to contract for various tenors (for example, long, mid, or short-term contracts. The inherent disadvantage of relying on market purchases is pricing uncertainty and potential negative exposure to future market changes.

Bilateral market capacity prices may vary by location, resource technology type, and timing of delivery. Bilateral capacity prices are expected to be soft for the next several years due to excess supply. However, because new capacity is increasingly needed and there are substantial anticipated generator retirements in California, capacity prices may rise in the future. In situations where market demand exceeds supply, the cost for capacity is expected to converge towards the cost of new entry (CONE).

1.4 Financial Assumptions

The 2018 Tax Reform bill changed the federal corporate tax rate from 35 percent to 21 percent, with state income taxes allowed to be tax deductible, resulting in the composite income taxes for the two states shown below.

Table B9 Federal and State Income Tax Rates

	California	Arizona
Federal Income Tax	21%	21%
State Income Tax	8.84%	6.97%
Composite Income Tax	28.0%	26.5%

1.4.1 Tax Credits

The Consolidated Appropriations Act, signed in December 2015, extended the investment tax credits (ITC) which apply to solar technologies and wind. Wind can opt for the ITC in lieu of the production tax credit (PTC), which was also extended, but wind typically benefits more from PTC at better wind sites. The credits decline over time.

- The ITC is a credit taken as a percentage against the capital cost of a renewable energy system. The capital cost basis allowed is defined by the IRS. If the project opts for the ITC, the depreciation basis will need to be reduced by 50% of the ITC (e.g. 30% ITC => Depreciation Basis would be 85% of the capital cost).

- The PTC is an inflation-adjusted per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The duration of the credit is 10 years after the date the facility is placed in service.

For 2020, solar projects can receive a 30 percent investment tax credit (ITC) to offset the total eligible cost of the project, assuming the project begins construction by the end of 2019. For this analysis, it was assumed that the solar projects begin construction in 2019 and come online in 2020 to take advantage of the 30 percent ITC. Projects that do not begin construction until 2020 are only eligible for 26 percent ITC. By 2030, the ITC drops to 10 percent.

Wind projects are allowed to select to take advantage of either the ITC or PTC incentive program. In general, wind projects that begin construction in 2020 have no incentives available, unless construction started in 2019. For this analysis, it was assumed that construction starts in 2019 and the project takes advantage of the PTC at a rate of $9 per MWh, escalated at the inflation rate, for the first 10 years of the project. By 2030, wind does not receive any tax credits.

Table B10 Tax Credit Assumptions

Resource	2020 (2019 Construction)	2030
Solar ITC	30%	10%
Wind PTC	$9/MWh	0

1.4.2 Accelerated Depreciation

Historically, solar and wind projects also were able to utilize a 5-year accelerated depreciation schedule (MACRS) that helped improve project economics. The 2018 Tax Reform bill now allow renewable energy projects to take a 100 percent tax depreciation on the total cost of the project in year 1. Industry experts believe, while quite generous, few investors would be able to take full advantage of this new depreciation schedule, so LCOE was modelled assuming the 5-year MACRS schedule, where about 90 percent of the total capital cost would be depreciable.

1.4.3 Cost of Capital

IPPs have multiple methods of funding renewable energy projects. For modeling purposes we assumed a debt/equity structure for both solar and wind projects as shown in the table below. In recent years, the cost of capital for renewable energy projects has dropped substantially, both from lower interest rates on debt as well as lower equity return requirements by investors. The following assumptions reflect today's estimated cost of capital, recognizing changes may occur by 2020 and beyond. The debt tenor for the projects was modeled for 20 years, which is considered typical for large capital projects.

Table B11 Cost of Capital Assumptions for Solar and Wind

Financial Factor	Solar	Wind
Debt Percentage	50%	60%
Debt Interest Rate (percent)	4.5%	4.5%
Debt Term (Years)	20	20
Economic Life (Years)	25	25
Cost of Equity (after tax)(percent)	10%	10%

1.5 Levelized Cost of Energy

The resulting LCOE for the renewable projects with commercial online dates in 2020 and 2030 is shown in the tables below. The LCOE represents a fixed price PPA for 25 years.

Table B12 Renewable Energy Projects LCOE (Nominal$) 2020 COD

Site	Technology	Location	Project Capacity [MWac]	Capacity Factor (ac)	Capital Cost [$/kWac]	ITC/PTC	Nominal LCOE result ($/MWh)
1	Solar SAT	North CA	10	27.9%	$1,770	30%	$53
2	Solar SAT	Arizona	100	33.1%	$1,380	30%	$38
3	Solar SAT	Central Valley	20	30.6%	$1,730	30%	$48
4	Solar SAT	Central Valley	100	29.8%	$1,580	30%	$46
5	Wind	North CA	100	30.0%	$1,700	$9/MWh	$61
6	Wind	Arizona	200	30.0%	$1,550	$9/MWh	$56

Table B13 Renewable Energy Projects LCOE (Nominal$) 2030 COD

Site	Technology	Location	Project Capacity [MWac]	Capacity Factor (ac)	Capital Cost [$/kWac]	ITC/PTC	Nominal LCOE result ($/MWh)
1	Solar SAT	North CA	10	27.9%	$2,049	10%	$78
2	Solar SAT	Arizona	100	33.1%	$1,598	10%	$58
3	Solar SAT	Central Valley	20	30.6%	$2,003	10%	$75
4	Solar SAT	Central Valley	100	29.8%	$1,829	10%	$71
5	Wind	North CA	100	33.1%	$1,968	$0	$76
6	Wind	Arizona	200	33.1%	$1,794	$0	$70

1.6 Energy Storage

1.6.1 Energy Storage Applications

Technology changes in the electric vehicle market have led to increasing interest in the use of batteries in the energy market. Battery energy storage systems (BESS) can be useful in a broad variety of grid-beneficial applications including use as a capacity resource, load shifting, and frequency and voltage support.

