CleanPowerSF 2020 Integrated Resource Plan

August 13, 2020

Contents

- Summary
- Key Terms
- What is an IRP?
- IRP Assumptions and Analysis
- Local Renewable Energy Report
- IRP Results
- IRP Evaluation
- Conclusions and Recommendations

Summary

- Based on the analysis and results summarized in this report, staff is recommending the SFPUC adopt the proposed Accelerated Portfolio as CleanPowerSF's "preferred portfolio" in its 2020 Integrated Resource Plan.
- The Accelerated Portfolio achieves 100% renewable and greenhouse gas free electricity by 2025, five years sooner than San Francisco's goal.
- The IRP is due to the California Public Utilities Commission on September 1st.
- Written comments will be accepted through Friday, August 21st.
- Staff proposal will be presented for a vote at the SFPUC's August 25th meeting.

Key Terms

- Portfolio: collection of generation resources used to serve electricity demand.
- Scenario: variations on a future state or objective that may influence the resources included in a portfolio.
- Sensitivity analysis: an analysis that involves changing one assumption to understand its influence on the portfolio.

WHAT IS AN IRP?

What is an Integrated Resource Plan (IRP)?

- An IRP is an energy planning tool to support achieving policy goals and meeting regulatory requirements.
- State law requires retail sellers of electricity to develop an IRP that evaluates electricity supply and demand and identifies energy resource options that can deliver reliable and cost-effective energy to customers.
- CCA IRPs are reviewed and certified by the California Public Utilities Commission (CPUC), every two years.

CleanPowerSF's IRP Components

- Customer **demand forecast**, with sensitivity analysis for expected changes in demand
- Analyze portfolios for meeting CleanPowerSF's **renewable and GHG reduction targets *and investing locally***
  - All energy supplied being 100% renewable & GHG-free by 2030
  - Scenarios examining alternative resource mixes and accelerated renewable targets
- Optimize around a portfolio that achieves program goals and delivers **competitively priced energy products**

What does the CPUC do with IRPs?

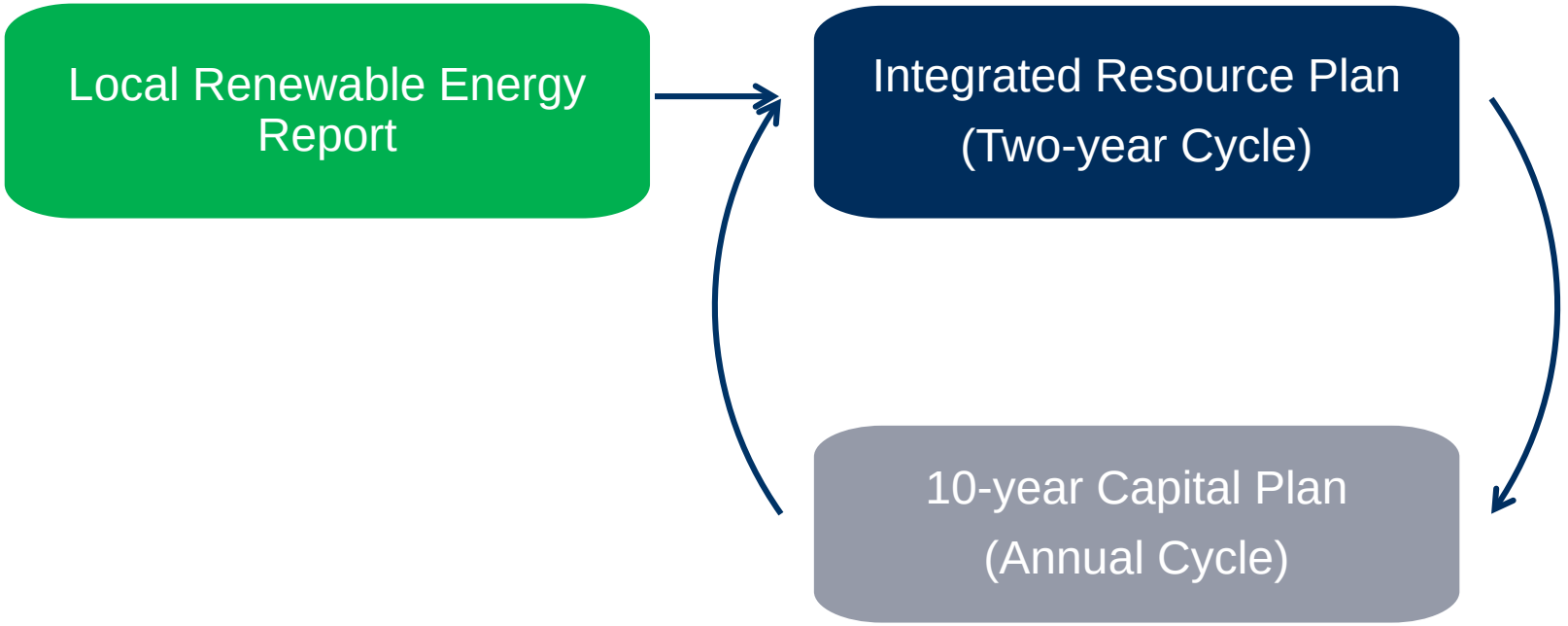
- Prior to retail sellers' developing their IRPs, the CPUC develops what it calls a ***"Reference System Portfolio"*** (RSP), which identifies resources needed to meet CPUC's statewide IRP emissions target, maintain reliability, and optimize costs.
- The RSP is adopted as guidance for individual retail seller's portfolio development. Individual portfolio submissions do not need to conform to the exact mix of resources adopted in the RSP.
- Once all individual IRPs are submitted, the CPUC aggregates them to create a ***"Hybrid Conforming Portfolio"***, which can be compared to the RSP.
- Finally, one of these two portfolios is selected by the CPUC as the ***"Preferred System Portfolio"***, which is used to guide necessary statewide procurement decisions, policymaking, and transmission planning.

LOCAL RENEWABLE ENERGY REPORT

Local Planning is Part of a Regular, Recurring Planning Cycle

- **Resolution 99-19** (adopted on March 8, 2019), “Urges SFPUC to develop a plan for the City to acquire and build cost-effective renewable energy resources on City owned property without increasing costs to ratepayers, by 2030”.

- SFPUC staff prepared a **“Local Renewable Energy Report”** for CleanPowerSF as part of its 2020 IRP and 10-year Capital Plan process which is responsive to Resolution 99-19.

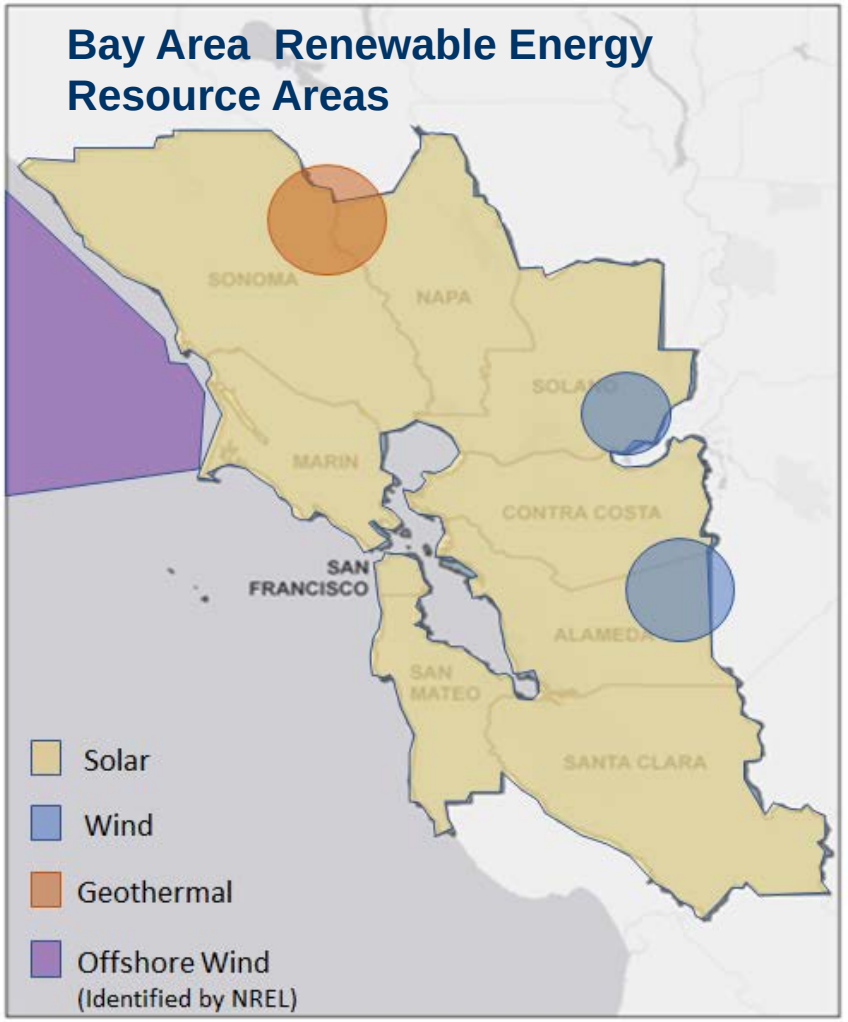


Evaluated Opportunities for Local Renewable Energy Development

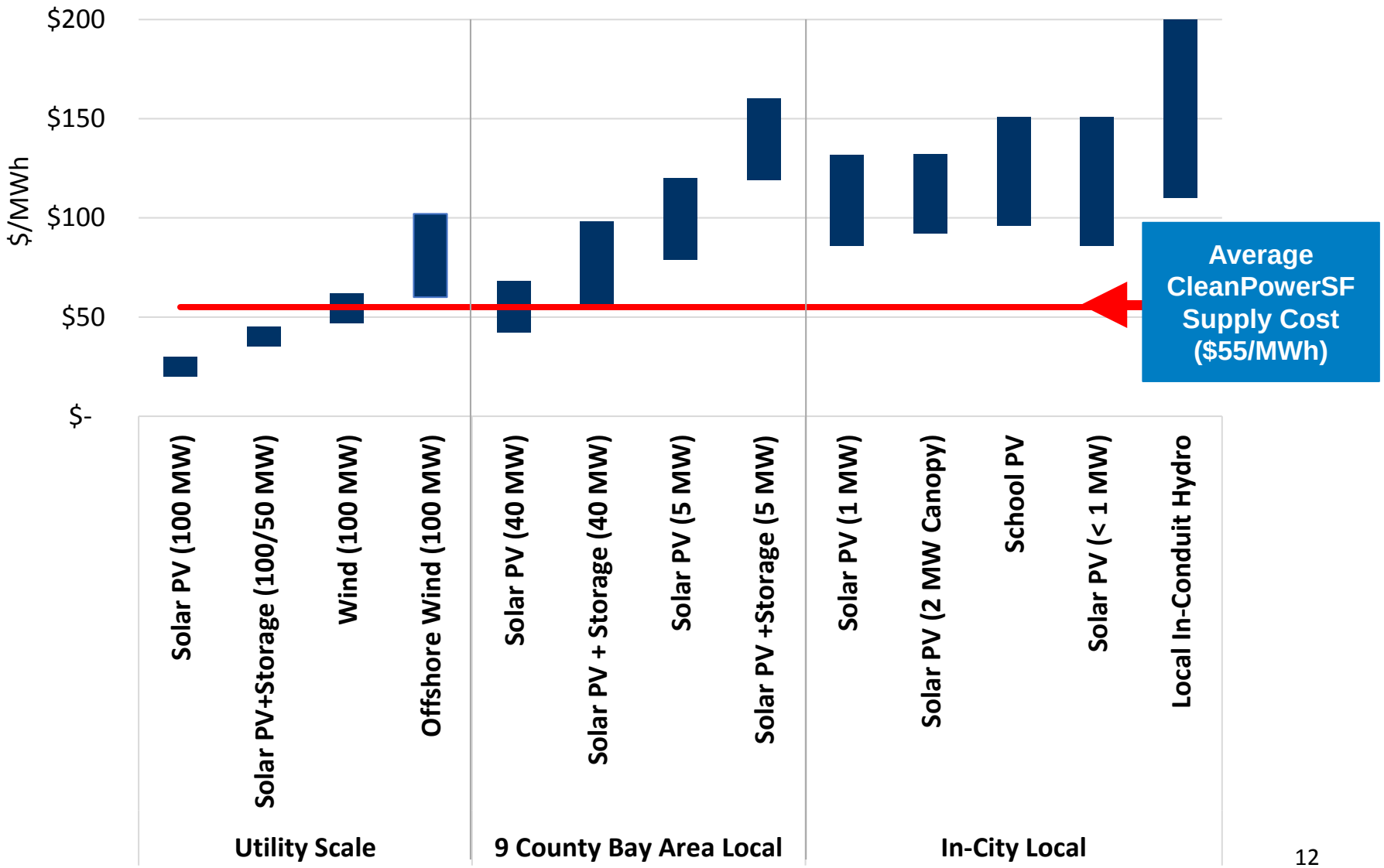
Local Renewable Energy Report

- Examined local renewable energy development opportunities:
  - In City, City-owned sites
  - Regional, City-owned sites
  - Other opportunities in and near San Francisco