A major benefit of BESS is the ability to provide multiple services in one location to meet the needs of the grid. BESS can be configured to respond in seconds, providing the capability for a faster response time than other conventional generation resources for fast response services. Some of the concepts being considered for BESS applications include:

Load Shifting: In load shifting applications, BESS are charged with lower priced energy (which can help mitigate curtailment of excess renewable generation (when renewable generation exceeds demand) and the stored energy used at a later time (such as during evening ramping periods).

Peaking Supply: The power output capacity of BESS can be used to meet capacity resource adequacy requirements and replace conventional peaking capacity to provide short-term power needs during periods of peak demand.

Frequency Regulation and Voltage Support: BESS can be used to mitigate load and generation imbalances and maintain grid frequency and voltage.

Spinning Reserve: BESS can be utilized to provide energy needs within 10 minutes, as an alternative to conventional generation that must be kept online and synchronized to the grid in anticipation of a need.

Firming of Intermittent Resources: BESS can be used to "firm" energy production of a variable energy resource (such as solar or wind generation) and provide a more predictable energy profile to the grid.

Transmission Upgrade Deferral: BESS may offer a way to defer or avoid transmission upgrades.

BESS applications are often selected for primary use in either a power or energy application. Power applications tend to be of shorter duration (approximately five minutes to one hour) with operational profiles involving frequent rapid responses or cycles. Energy applications generally require longer duration (approximately one hour or more).

The CEC has recommended that POU's consider the role of storage in addressing over generation of renewable energy when solar energy production exceeds local demand; which can occur during the daytime peak solar production periods. If the excess renewable energy is used to charge a BESS system, the stored energy can be used during the evening ramping period, avoiding the greenhouse gas emissions that would otherwise be produced if the energy demand during the evening ramping period was met by energy produced from conventional thermal resources.

1.6.2 Performance and Cost Assumptions for Energy Storage

Because lithium ion batteries are widely accepted as a proven technology for BESS applications, a lithium ion battery was chosen as the technology for this analysis. Table B14 highlights the performance parameters used in the IRP analysis.

Table B14 Representative Performance Parameters for Lithium Ion Battery Systems

Parameter	Li-Ion
Facility Capacity Power Rating, MW	5
Discharge Duration at Rated Capacity, hours	4
Facility Energy Rating, MWh[1]	20
Round-Trip Efficiency, percent	85
Estimated life, cycles	~5,000
Installed Levelized Capital Cost, $/kW-yr[2]	533
Fixed O&M Costs, $/kW-yr	20
Variable O&M Costs, $/kWh (charge or discharge)	0.001 to 0.005

Notes:

1. The rating is based on installed project size.
2. Battery cost scales with MWh, whereas balance of plant and PCS costs tend to scale with power (MW). Because of this, installed costs tend to have a wide array of values.

Exhibit C - RPS Procurement Plan

1. Introduction

A Renewables Portfolio Standard (RPS) Procurement Plan is required by Senate Bill (SB) X1-2 (Simitian, Stats. 2011, 1st Ex. Session, Ch. 1), the "California Renewable Energy Resources Act" and must be approved by the Roseville City Council. This document describes the City of Roseville's RPS Procurement Plan, as required by the Public Utility Code § 399.30(a)(1) and (a)(2) and Section 3205 of the California Energy Commission's (CEC or Commission) regulations for *Enforcement Procedures for the Renewables Portfolio Standard for Local Publicly Owned Electric Utilities* (*RPS Regulations*).[52]

2. Notifications

Pursuant to Public Utilities Code § 399.30(f) and Section 3205 of the RPS Regulations, City Council's consideration of this RPS Procurement Plan will be posted using the standard City Council agenda posting process. The CEC will be notified of the date, time, and location of the meeting. Within 30 days of adoption by City Council, this RPS Procurement Plan will be sent to the CEC. Notice shall be published and the CEC shall be notified whenever City Council will deliberate in public on the RPS Procurement Plan. Information distributed to City Council regarding Roseville's renewable energy resources procurement status and future plans for consideration at a public meeting shall be made available to the public and shall be provided to the CEC electronically for posting.

Pursuant to Public Utilities Code § 399.30(d) and Section 3206 of the RPS Regulations, this RPS Procurement Plan includes optional measures for adoption by the City Council. Optional measures must be adopted at a publicly noticed meeting prior to the end of the compliance period in which they will be used. All optional measures adopted must be sent to the CEC within 30 days of adoption.

3. Compliance Periods and Procurement Requirements

Public Utility Code § 399.30(b) and (c), § 399.15(b)(1) and (b)(2), and Section 3204 of the RPS Regulations mandate that state-defined renewable resources make up a specified percentage of each utility's retail sales with an ultimate goal of 50% by 2030. This is accomplished with minimum targets and compliance periods. Although Compliance Periods 1 and 2 have passed, they are included below for reference.

i. Compliance Period 1 is calendar years 2011 through 2013 and requires an average of twenty percent (20%) renewables, applying the following formula:

$$\sum_{x=2011}^{2013} EP_x \geq .20\,(RS_{2011} + RS_{2012} + RS_{2013})$$

Where: EP_x = Electricity products retired for the specified year x; this may include excess that Roseville has chosen to apply to the compliance period containing year x.

RS_x = Total retail sales made by Roseville for the specified year x.