- Sites ranked on suitability by:
  - Energy production potential
  - Cost ($/MWh)
  - Development timeframe (5-10 year target)
  - Other site-specific characteristics



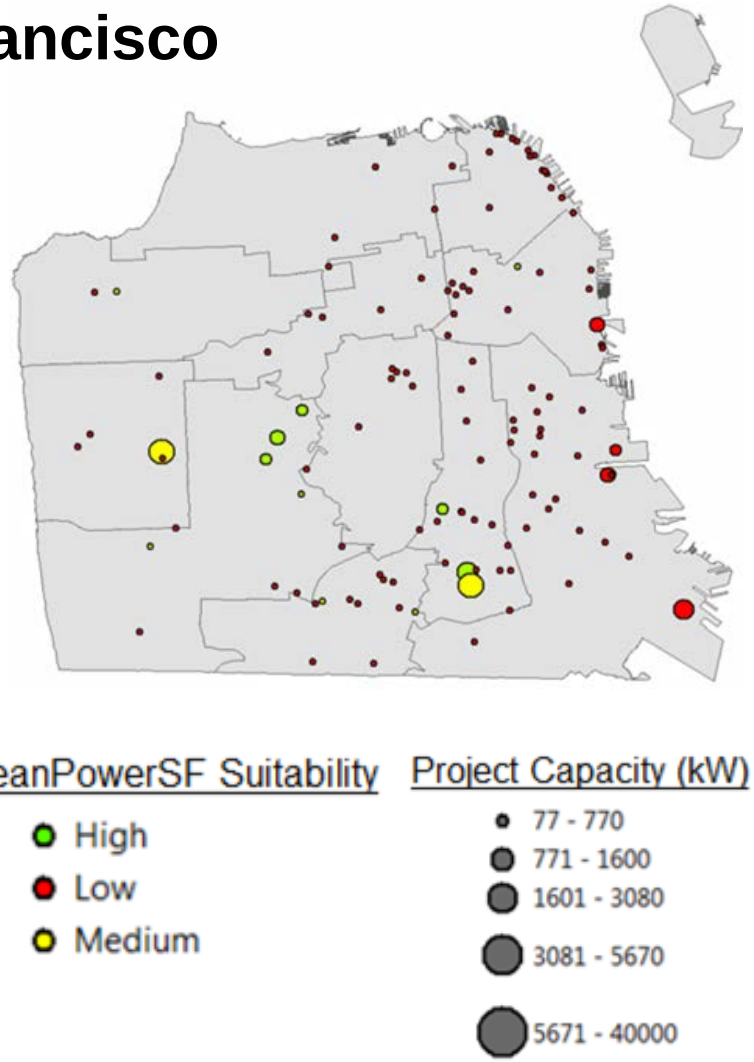
Cost Comparison of Local Renewable Energy Development



Energy Opportunities in San Francisco

City-owned Sites within San Francisco

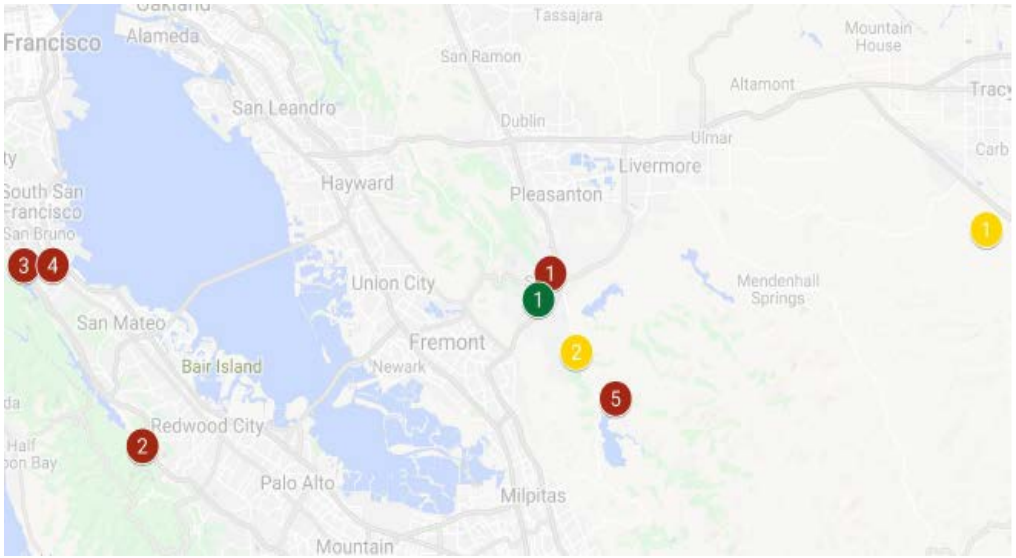
- 132 sites reviewed, 14 identified as Medium to High Suitability
- 9.3 MW High Suitability, 16.6 MW Medium Suitability
- Projected costs: **$79/MWh to $151/MWh**



Regional Energy Opportunities

Regional City-owned Sites

- 6 sites reviewed, 3 identified as Medium to High Suitability
- 40 MW of High Suitability, 4 MW of Medium Suitability
- Projected costs: **$42/MWh to $104/MWh**



High Suitability

1. Sunol Golf Course

Medium Suitability

1. Tesla Portal
2. Sunol Wastewater Treatment Plant

Low Suitability

1. Sunol Yard
2. Pulgas Reservoir
3. Harry Tracy Admin
4. Millbrae Yard
5. Calaveras Dam

Next Steps

Completed

- Included High Suitability and some Medium Suitability sites (totaling 81 MW of solar and 27 MW of storage) in Integrated Resource Plan (IRP) analysis
- Included funding to begin developing High Suitability sites in proposed 10-year capital plan

Continuing

- Monitor emerging renewable technologies market
- Work on programs to support local project investment
- Monitor developments in citywide capital planning
- Conduct additional analyses on power export potential
- Explore partnership opportunities

IRP ASSUMPTIONS & ANALYSIS

Analytical Process

Develop Inputs and Assumptions

- Goal setting
- Baseline energy resources & demand
- Resource cost assumptions
- Local renewable energy analysis

Develop Energy Portfolios

- Worked with consultant to conduct portfolio modeling
- Used industry standard electricity production cost modeling software

Run Sensitivity Analysis

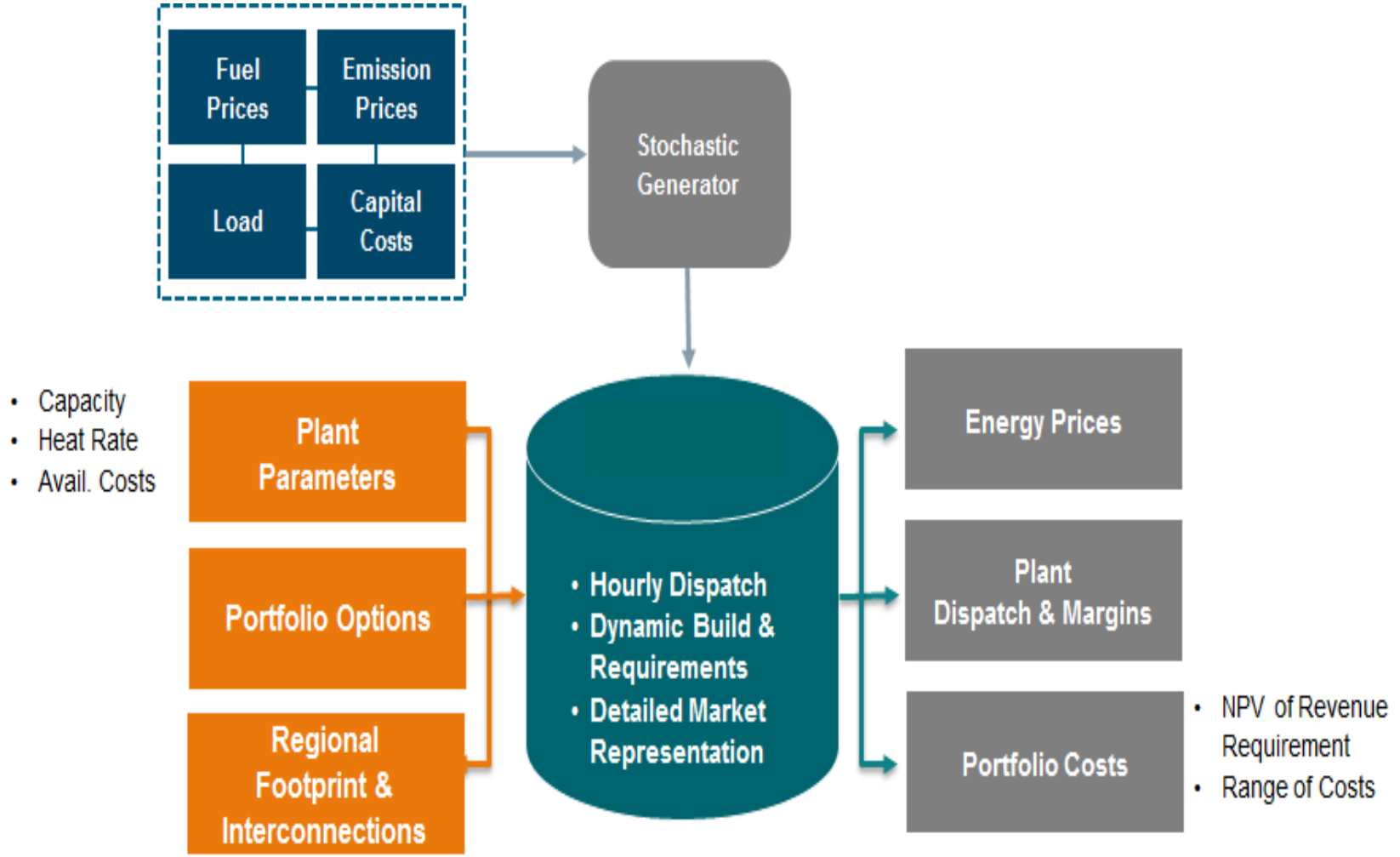
- Analyze impact of changes to customer demand

Evaluate Results

- Assess results against program goals

Portfolio Analysis Methodology

Developing the energy portfolios requires the key inputs, algorithms, and outputs illustrated below.



CPUC-required and CleanPowerSF-specific IRP Assumptions

The CPUC requires retail sellers to use a common set of assumptions in developing their IRPs to support statewide aggregation and “apples-to-apples” comparisons of all IRPs.

CPUC-required Assumptions

- Annual retail sales forecast through 2030 from State Integrated Energy Policy Report (IEPR)
- Load modifiers (i.e., demand-side changes to load like electrification, energy efficiency, behind-the-meter solar)
- New and existing resource availability and costs
- Emissions accounting methodology

CleanPowerSF-specific Assumptions

- Hourly customer demand shape (must equal IEPR retail sales forecast)
- Greenhouse gas free resource generation shapes
- Project specific (e.g., local project) costs
- Minimum portfolio reliability requirements

CPUC GHG Emissions Target Requirements for IRPs

- CleanPowerSF is required to submit at least two portfolios to the CPUC under two 2030 statewide GHG emissions targets: 46 and 38 million metric tons (MMT).
- Assigned targets are calculated based on CleanPowerSF's proportional share of statewide electricity usage and represent CleanPowerSF's allotted portion of the 2030 GHG emissions targets.
- CleanPowerSF must prepare a portfolio that equals its share of the 46 MMT state GHG emissions target.
- CleanPowerSF must also prepare a portfolio that meets or performs better than its share of the 38 MMT state GHG emissions target.

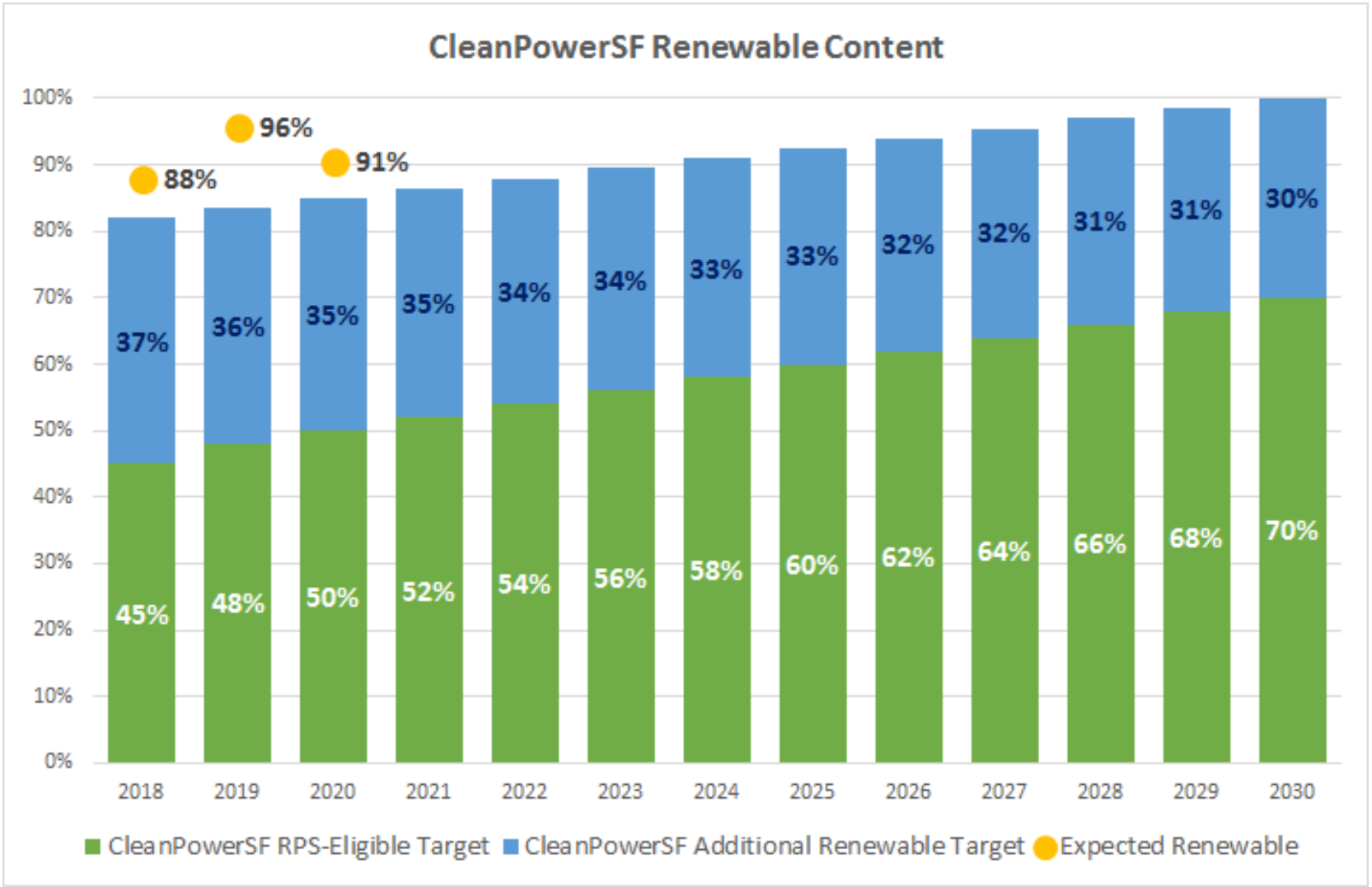
CleanPowerSF 46 MMT CO2 Benchmark	CleanPowerSF 38 MMT CO2 Benchmark
0.544 MMT CO2	0.434 MMT CO2

Additional CleanPowerSF-specific IRP Portfolio Requirements

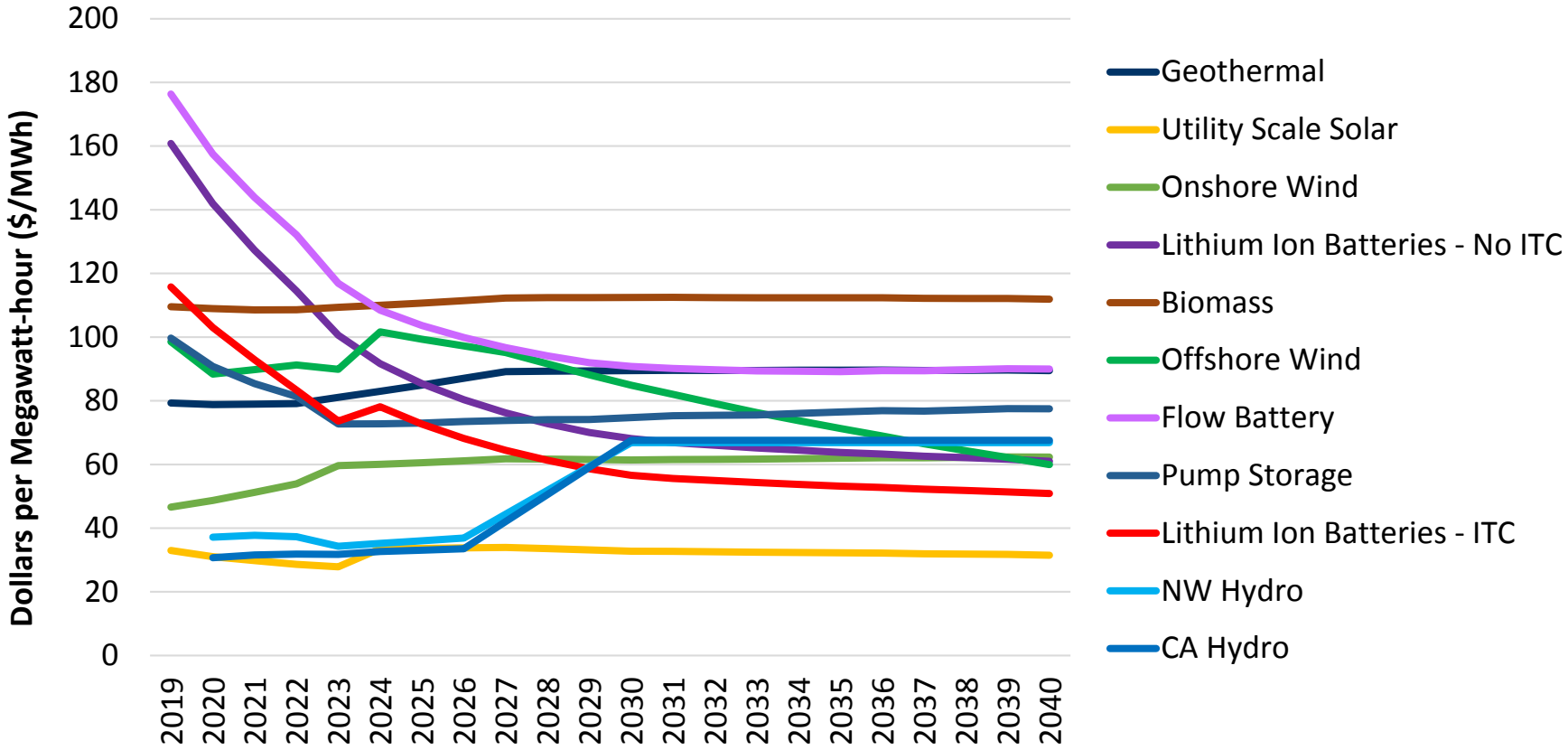
- CleanPowerSF required that all portfolios developed in its IRP meet the following additional requirements:
  - ✓ Be Greenhouse Gas Free by 2030
  - ✓ Be at least 70% RPS-eligible renewable by 2030
  - ✓ Meet at least 65% of projected Resource Adequacy obligation with long-term resources
  - ✓ Include 81 MW of local solar and 27 MW of local storage
  - ✓ New renewable resources not already under contract may be developed as soon as 2023 (project lead times)
  - ✓ All new build sited in California
  - ✓ Limit large hydro purchases to CleanPowerSF's proportional share of what CPUC estimates will be available

Program Annual Power Content Targets and Progress to Date

50% RPS-eligible renewable by 2020; 100% renewable by 2030



Energy Resource Cost Assumptions
Levelized Cost of Energy ($/MWh)



*Source: CPUC Resolve Model, adjusted by Siemens that includes Capital Cost, Interconnection Cost, Investment Tax Credit, Periodic Replacement and Augmentation

CPUC New Resource Availability Assumptions

The CPUC specified the first available year that retail sellers could assume new projects of certain technology types may become operational to deliver energy in their IRPs.

Resource Type	First Available Year
Solar PV	2020
Wind (CA onshore)	2022-2023
Wind (OOS onshore)	2026
Wind (offshore)	2030
Geothermal	2024-2026
Biomass	2020
Pumped Storage	2026
Battery Storage	2020

CleanPowerSF IRP Modeling: Four Portfolios

1. CleanPowerSF Goals by 2030
- ✓ 100% renewable by 2030
- ✓ Local resource prioritization

2. CleanPowerSF Goals by 2025
- ✓ 100% renewable by 2025
- ✓ Local resource prioritization

3. CleanPowerSF Goals and Time Coincidence by 2030
- ✓ 100% renewable by 2030
- ✓ Resource generation meets customer usage in real time
- ✓ Local resource prioritization

4. CPUC 46 MMT Case
- ✓ Portfolio that meets the CPUC's assigned emissions benchmark (Required)

CleanPowerSF IRP Modeling: Sensitivity Analysis

Increased Electric Vehicle (EV) Adoption

What if 100% of new vehicle registrations in 2030 are EVs?

What if all vehicle trips originating, through, and ending in San Francisco are EVs?