52 At the time of writing for this edition of Roseville Electric's RPS Procurement Plan, the RPS Regulations were not updated with SB 350 and subsequent legislative requirements. Where both Public Utility Codes and RPS Regulations are cited but the RPS Regulations are outdated, Roseville's RPS Procurement Plan will reflect the more current Public Utility Codes.

ii. Compliance Period 2 is calendar years 2014 through 2016 and requires twenty-five percent (25%) renewables by the end of the compliance period, applying the following formula:

$$\sum_{x=2014}^{2016} EP_x \geq .20(RS_{2014}) + .20(RS_{2015}) + .25(RS_{2016})$$

iii. Compliance Period 3 is calendar years 2017 through 2020 and requires thirty-three percent (33%) renewables by the end of the compliance period, applying the following formula:

$$\sum_{x=2017}^{2020} EP_x \geq .27(RS_{2017}) + .29(RS_{2018}) + .31(RS_{2019}) + .33(RS_{2020})$$

iv. Compliance Period 4 is calendar years 2021 through 2024 and requires forty percent (40%) renewables by the end of the compliance period, applying the following formula:

$$\sum_{x=2021}^{2024} EP_x \geq .3475(RS_{2021}) + .365(RS_{2022}) + .3825(RS_{2023}) + .40(RS_{2024})$$

v. Compliance Period 5 is calendar years 2025 through 2027 and requires forty-five percent (45%) renewables by the end of the compliance period, applying the following formula:

$$\sum_{x=2025}^{2027} EP_x \geq .4167(RS_{2025}) + .4333(RS_{2026}) + .45(RS_{2027})$$

vi. Compliance Period 6 is calendar years 2028 through 2030 and requires fifty percent (50%) renewables by the end of the compliance period, applying the following formula:

$$\sum_{x=2028}^{2030} EP_x \geq .4667(RS_{2028}) + .4833(RS_{2029}) + .50(RS_{2030})$$

vii. Beginning in the three-year compliance period starting in 2031, and subsequent three-year compliance periods thereafter, there is a requirement to maintain the 50% renewable standard. These compliance periods are to be established by the CEC.

Roseville shall demonstrate reasonable progress toward meeting the compliance period targets in each compliance period's included years. The following table summarizes the annual "soft" targets, but compliance is determined over the entire compliance period using the formulas above.

Compliance Period 3				Compliance Period 4				Compliance Period 5			Compliance Period 6			Annually
2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031 and beyond
27%	29%	31%	33%	34.75%	36.5%	38.25%	40%	41.67%	43.33%	45%	46.67%	48.33%	50%	50%

Table 55. Renewables Portfolio Standard requirements for renewable energy

4. Portfolio Content Categories and Portfolio Balance Requirements

4A. Portfolio Content Categories

In addition to meeting the renewable energy procurement target, the renewable energy must meet portfolio content category requirements as defined in Public Utilities Code § 399.16(b) and Section 3203 of the RPS Regulations; however, as defined in the Public Utilities Code § 399.16(d) renewable energy procured prior to June 1, 2010, is termed “grandfathered” and does not have to meet the category requirements. There are four categories of renewable energy, as follows:

i. Portfolio Content Category 1 (PCC1) must be procured bundled to be classified as PCC1, and Roseville Electric may not resell the underlying electricity from the electricity product back to the eligible renewable energy resource from which the electricity product was procured. The electricity products must be generated by an eligible renewable energy resource that is interconnected to a transmission network within the WECC service territory. The first point of interconnection to the WECC transmission grid is the substation or other facility where generation tie lines from the eligible renewable energy resource interconnect to the network transmission grid. Additionally, PCC1 products must meet the following criteria, as applicable:

   a. Electricity products must be generated by an eligible renewable energy resource that has its first point of interconnection within the metered boundaries of a California balancing authority area.

   b. Electricity products must be generated by an eligible renewable energy resource that has its first point of interconnection to an electricity distribution system used to serve end users within the metered boundaries of a California balancing authority area. The first point of interconnection to an electricity distribution system is within the service area boundaries of a utility distribution company.

   c. Electricity products from the eligible renewable energy resource with a first point of interconnection outside the metered boundaries of a California balancing authority must be scheduled into a California balancing authority without substituting electricity from another source. Electricity generated by the eligible renewable energy resource must be scheduled into a California balancing authority on an hourly or sub-hourly basis, and City Council must have approved an agreement, before the electricity is generated, to schedule the electricity from the eligible renewable energy resource into the California balancing authority on an hourly or sub-hourly basis. If there is a difference between the amount of electricity generated within an hour and the amount of electricity scheduled into a California balancing authority within that same hour, only the lesser of the two amounts shall be classified as Portfolio Content Category 1.

d. Electricity products must be subject to an agreement between a California balancing authority and the balancing authority in which the eligible renewable energy resource is located, executed before the product is generated, to dynamically transfer electricity from the eligible renewable energy resource into the California balancing authority area. Electricity generated by the eligible renewable energy resource shall be scheduled into a California balancing authority area on an hourly or sub-hourly basis.

ii. Portfolio Content Category 2 (PCC2) electricity products must be generated by an eligible renewable energy resource that is interconnected to a transmission network within the WECC service territory, and the electricity must be matched with incremental electricity that is scheduled into a California balancing authority. Additionally, PCC2 products must be procured bundled and must meet all of the following criteria:

   a. The first point of interconnection to the WECC transmission grid for both the eligible renewable energy resource and the resource providing the incremental electricity must be located outside the metered boundaries of a California balancing authority area.

   b. The incremental electricity used to match the electricity from the eligible renewable energy resource must be incremental to Roseville Electric. "Incremental electricity" means electricity that is generated by a resource located outside the metered boundaries of a California balancing authority area and that is not in the portfolio of Roseville Electric prior to the date the contract or ownership agreement for the electricity products from the eligible renewable energy resource, with which the incremental electricity is being matched, is executed by Roseville Electric.

   c. The contract or ownership agreement for the incremental electricity is executed by Roseville Electric, at the same time or after the contract or ownership agreement for the electricity products from the eligible renewable energy resource is executed.