Increased Building Decarbonization

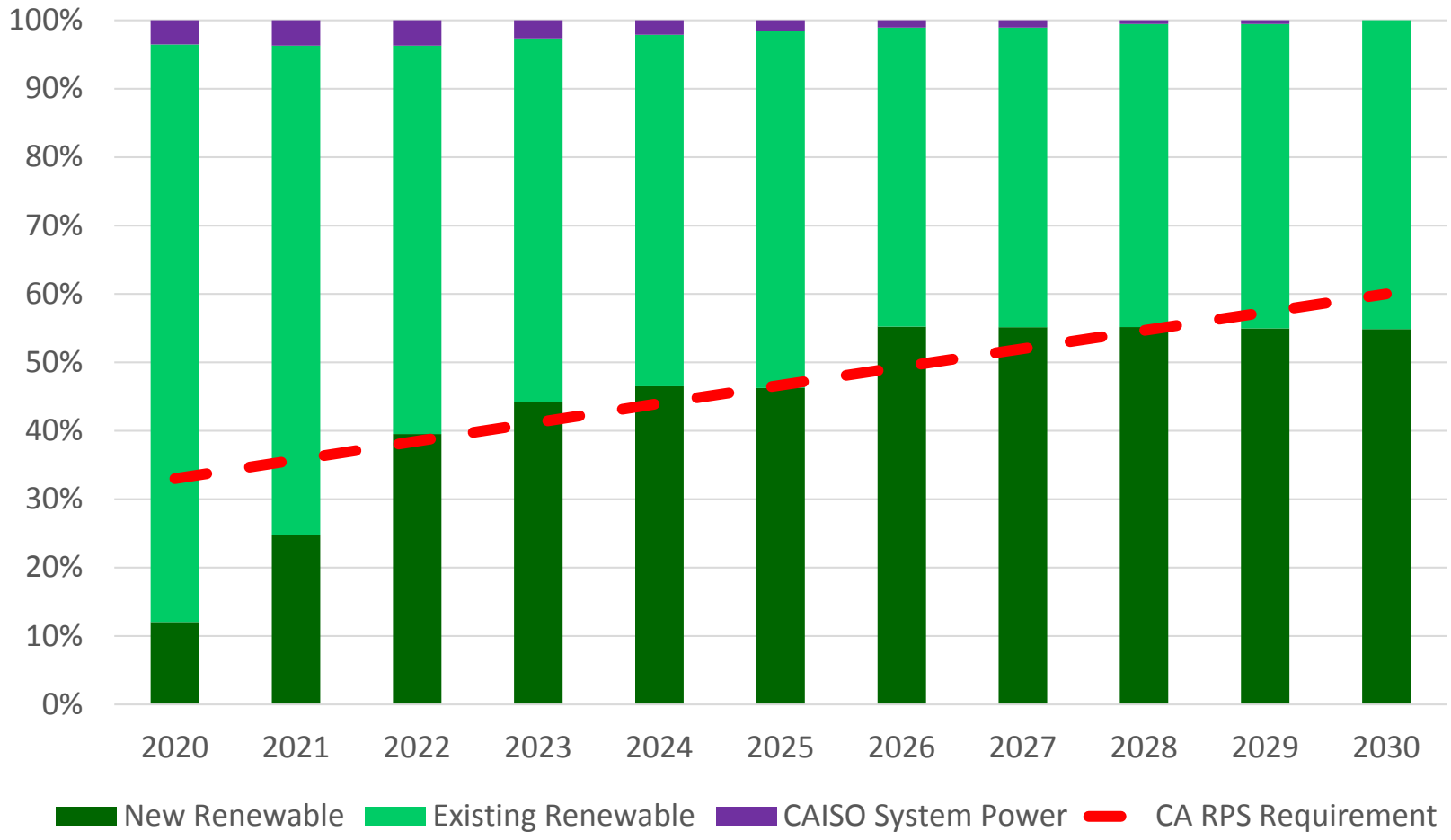
What if all new construction is 100% electric?

IRP RESULTS

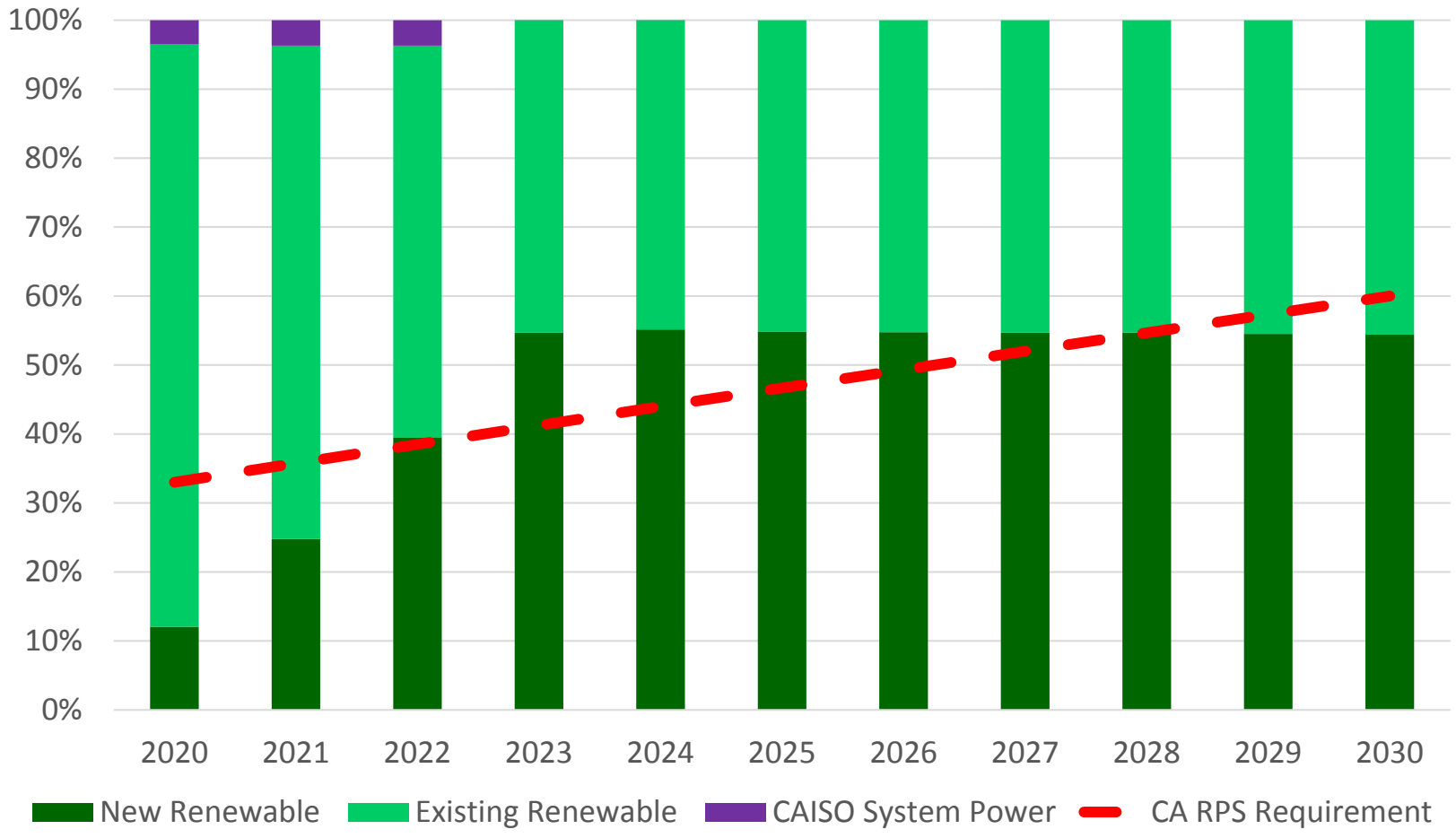
Note

Slides that follow focus on the 38 MMT CO2 portfolios (1-3 on slide 26 above) because the 46 MMT CO2 portfolio does not meet the City's power content goals.

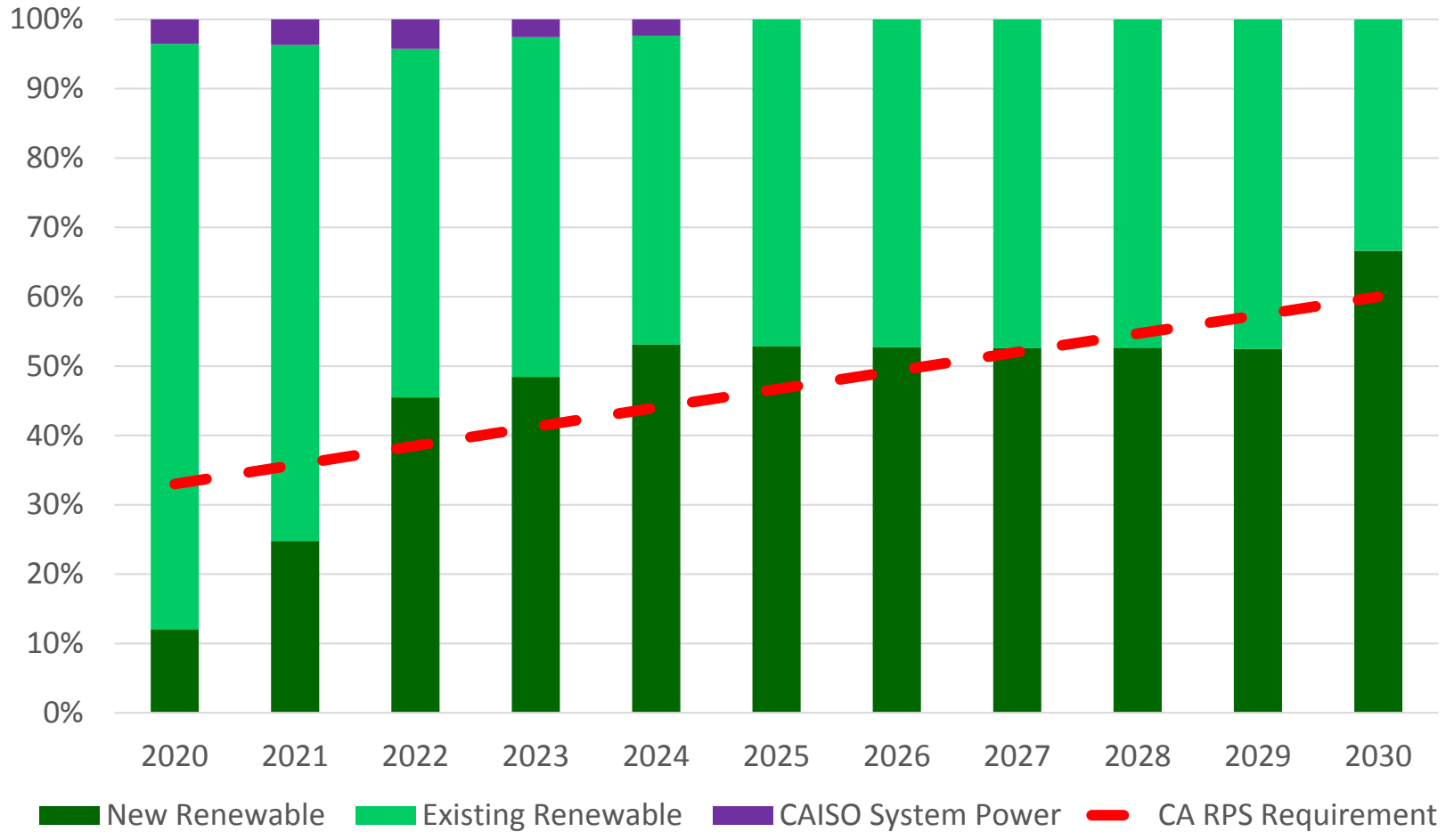
Results: Base Case Portfolio Content



Results: Accelerated Case Portfolio Content

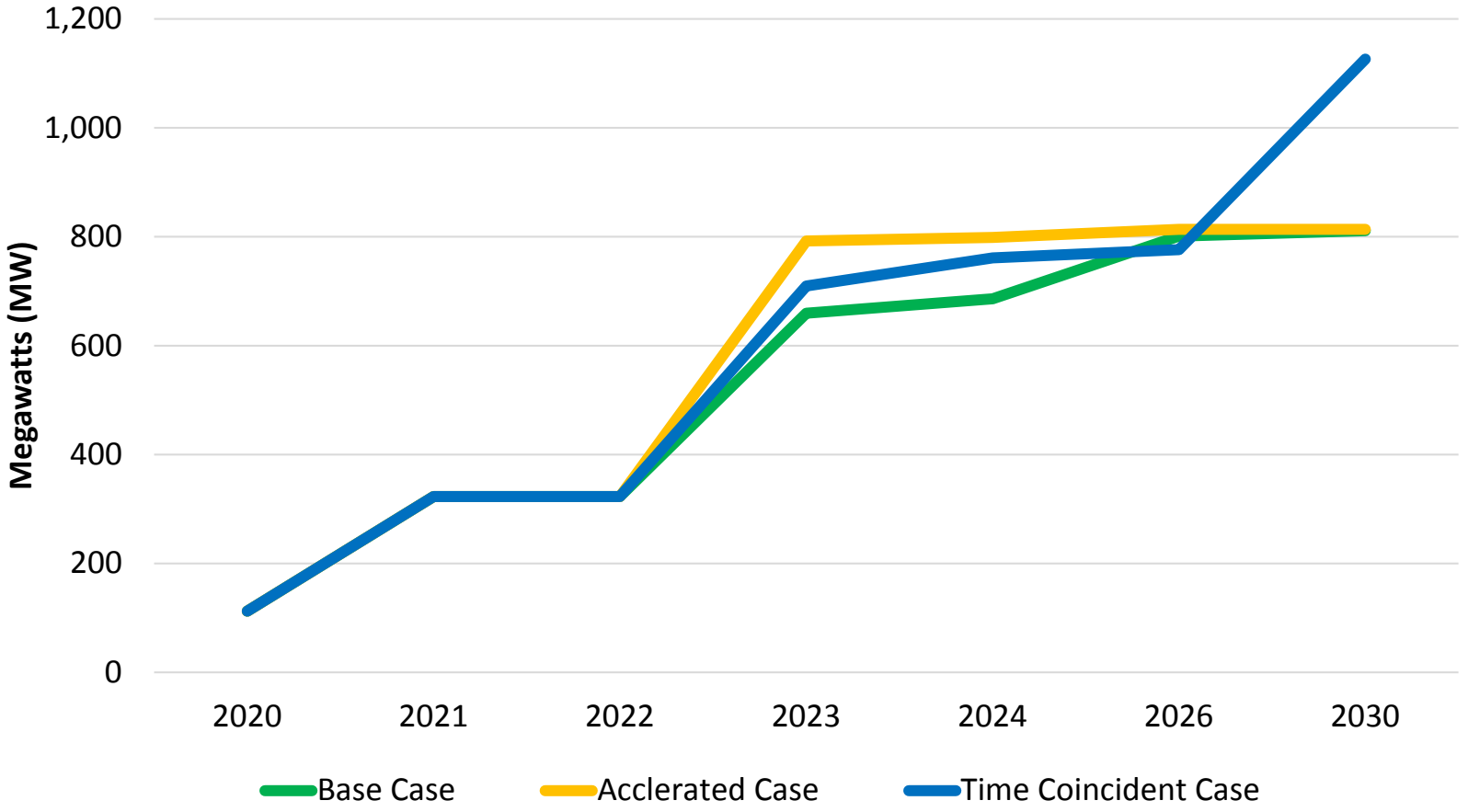


Results: Time Coincident Case Portfolio Content



Results: Comparison of New Resource Capacity Build (MW)

The Accelerated Case (yellow line) adds capacity faster than the other cases, then levels off; the Time Coincident Case adds a significant amount of capacity in 2030.

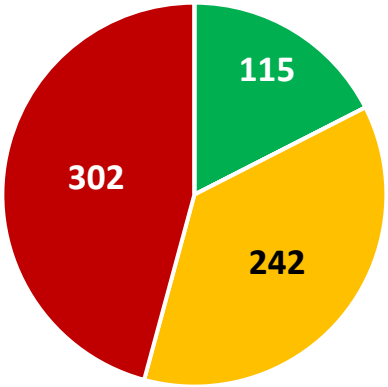


Results: Comparison of New Resource Capacity Build by Technology (2023)

■ Wind ■ Utility Scale Solar ■ 4-Hour Storage

Base Case 2023

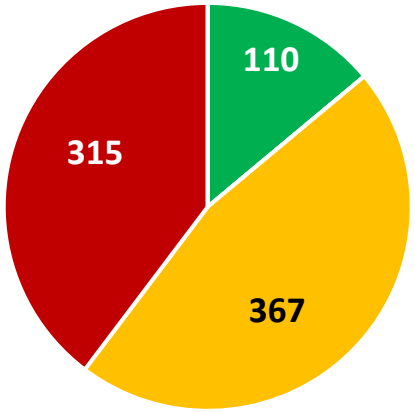
Total Capacity = 660 MW



The Accelerated Case requires more new build, including new local resources, sooner to meet program goals by 2025 rather than 2030. Battery Storage (4-hour storage) is featured prominently in all portfolios.

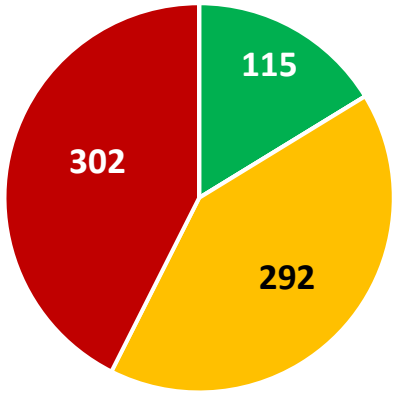
Accelerated Case 2023

Total Capacity = 792 MW



Time Coincident Case 2023

Total Capacity = 709 MW

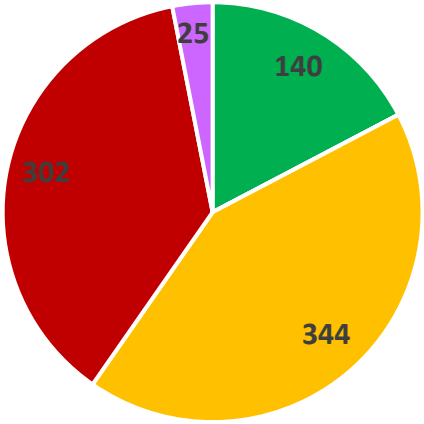


Results: Comparison of New Resource Capacity Build by Technology (2030)

- Onshore Wind
- Utility Scale Solar
- 4-Hour Storage
- Long Duration Storage
- Offshore Wind

Base Case 2030

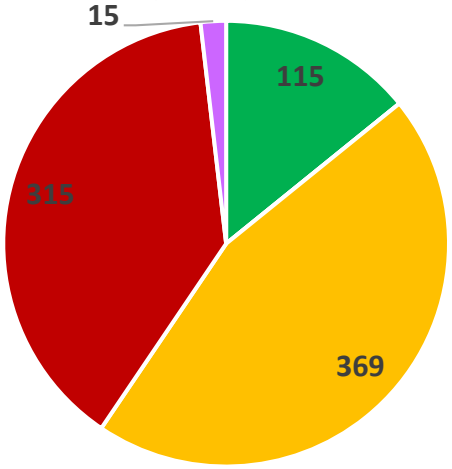
Total Capacity = 811 MW



The Time Coincident Case requires more storage capacity, resulting in total portfolio capacity that is 109% of CleanPowerSF's projected Resource Adequacy need in 2030.

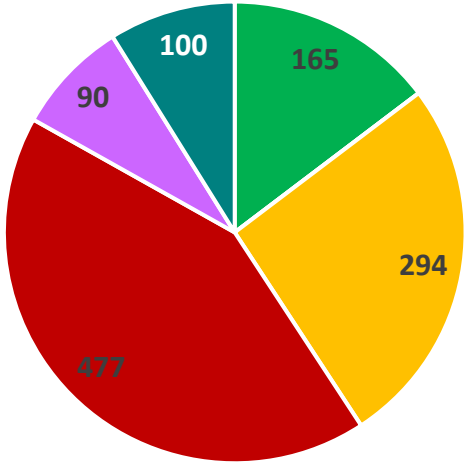
Accelerated Case 2030

Total Capacity = 814 MW



Time Coincident Case 2030

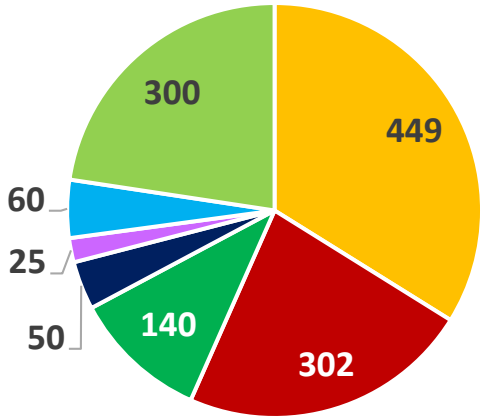
Total Capacity = 1,126 MW



Results: Comparison of Total Portfolio Capacity by Technology (2030)

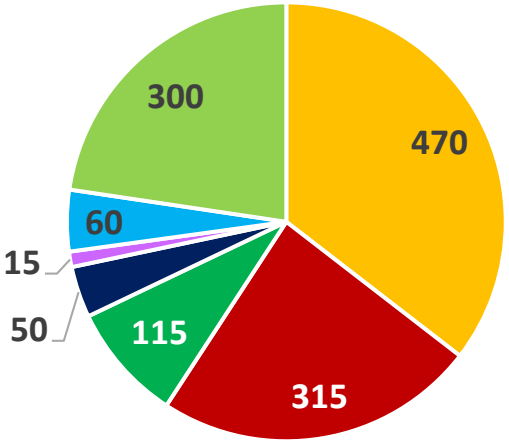
- Solar
- 4-Hour Storage
- Onshore Wind
- Geothermal
- Offshore Wind
- Long Duration Storage
- CA Hydro
- Existing Renewable

Base Case 2030
Total Capacity = 1,327 MW

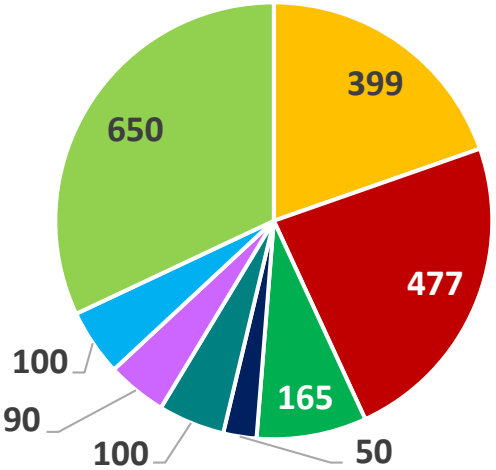


The Time Coincident Case requires significantly more capacity than other cases to meet time coincident goal.