   d. The incremental electricity must be scheduled into the California balancing authority within the same calendar year as the electricity from the eligible renewable energy resource is generated.

   e. The electricity from the eligible renewable energy resource must be available to be procured by Roseville Electric and may not be sold back to that resource.

iii. All unbundled renewable energy credits and other electricity products procured from eligible renewable energy resources located within the WECC transmission grid that do not meet the requirements of either Portfolio Content Category 1 or Portfolio Content Category 2 fall within Portfolio Content Category 3.

iv. Grandfathered Resources (also referred to as PCC0) include any contract or ownership agreement originally executed prior to June 1, 2010, and the electricity product is associated with generation from an eligible renewable energy resource that met the Commission's RPS eligibility requirements that were in effect when the original procurement contract or ownership agreement was executed by Roseville Electric.

   a. Except as provided in the following sections e. and f., the electricity product shall count in full toward the RPS procurement requirements, subject to the following:

b. If the associated REC is retired within 36 months of the date the electricity product is generated, the electricity product will count toward the RPS procurement targets.

c. The electricity product will not be classified within a portfolio content category and will not count toward the portfolio balance requirements in the following section B.

d. Electricity products associated with contracts of less than 10 years will not be subtracted when calculating excess procurement in Section 7.A.

e. If contract amendments or modifications after June 1, 2010, increase nameplate capacity or expected quantities of annual generation, increase the term of the contract except as provided section f. below, or substitute a different eligible renewable energy resource, only the MWhs or resources procured prior to June 1, 2010, shall count in full toward the RPS procurement targets. The remaining procurement must be classified into a portfolio content category and follow the portfolio balance requirements in accordance with the following section B.

f. The term of such procurement contract may be extended if the initial term of the contract specified a procurement commitment of 15 years or more.

4B. Portfolio Balance Requirements

In meeting the RPS procurement requirements identified in section 3 of this RPS Procurement Plan, Roseville shall also be subject to the portfolio balance requirements. Public Resources Code § 399.16(c)(1) and (c)(2) and Section 3204 of the RPS Regulations identify minimum procurement requirements for PCC1 and maximum procurement requirements for PCC3 in each compliance period. Renewable energy that is classified as "grandfathered" is not subject to these portfolio balance requirements. The following table summarizes the portfolio balance requirements for renewable energy that is not grandfathered.

Product Content Category	Compliance Period 1 2011 - 2013	Compliance Period 2 2014 - 2016	Compliance Period 3 2017 – 2020
PCC1 (Minimum)	50%	65%	75%
PCC2 (No Direct Restriction)	n/a	n/a	n/a
PCC3 (Maximum)	25%	15%	10%
The balance requirements starting in 2021 and thereafter are the same as for Compliance Period 3.			

Table 56. Renewables Portfolio Standard portfolio balance requirements

4C. Long-term Contract Requirement

In meeting the RPS procurement requirements identified in section 3 of this RPS Procurement Plan, Roseville shall also be subject to long-term contract requirements. Consistent with Public Resources Code § 399.13(b), Roseville Electric may enter into a combination of long- and short-term contracts for electricity and associated renewable energy credits. Beginning January 1, 2021, at least 65 percent of Roseville Electric's procurement that counts toward the RPS requirement of each compliance period shall be from its contracts of 10 years or more in duration or in its ownership or ownership agreements for eligible renewable energy resources.

5. Plan for Roseville's RPS Requirement

5A. Procurement/Retirement Strategy

The City of Roseville Electric Utility (Roseville Electric) plans to pursue a procurement strategy that maximizes flexibility and allows for retirement and banking of excess renewable energy credits (REC). This strategy will allow Roseville Electric to bank excess PCC1 and PCC2 RECs and apply them to future compliance periods. In order to implement this strategy, all RECs that are retired for a compliance period and subject to the portfolio balance requirements must be procured from long-term contracts (ten plus years).

Because RECs must be retired within three years of being created, the only way to "bank" a REC for longer periods is to take advantage of the excess procurement optional compliance measure identified later in this document (section 7.A.).

5B. Grandfathered and "Other" Resources not Subject to Portfolio Balance Requirements

Roseville Electric entered into several contracts prior to June 1, 2010, which makes them either grandfathered resources or PCC1, PCC2, or PCC3 resources ("other") that are not subject to the portfolio balance requirements. "Other" resources are defined as those from pre-June 1, 2010, contracts that meet the current RPS requirements, but did not meet the RPS "rules in place" at the time the contract was signed. The following list describes Roseville's grandfathered resources and "other" resources not subject to the portfolio balance requirements.

i. Roseville has a contract with the Western Area Power Administration (WAPA) for a share of the output of the Central Valley Project Base Resource, located in California. A portion of this project is small hydro which qualifies as renewable.

ii. Roseville has a contract with Northern California Power Agency for 12% of the Calaveras hydro project which includes the 6 MW New Spicer power plant located in California. The energy from the New Spicer plant qualifies as renewable.

iii. Roseville has contracts with Northern California Power Agency for a combined total of 7.883% of the Geothermal projects output. The projects have a total capacity of 220 MW and are located in California. The energy from these projects qualify as renewable.

5C. Portfolio Content Category Resources

In general, PCC1 renewable energy is the most expensive and PCC3 is the least expensive. To meet the RPS requirements in the most cost effective way and minimize costs to ratepayers, PCC3 energy should be maximized in order to minimize the amount of PCC1 needed, with the balance met by PCC2 energy.

In September 2012, Roseville entered into a contract with the City of Santa Clara to procure PCC1 energy and RECs.

In July 2013, Roseville entered into a contract with Lost Hills Solar, LLC and Blackwell Solar, LLC to procure PCC1 energy and RECs.

In September 2014, Roseville entered into a contract with Iberdrola Renewables, LLC, to procure PCC1, PCC2, and PCC3 energy and/or RECs.

In March 2015, Roseville entered into a contract with Powerex, Inc., to procure PCC1 energy and RECs.

With the above contracts, Roseville has contracted for sufficient renewables to meet Roseville's RPS obligations through the year 2024 under the fifty percent (50%) RPS standard.

6. Procurement Process

Pursuant to Public Utilities Code § 399.30(n), in all manners regarding compliance with the RPS, the City of Roseville shall retain exclusive control and discretion over both of the following:

i. The mix of eligible renewable energy resources procured by the Utility and those additional generation resources procured by the Utility for purposes of ensuring resource adequacy and reliability.

ii. The reasonable costs incurred by the Utility for eligible renewable energy resources owned by the Utility.

The Power Supply Division regularly analyzes the City of Roseville's RPS procurement needs. Portfolio supply and demand are assessed. If needed, a solicitation for renewable energy is conducted. The best offers of each PCC and generator type are identified and short-listed. These offers are the first to be considered. Offers received outside the solicitation process are only considered if they are competitive with the most recent solicitation short-listed offers.

Offers are evaluated for:

i. Direct and indirect costs, including but not limited to contract price of energy and REC, plus transmission and integration costs

ii. Risk, including but not limited to cost risk, credit risk, deliverability risk, regulatory risk, and project viability

iii. Portfolio fit

Offers are pursued and contracts are negotiated within the cost limitations for expenditures, set in section 7 of this RPS Procurement Plan.

Pursuant to Public Utilities Code § 399.21(a)(7) and Section 3202 of the RPS Regulations, all RECs will be retired within 36 months from the initial date of generation of the associated electricity.

7. Optional Measures

Specific optional measures are allowed pursuant to Public Utilities Code § 399.30(d) and Section 3206 of The RPS Regulations. Measures must be adopted by City Council prior to the end of the compliance period in which they will be used. The City of Roseville is adopting the following optional measures as part of this RPS Procurement Plan.

7A. Excess Procurement

Pursuant to Public Utilities Code § 399.30(d) and § 399.13(a)(4)(B) and Section 3206(a)(1) of the RPS Regulations, the City of Roseville shall be allowed to apply excess procurement in one compliance period to subsequent compliance periods, up to and including the third compliance period ending in 2020, as long as the following conditions are met:

i. Excess procurement must be generated no earlier than January 1, 2011;

ii. The total amount of procurement associated with either Portfolio Content Category 3 in excess of PCC3 limits, or short term contracts (less than 10 years in duration) shall be deducted from actual procurement quantities;

iii. Renewable energy from Portfolio Content Category 3 resources shall not be counted as excess procurement.

Excess procurement for each compliance period through 2020 shall be calculated using the following formula as specified in the RPS Regulations, Section 3206(a)(1):

$$(Excess\ Procurement)_x = EPR_x - (RPS_x + S3_x + STC_x)$$

Where: x = Compliance Period: 2011 – 2013, 2014 – 2016, and 2017 – 2020.

EPR_x = Electricity Products Retired and applied toward the RPS procurement target for compliance period x

RPS_x = The RPS procurement target for compliance period x

$S3_x$ = Retired PCC3 RECs in excess of the maximum allowed for compliance period x

STC_x = Short-term Contract

In other words, for Compliance Periods 1 through 3, only long-term PCC1 and PCC2 contracts will count towards excess procurement. The retirement of any RECs from short term contracts, and/or PCC3 RECs retired in excess of the maximum amount allowed that compliance period will count against excess procurement.

Pursuant to § 399.13(a)(4)(B), for subsequent compliance periods, only PCC1 RECs from contracts of any duration may count as excess procurement. PCC2 and PCC3 RECs from contracts of any duration may not count as excess procurement, but neither will they be deducted from a retail seller's procurement for purposes of calculating excess procurement.

7B. Waiver of Timely Compliance

Pursuant to Public Utilities Code § 399.30(d)(2)(A) and § 399.15(b)(5) and Section 3204(a)(2) of the RPS Regulations, the City of Roseville shall be allowed a Waiver of Timely Compliance if it demonstrates any of the following conditions are beyond its control and will prevent compliance:

i. There is inadequate transmission capacity to allow for sufficient electricity to be delivered from eligible renewable energy resources, or proposed eligible renewable energy resource projects using the current operational protocols of the Independent System Operator or relevant Balancing Authorities, as applicable. In making findings relative to the existence of this condition, deliberations shall minimally consider the following:

a. Whether the City of Roseville has undertaken, in a timely fashion, reasonable measures under its control and consistent with its obligations under local, state, and federal laws and regulations, to develop and construct new transmission lines or upgrades to existing lines intended to transmit electricity generated by eligible renewable energy resources. In determining the reasonableness of the City's actions, the City shall consider its expectations for full-cost recovery for these transmission lines and upgrades, and

b. Whether the City of Roseville has taken all reasonable operational measures to maximize cost-effective deliveries of electricity from eligible renewable energy resources in advance of transmission availability.

ii. Permitting, interconnection, or other circumstances that result in delays of procured eligible renewable energy resource projects, or an insufficient supply of eligible renewable resources available to the City of Roseville. The City of Roseville shall consider all the following in making a finding that this condition prevents timely compliance:

a. Prudently managed portfolio risks, including relying on a sufficient number of viable projects.

b. Sought to develop one of the following: its own eligible renewable energy resources, transmission to interconnect to eligible renewable resources, or energy storage used to integrate eligible renewable resources.

c. Procured an appropriate minimum margin of procurement above the minimum procurement level necessary to comply with the renewables portfolio standard to compensate for foreseeable delays or insufficient supply.

d. Taken reasonable measures, under its control, to procure cost-effective distributed generation and allowable unbundled renewable energy credits.

iii. Unanticipated curtailment of eligible renewable energy resources if the waiver would not result in an increase in greenhouse gas emissions.

iv. Unanticipated increase in retail sales due to transportation electrification. In making a finding that this condition prevents timely compliance, Roseville shall consider all of the following:

a. Whether transportation electrification significantly exceeded forecasts in Roseville's service territory based on the best and most recently available information filed with the State Air Resources Board, the Energy Commission, or other state agency.

b. Whether Roseville has taken reasonable measures to procure sufficient resources to account for unanticipated increases in retail sales due to transportation electrification.