Accelerated Case 2030
Total Capacity = 1,325 MW



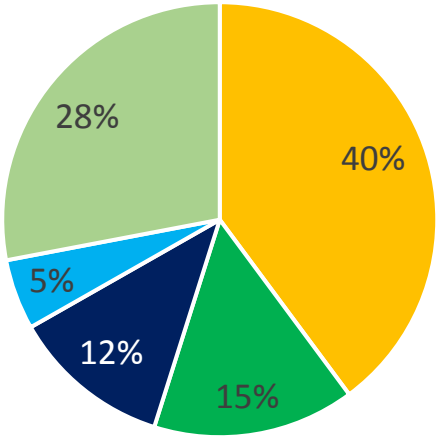
Time Coincident Case 2030
Total Capacity = 2,031 MW



Results: Comparison of Total Portfolio Energy Supply by Resource Type (2030)

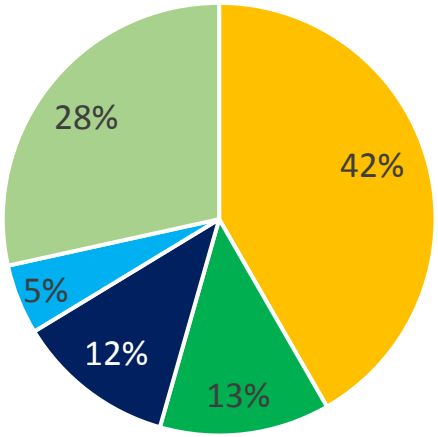
Solar
Onshore Wind
Geothermal
CA Hydro
Offshore Wind
Existing Renewable

Base Case2030

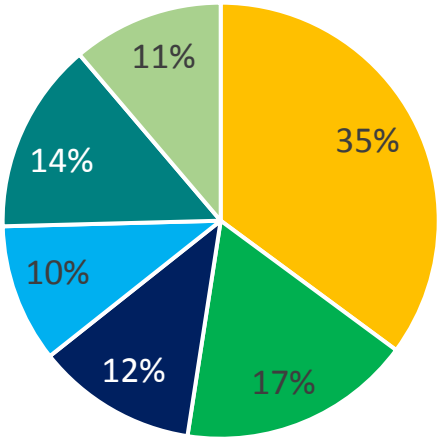


The portfolios have similar energy mixes. The Time Coincident Case includes more wind, including Offshore Wind and some additional Hydro.

Accelerated Case 2030



Time Coincident Case 2030

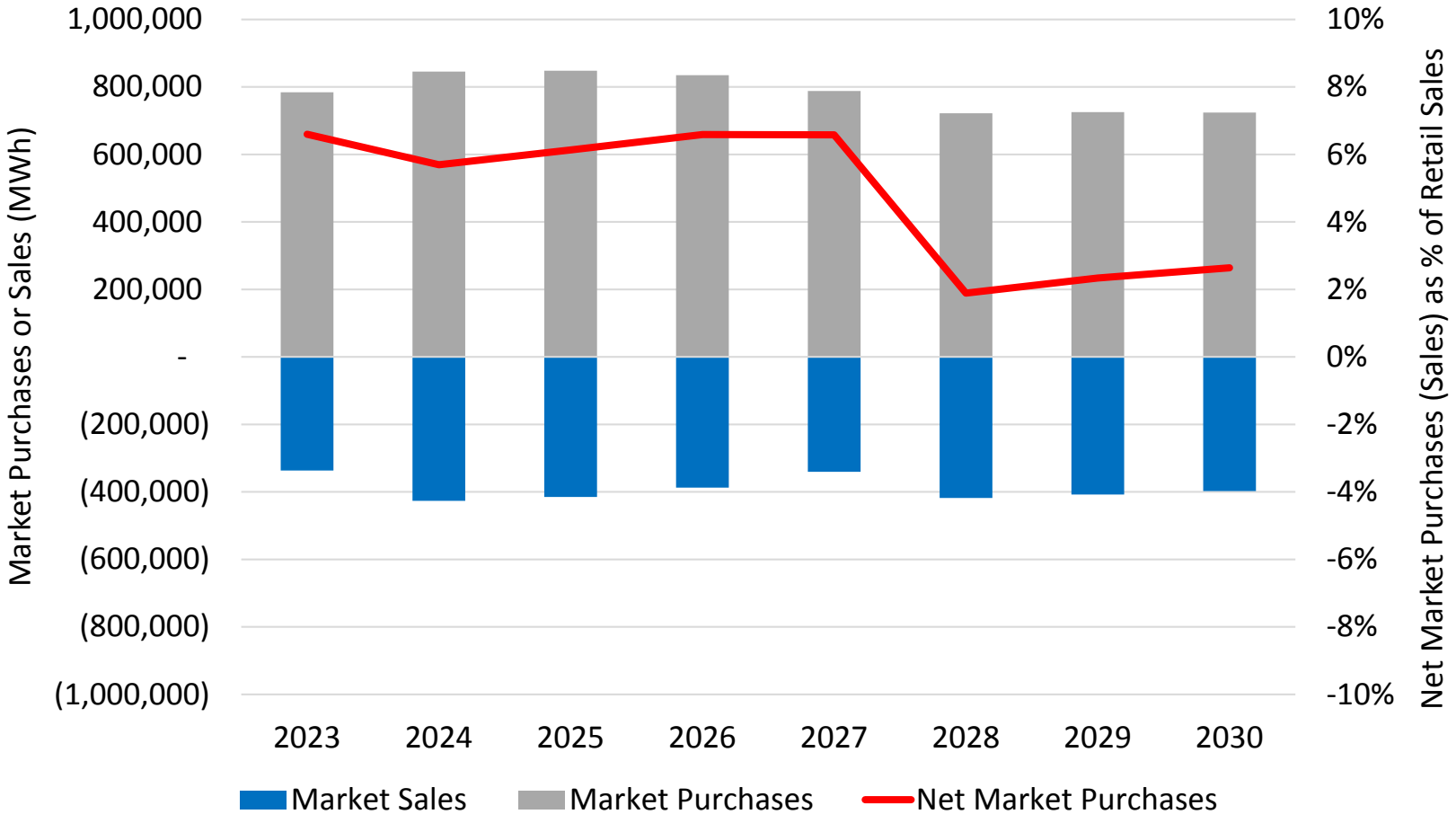


Risk Analysis

- The following charts examine the annual California Independent System Operator (CAISO) system electricity market purchases and sales required to balance each portfolio.
- We are using this information as a measure of portfolio market exposure as more purchases and sales on the wholesale market means greater portfolio exposure to market price volatility.

CAISO Market Purchases & Sales Base Case Portfolio

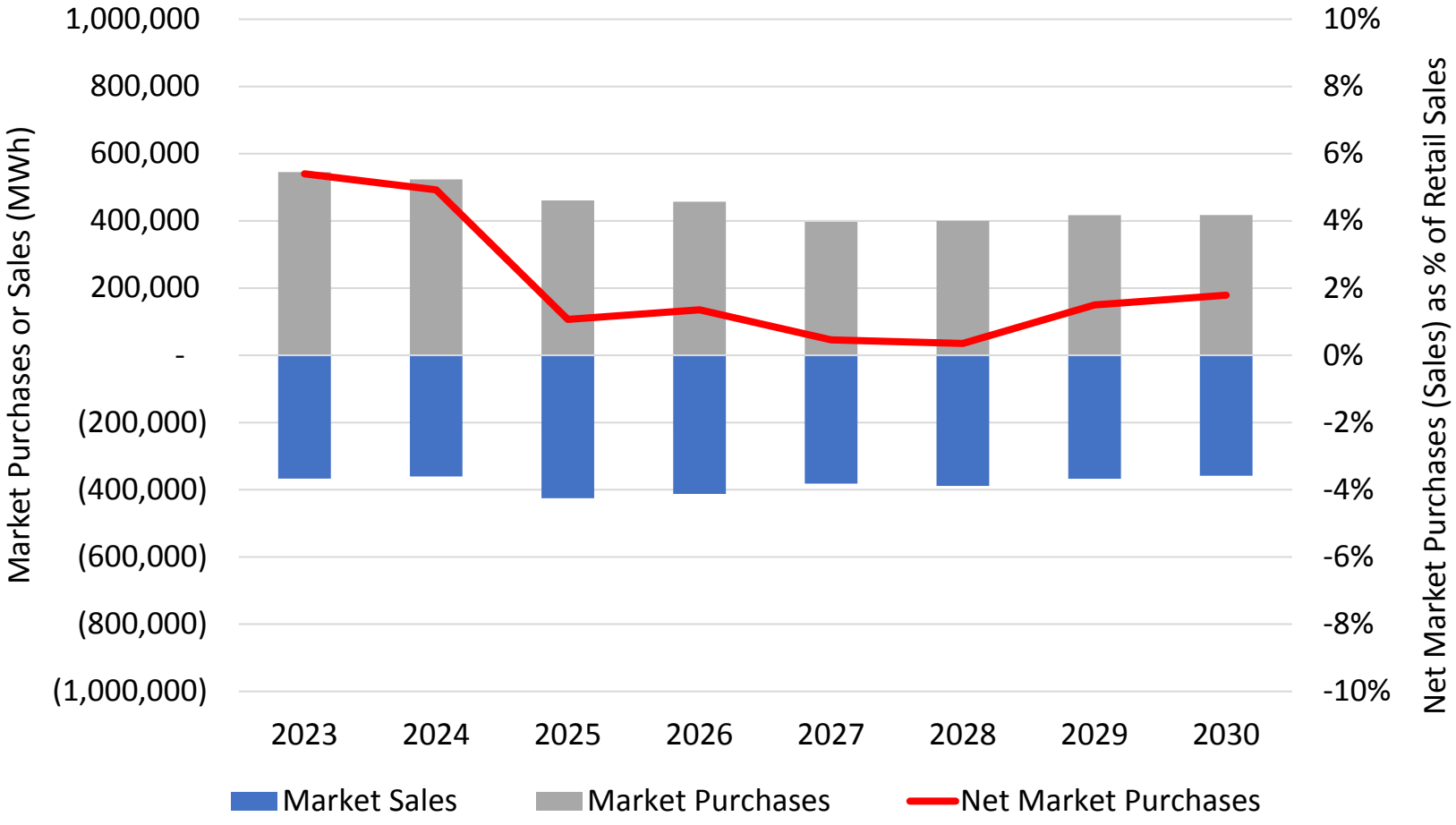
The buildout required for this portfolio results in moderate market purchases and sales, with net purchases representing 2-7% of annual sales