If a Waiver of Timely Compliance is allowed, the City of Roseville shall establish additional reporting requirements to demonstrate that all reasonable actions under its control are taken in each of the intervening years sufficient to satisfy future procurement requirements.

Pursuant to Public Utilities Code § 399.15(b) (9) and Section 3204(b) of the RPS Regulations, in no event shall a deficit associated with the compliance period be added to a future compliance period.

7C. Cost Limitations for Expenditures

Pursuant to Public Utilities Code § 399.30(d)(2)(B) and § 399.15(c) and Section 3204(a)(3) of the RPS Regulations, the City of Roseville shall establish a cost limitation for all eligible renewable energy resources used to comply with the RPS procurement requirements. This limitation shall be set at a level that prevents disproportionate rate impacts. The costs of all procurement credited toward achieving the RPS are counted toward the limitation. Procurement expenditures do not include any indirect expenses including, without limitation, imbalance energy charges, sale of excess energy, decreased generation from existing resources, transmission upgrades, or the costs associated with relicensing any owned hydroelectric facilities. In establishing the limitation, the following factors shall also be relied on:

i. The most recent renewable energy procurement plan.

ii. Procurement expenditures that approximate the expected cost of building, owning, and operating eligible renewable energy resources.

iii. The potential that some planned resource additions may be delayed or canceled.

When applying procurement expenditures under the cost limitation, the City of Roseville shall apply only those types of procurement expenditures that are permitted under the cost limitation. The cost limitation includes the following planned actions to be taken in the event the projected cost of meeting the RPS procurement requirements exceeds the cost limitation:

a. Review the City's RPS Procurement Plan to determine what changes, if any, are necessary to ensure compliance in the next Compliance Period while remaining within the cost limitation;

b. Report quarterly to the City Council regarding the progress being made toward meeting the compliance obligation for the next Compliance Period while remaining within the cost limitation;

c. Report to the City Council regarding the status of meeting subsequent compliance targets, and all steps being taken to ensure that the obligation is timely met while remaining within the cost limitation.

7D. Portfolio Balance Requirement Reduction

Pursuant to Public Utilities Code § 399.16(e) and Section 3204(a)(4) of the RPS Regulations, the City of Roseville shall be allowed to reduce the portfolio balance requirement for PCC1 for a specified compliance period. In applying this provision, the City of Roseville must consider all of the following:

i. The City of Roseville must demonstrate that the need to reduce the portfolio balance requirement for PCC1 occurred as a result of conditions beyond its control, as spelled out earlier in this plan in the Waiver of Timely Compliance section (items i, ii, and iii).

ii. A reduction of the portfolio balance requirement for PCC1 below sixty-five percent (65%) for any compliance period after December 31, 2016, will not be considered consistent with Public Utilities Code section 399.16(e).

iii. The City of Roseville must adopt this reduction at a publicly noticed meeting, providing at least ten (10) calendar days advance notice to the CEC, and must include this information in an updated procurement plan which is submitted to the CEC. A notice to consider the portfolio balance requirement reduction and the procurement plan must include the following information:

   a. The compliance period for which the reduction may be adopted.

   b. The level to which the POU has reduced the requirement

   c. The reason or reasons the City of Roseville has proposed for adopting the reduction.

   d. An explanation of how the needed reduction resulted from conditions beyond the control of the City of Roseville.

7E. Invoking Optional Measures

Roseville Electric plans to invoke and take advantage of the Excess Procurement provisions as described in section 7.A. of this plan.

8. Reporting

Pursuant to Section 3207 of the RPS Regulations, the City of Roseville shall submit annual and compliance period reports to the CEC as identified below.

8A. Annual Reports

i. Identifying information, including:

   a. Publicly Owned Utility (POU) name, contact name, mailing address, phone number, and e- mail address.

   b. Year Roseville Electric was established.

   c. Number of end-use retail customer accounts in California.

ii. RPS annual progress information for the prior calendar year, including:

a. Amount of total retail sales to end-use customers, in MWh, and projected retail sales for the current compliance period.

b. Amount of procured electricity products retired, in MWh.

c. Western Renewable Energy Generation Information System (WREGIS) compliance report for procurement claims in the prior calendar year. For any procurement claims not tracked through WREGIS as permitted by the RPS Eligibility Guidebook, the City of Roseville shall report procurement claims using the interim tracking system established by the CEC prior to the implementation of WREGIS.

d. An initial, nonbinding classification of retired electricity products qualifying for each portfolio content category or qualifying to count in full in accordance with section 3202 (a)(2) of the RPS Regulation.

e. A description of each of the eligible renewable energy resources with which the City of Roseville has executed contracts or ownership agreements during the prior year, including but not limited to the contracted amount of MWh, the contracted amount of MWh as a percentage of retail sales, resource fuel type, the execution date of the procurement contract or ownership agreement, the duration of the procurement contract or ownership agreement, a summary of the procurement contract or ownership agreement, the operational status of the resource, the date the resource came on-line, the date the resource came on-line using a renewable fuel or technology, if different, the date on which procurement of electricity products begins, if different, RPS certification status, the county, state, and country in which the resource is located, and a summary of the resource names and identification numbers.

f. Documentation demonstrating the portfolio content category classification claimed for procured electricity products. This documentation may include, but is not limited to, interconnection agreements, NERC e-Tag data, scheduling agreements, firming and shaping agreements, and electricity product procurement contracts or similar ownership agreements and information.

g. An explanation of any public goods funds collected for eligible renewable energy resource development, including a description of programs, expenditures, and expected or actual results.

h. A description of any identified issues that occurred that have the potential to delay the timely compliance with the RPS procurement requirements defined in Public Utility Code § 399.30(b) and (c), § 399.15(b)(1) and (b)(2), and Section 3204 of the RPS Regulations, and planned actions to minimize the delay of timely compliance. Such issues may include, but are not limited to, inadequate transmission to allow for procurement to be delivered from eligible renewable energy resources, permitting, interconnection, or other circumstances that have delayed the procurement from eligible renewable energy resources, unanticipated curtailment of a contracted or owned eligible renewable energy resource, and higher-than-expected costs for the procurement or development of eligible renewable energy resources.

i. A description of the energy consumption by the POU, including any electricity used by the POU for water pumping, the purpose of this consumption, the annual amount in MWh, and the annual amount in MWh being satisfied with electricity products.

j. An attestation, signed by an authorized agent, affirming that the information provided in the report is true and correct.

iii. Actions taken by the City of Roseville demonstrating reasonable progress toward meeting its RPS procurement requirements. The information reported shall include, but not be limited to, a discussion of the following actions taken during the prior calendar year:

a. Solicitations released to solicit bid for contracts to procure electricity products from eligible renewable energy resources to satisfy the POU's RPS procurement requirements.

b. Solicitations released to solicit bid for ownership agreements for eligible renewable energy resources to satisfy the POU's RPS procurement requirements.

c. Actions taken to develop eligible renewable energy resources to satisfy the City of Roseville's RPS procurement requirements, including initiating environmental studies, completing environmental studies, acquiring interests in land for facility siting or transmission, filing applications for facility or transmission siting permits, and receiving approval for facility or transmission siting permits.

d. Interconnection requests filed for eligible renewable energy resources to satisfy the City of Roseville's RPS procurement requirements.

e. Interconnection agreements negotiated and executed for eligible renewable energy resources to satisfy the City of Roseville's RPS procurement requirements.

f. Transmission-related agreements negotiated and executed to transmit electricity products procured from eligible renewable energy resources to satisfy the City of Roseville's RPS procurement requirements.

g. Other planning activities to procure electricity products from eligible renewable energy resources.

iv. The City of Roseville shall include a description of all actions planned in the current calendar year to demonstrate progress towards achieving its RPS procurement requirements.

8B. Compliance Period Reports

By July 1, 2014; July 1, 2017; July 1, 2021; and by July 1 of each year thereafter, the City of Roseville shall submit to the CEC a compliance report that addresses the reporting requirements identified above for Annual Reports, and the following information for the preceding compliance period:

i. Classification per RPS-certified facility of the amount of procurement qualifying for each portfolio content category and procurement that shall count in full in accordance with section 3202 (a)(2).

ii. The City of Roseville's RPS procurement target for the compliance period, in MWh.

iii. The amount of excess procurement, in MWh, from previous compliance periods, if any, and historic carryover, if any, that the City of Roseville is applying to the compliance period.

iv. The amount of procurement retired, in MWh, which the City of Roseville wishes to claim toward the RPS procurement target for calculating the portfolio balance requirements.

v. The amount of excess procurement, in MWh, for the compliance period, if any, that may be applied toward future compliance periods, as determined by applying the calculation in section 3206 (a)(1)(D), as applicable.

vi. If the compliance report indicates that the City of Roseville's RPS procurement requirements were not met, the City of Roseville's shall provide documentation to justify the application of any optional compliance measures adopted in accordance with this plan. The documentation shall include all reports, analyses, proposed findings, and any other information upon which the City of Roseville relied in applying the measure. The City of Roseville shall also submit an updated enforcement program and/or procurement plan that includes a schedule identifying potential sources of electricity products currently available or anticipated to be available in the future for meeting the shortfall.

   a. If the City of Roseville applies adopted cost limitation measures, it shall report that cost limitation to the CEC in dollars spent during the compliance period. The City of Roseville shall also provide the CEC with an estimate of the total cost to procure sufficient electricity products to meet the RPS procurement requirements for the preceding compliance period. The City of Roseville shall also report on actions taken in response to RPS procurement expenditures meeting or exceeding the cost limitation.

Exhibit D - RPS Enforcement Plan

1. The City of Roseville shall have a program for the enforcement of a Renewables Portfolio Standard (RPS) program, which shall include all of the provisions set forth herein and shall be known as the City's "RPS Enforcement Program";

2. The RPS Enforcement Program shall be effective January 1, 2012;

3. Not less than ten (10) days' advance notice shall be given to the public and the California Energy Commission (CEC) of the date, time, and location of any meeting held to make a substantive change to the RPS Enforcement Program;

4. Annually, the Director of City's Electric Utility shall cause to be reviewed, the City's RPS Procurement Plan to determine compliance with the RPS Enforcement Program;

5. Annual review of the RPS Procurement Plan shall include consideration of each of the following elements:

   A. By December 31, 2017:

      - Ensure that the City is making reasonable progress toward meeting the December 31, 2020, compliance obligation of thirty-three percent (33%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

   B. By December 31, 2018:

      - Ensure that the City is making reasonable progress toward meeting the December 31, 2020, compliance obligation of thirty-three percent (33%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

   C. By December 31, 2019:

      - Ensure that the City is making reasonable progress toward meeting the December 31, 2020, compliance obligation of thirty three percent (33%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