*Does not include line losses

CAISO Market Purchases & Sales Accelerated Case Portfolio

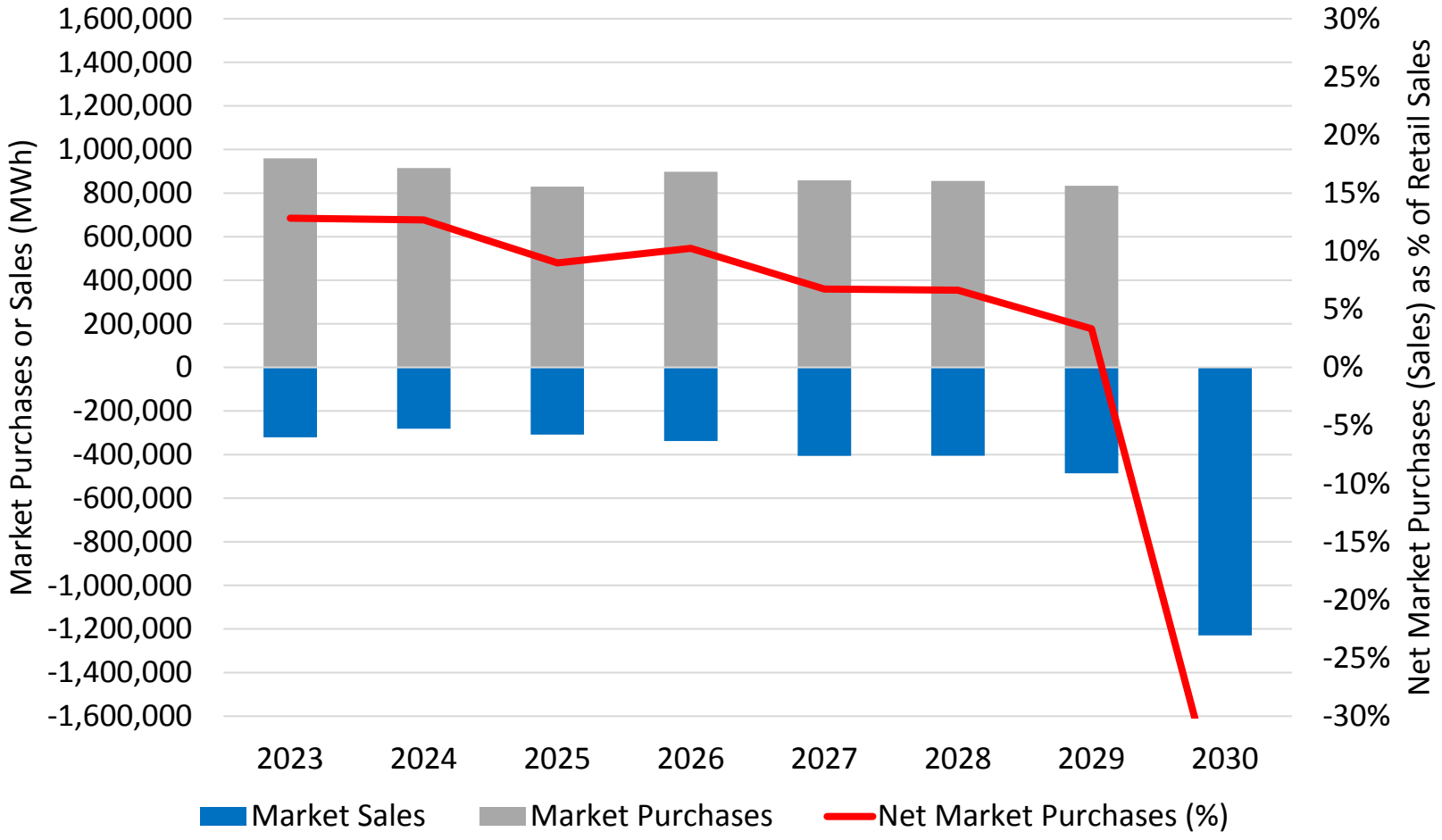
The buildout required for this portfolio results in low to moderate market purchases and sales, with net purchases representing 0-5% in 2030



*Does not include line losses

CAISO Market Purchases & Sales Time Coincident Case Portfolio

The large buildout required for this portfolio results in significant sales of excess generation (40% of total retail sales) to the market in 2030



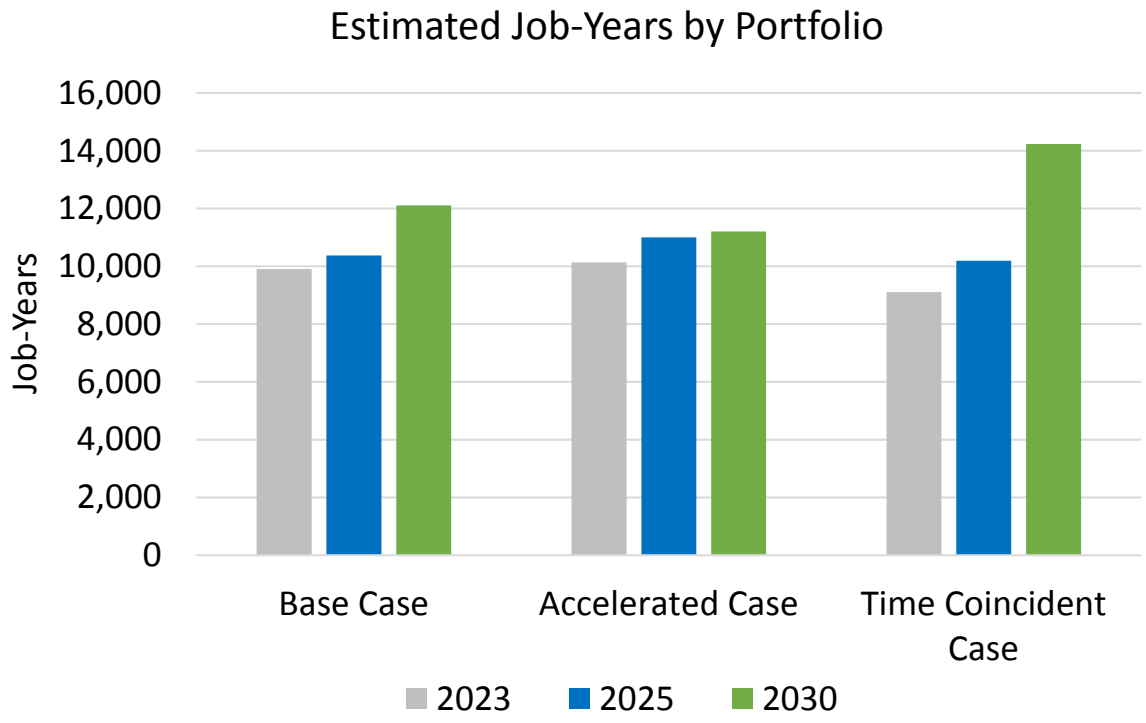
*Does not include line losses

Results: Local Investment

- All portfolios include 81 MW of local solar and 27 MW of local battery storage
- This represents $186 million of local investment

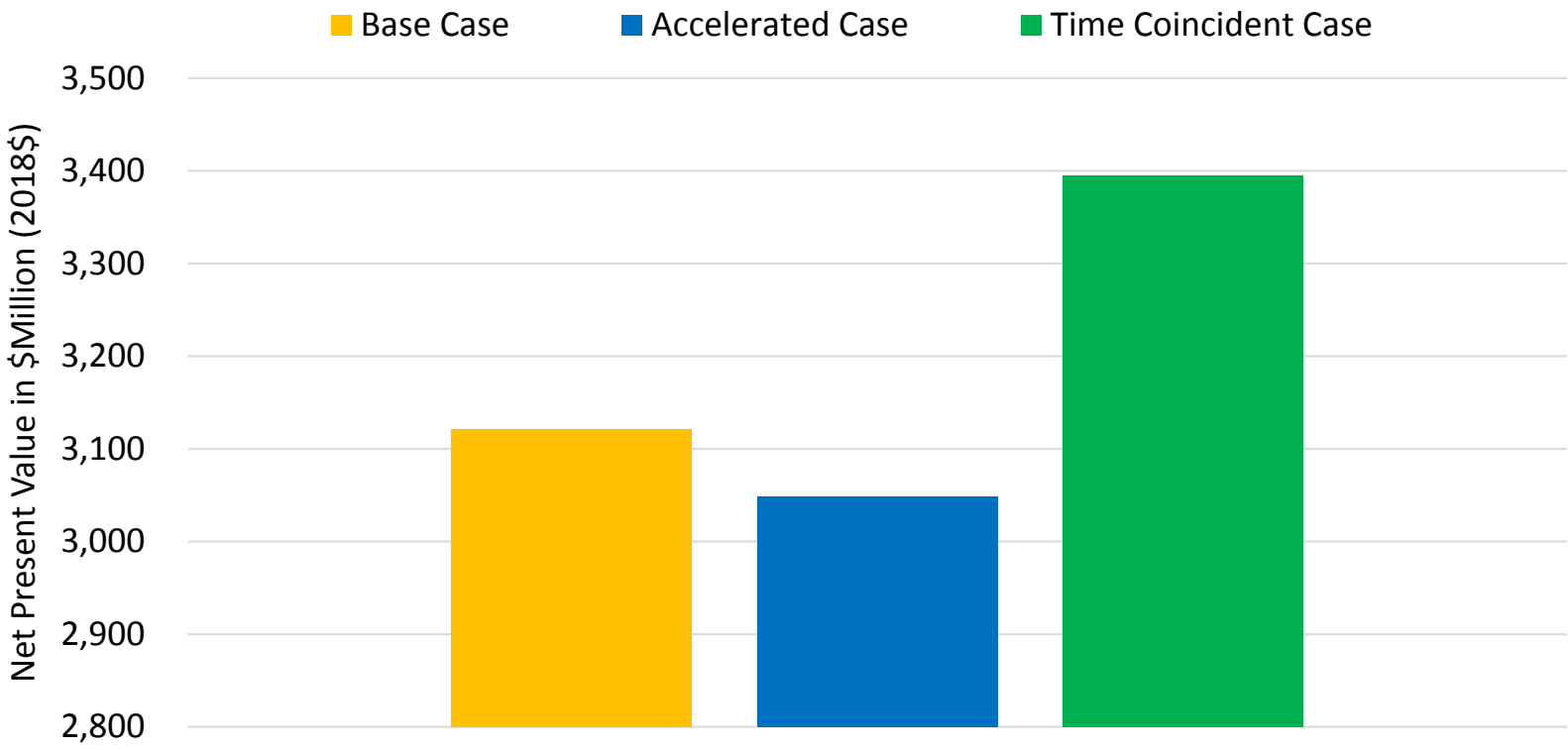
Results: Job-year Estimates Under Each Portfolio

- Job-year = equivalent to one full-time job for one year (2,080 working hours)
- For all portfolios there is expected to be **1,394 local job-years created**
- The chart below represents job-years estimates for the construction and operating phases of all projects identified for development in the portfolios.



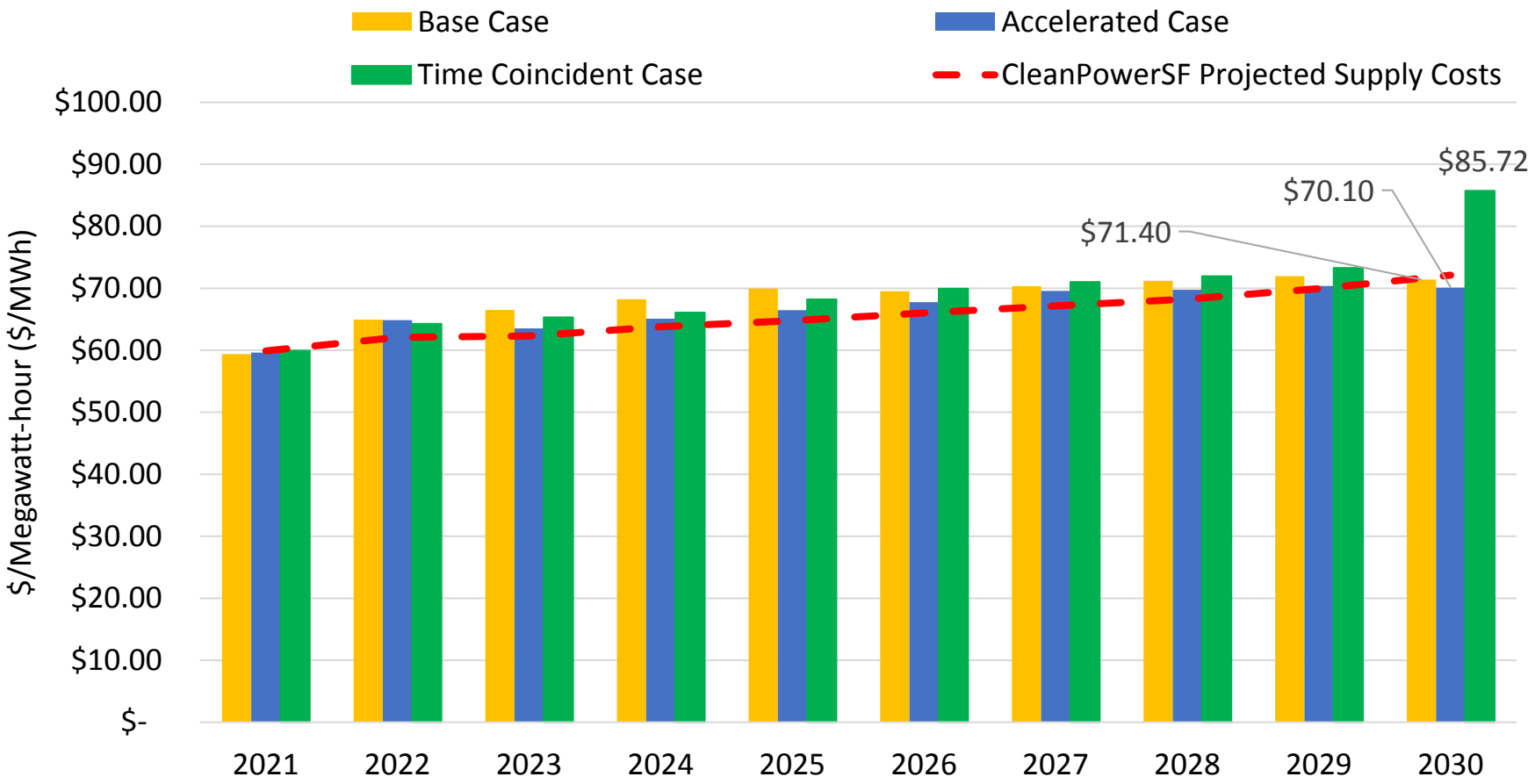
The Time Coincident Case is expected to create more jobs in 2030 because it requires more new capacity.