   D. By December 31, 2020 (end of Compliance Period 3):

      - Verify that the City procured sufficient electricity products to meet the sum of twenty-seven percent (27%) of its 2017, twenty-nine percent (29%) of its 2018, thirty-one percent (31%) of its 2019, and thirty-three percent (33%) of its 2020 retail sales with eligible renewable resources from the specified Content Categories for the compliance period ending December 31, 2020, consistent with the RPS Procurement Plan;

      - If targets are not met, the City shall direct Roseville Electric to:

- Review the applicability of applying Excess Procurement from a previous Compliance Period consistent with the provisions of the RPS Procurement Plan,

- Ensure that any Waiver of Timely Compliance was compliant with the provisions in the RPS Procurement Plan,

- Ensure that any Portfolio Balance Requirement Reduction was compliant with the provisions in the RPS Procurement Plan,

- Review applicability and appropriateness of excusing performance based on the Cost Limitations on Expenditures provisions of the RPS Procurement Plan.

E. By December 31, 2021:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2024, compliance obligation of forty percent (40%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

F. By December 31, 2022:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2024, compliance obligation of forty percent (40%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

G. By December 31, 2023:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2024, compliance obligation of forty percent (40%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

H. By December 31, 2024 (end of Compliance Period 4):

- Verify that the City procured sufficient electricity products to meet the sum of thirty-four point seventy-five percent (34.75%) of its 2021, thirty-six point five percent (36.5%) of its 2022, thirty-eight point twenty-five percent (38.25%) of its 2023, and forty percent (40%) of its 2024 retail sales with eligible renewable resources from the specified Content Categories for the compliance period ending December 31, 2024, consistent with the RPS Procurement Plan;

- If targets are not met, the City shall direct Roseville Electric to:

    - Review the applicability of applying Excess Procurement from a previous Compliance Period consistent with the provisions of the RPS Procurement Plan,

- Ensure that any Waiver of Timely Compliance was compliant with the provisions in the RPS Procurement Plan,
- Ensure that any Portfolio Balance Requirement Reduction was compliant with the provisions in the RPS Procurement Plan,
- Review applicability and appropriateness of excusing performance based on the Cost Limitations on Expenditures provisions of the RPS Procurement Plan.

I. By December 31, 2025:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2027, compliance obligation of forty-five percent (45%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

J. By December 31, 2026:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2027, compliance obligation of forty-five percent (45%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

K. By December 31, 2027 (end of Compliance Period 5):

- Verify that the City procured sufficient electricity products to meet the sum of forty-one point sixty-seven percent (41.67%) of its 2025, forty-three point thirty-three percent (43.33%) of its 2026, and forty-five percent (45%) of its 2027 retail sales with eligible renewable resources from the specified Content Categories for the compliance period ending December 31, 2027, consistent with the RPS Procurement Plan;
- If targets are not met, the City shall direct Roseville Electric to:
    - Review the applicability of applying Excess Procurement from a previous Compliance Period consistent with the provisions of the RPS Procurement Plan,
    - Ensure that any Waiver of Timely Compliance was compliant with the provisions in the RPS Procurement Plan,
    - Ensure that any Portfolio Balance Requirement Reduction was compliant with the provisions in the RPS Procurement Plan,
    - Review applicability and appropriateness of excusing performance based on the Cost Limitations on Expenditures provisions of the RPS Procurement Plan.

L. By December 31, 2028:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2030, compliance obligation of fifty percent (50%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

M. By December 31, 2029:

- Ensure that the City is making reasonable progress toward meeting the December 31, 2030, compliance obligation of fifty percent (50%) of retail sales with eligible renewable resources, consistent with the RPS Procurement Plan.

N. By December 31, 2030 (end of Compliance Period 6):

- Verify that the City procured sufficient electricity products to meet the sum of forty-six point sixty-seven percent (46.67%) of its 2028, forty-eight point thirty-three percent (48.33%) of its 2029, and fifty percent (50%) of its 2030 retail sales with eligible renewable resources from the specified Content Categories for the compliance period ending December 31, 2030, consistent with the RPS Procurement Plan;
- If targets are not met, the City shall direct Roseville Electric to:
    - Review the applicability of applying Excess Procurement from a previous Compliance Period consistent with the provisions of the RPS Procurement Plan,
    - Ensure that any Waiver of Timely Compliance was compliant with the provisions in the RPS Procurement Plan,
    - Ensure that any Portfolio Balance Requirement Reduction was compliant with the provisions in the RPS Procurement Plan,
    - Review applicability and appropriateness of excusing performance based on the Cost Limitations on Expenditures provisions of the RPS Procurement Plan.

O. By December 31, 2031 and annually thereafter:

- Verify that the City met fifty percent (50%) of retail sales with eligible renewable resources from the specified Content Categories, consistent with the RPS Procurement Plan;
- If targets are not met, the City shall direct Roseville Electric to:
    - Review the applicability of applying Excess Procurement from a previous Compliance Period consistent with the provisions of the RPS Procurement Plan,

- Ensure that any Waiver of Timely Compliance was compliant with the provisions in the RPS Procurement Plan,
- Ensure that any Portfolio Balance Requirement Reduction was compliant with the provisions in the RPS Procurement Plan,
- Review applicability and appropriateness of excusing performance based on the Cost Limitations on Expenditures provisions of the RPS Procurement Plan.

6. If it is determined that the City has failed to comply with the provisions of its RPS Procurement Plan, Roseville Electric shall take steps to correct any untimely compliance, including:

   A. Review the City's RPS Procurement Plan to determine what changes, if any, are necessary to ensure compliance in the next Compliance Period;

   B. Report quarterly to the City Council regarding the progress being made toward meeting the compliance obligation for the next Compliance Period;

   C. Report to the City Council regarding the status of meeting subsequent compliance targets, and all steps being taken to ensure that the obligation is timely met.