Results: Portfolio Costs, 2021-2038



Million$ (2018$)	Base Case	Accelerated Case	Time Coincident
2021-2038 Portfolio Cost (NPV)	$ 3,121	$ 3,049	$ 3,395
Difference from Base Case (NPV)		$ (72)	$ 274
Difference from Base Case (%)		-2%	9%

Results: Average Portfolio Costs

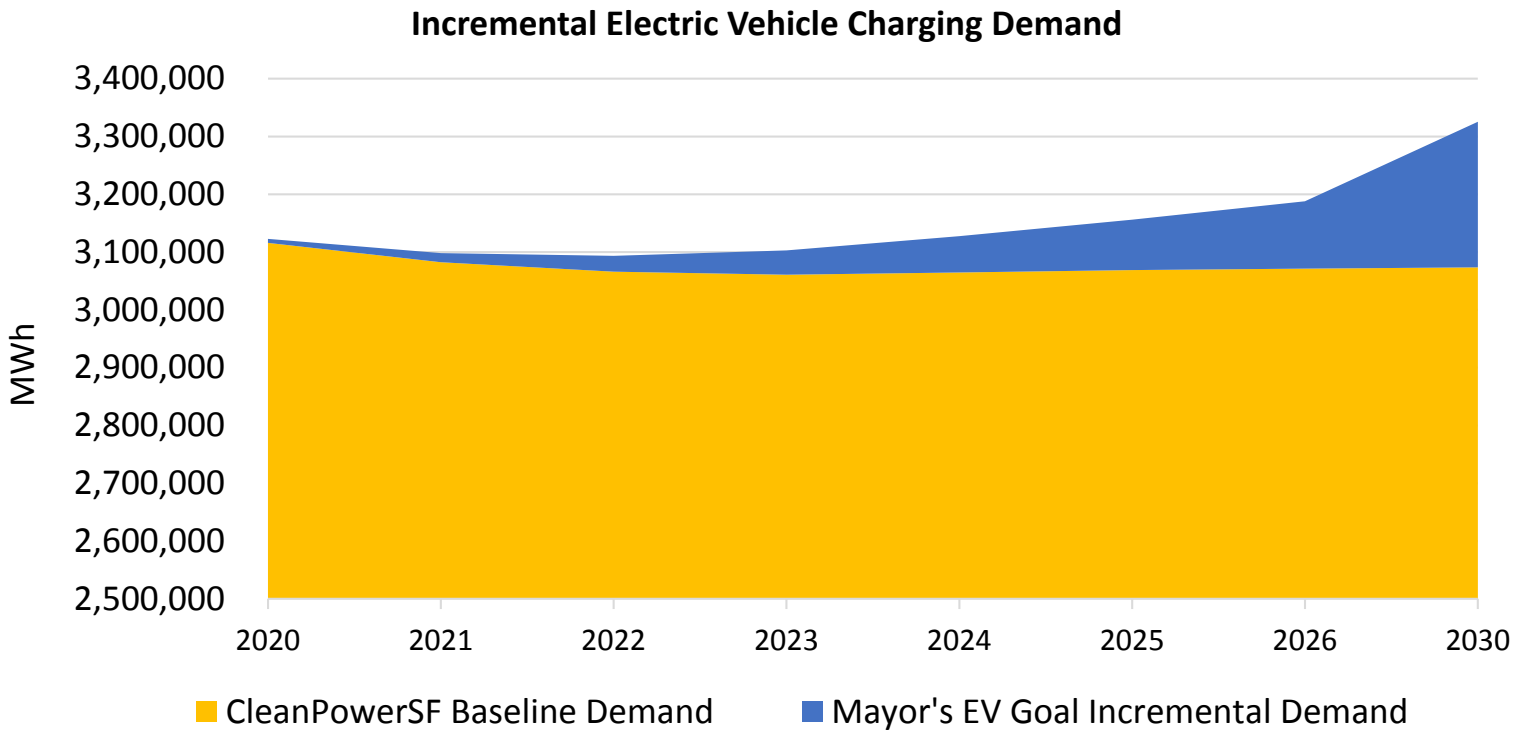


Million$ (2018$)	Base Case	Accelerated Case	Time Coincident
2030 Portfolio Cost (NPV)	$ 218	$ 214	$ 262
Difference from Base Case (NPV)		$ (4)	$ 44
Difference from Base Case (%)		-2%	20%

Results: Electric Vehicle Sensitivity Analysis

2030 Goal: All new vehicle registrations in San Francisco are EVs by 2030

2040 Goal: All vehicle trips originating, through, and ending in San Francisco are EVs



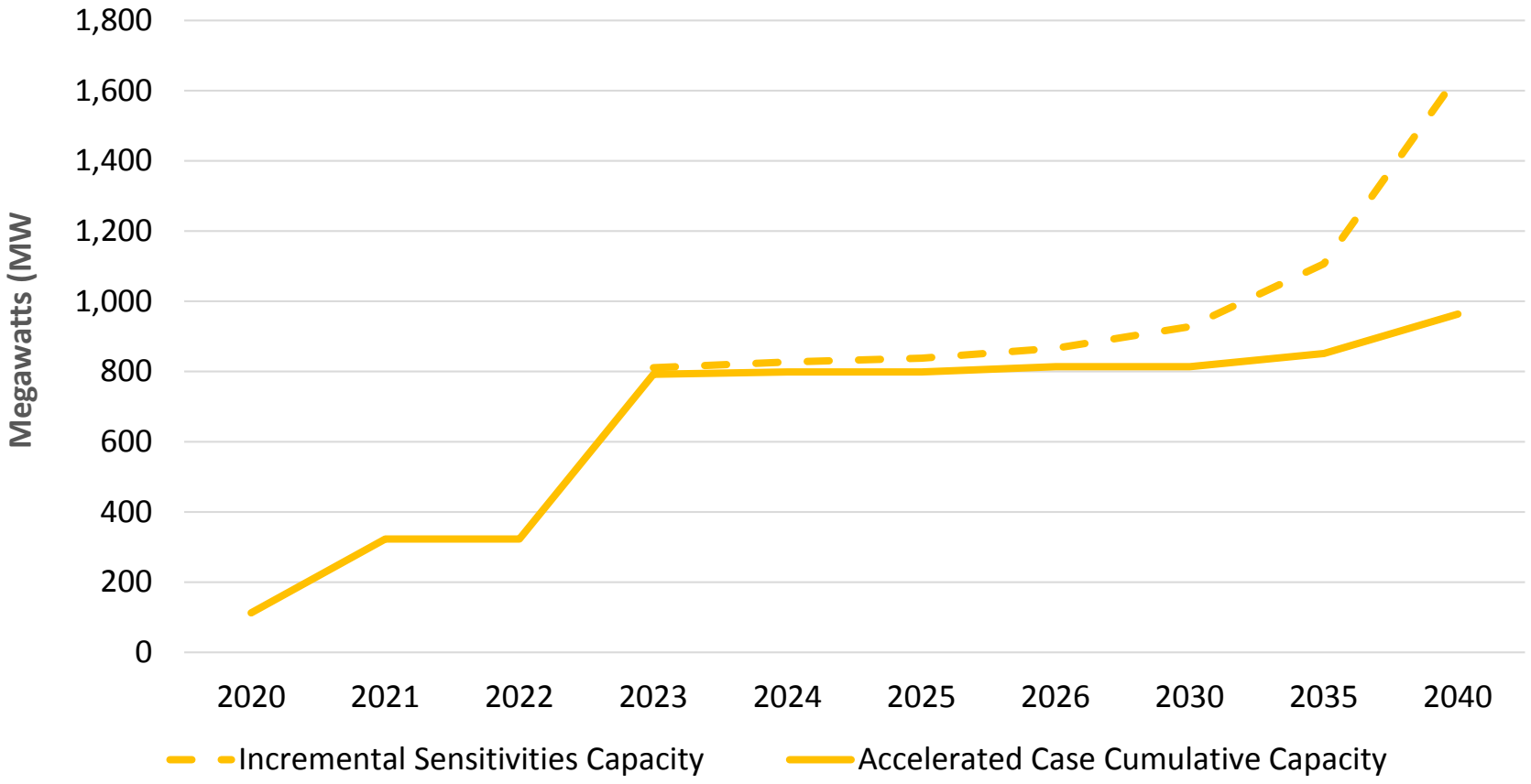
If CleanPowerSF served all the additional EV demand, achieving the Mayor's EV goals is projected to increase CleanPowerSF electricity demand by 8.2% in 2030 and 46.8% in 2040.

Results: Building Decarbonization Sensitivity Analysis

- The building decarbonization sensitivity analysis examined the increases in electricity demand that would result from an Ordinance requiring new construction to be all-electric starting in 2024.
- Our initial analysis found that the incremental electricity demand from an all-electric requirement would cause only a 0.1% increase in CleanPowerSF's baseline demand in 2030.

Results: Electrification Would Require Additional Renewable Capacity

An additional 114 MW of new renewable development would meet the incremental demand from the two sensitivities by 2030. In 2040, an additional 679 MW would be needed



IRP EVALUATION

Integrated Resource Plan Objectives

The Sweet Spot:
CleanPowerSF's
Preferred Portfolio

CleanPowerSF Goals and Objectives

Lead with **Affordable** and Reliable Service

Provide **Cleaner** Electricity Alternatives

Invest in **Local Renewable Projects** and **Local Jobs**

*While Providing for Long-Term **Rate and Financial Stability***

Balanced Program Design

Allows Delivery Across Competing Objectives While Providing Financial Stability

CleanPowerSF Portfolio Evaluation

Lead with **Affordable** and Reliable Service	• Portfolio Cost ($/MWh) • Portfolio Reliability • Resource Diversity
Provide **Cleaner** Electricity Alternatives	• Portfolio Emissions • Renewable Energy Content
Invest in **Local Renewable Projects** and **Local Jobs**	• $ Invested Locally • MW Developed Locally • Job Development Potential
*While Providing for Long-Term **Rate and Financial Stability***	• % Long-term Contracted • Market Exposure (Net Market Purchases)

CleanPowerSF Portfolio Evaluation: Affordable

Lead with **Affordable** and Reliable Service

- Portfolio Cost ($/MWh)
- Portfolio Reliability
- Resource Diversity

- The Accelerated Portfolio is the lowest cost in 2030 and over the 2021-2038 period.
  - In 2030, the Accelerated Portfolio is projected to cost about $4 million less than the Base Case and about $48 million less than the Time Coincident Portfolio.
- All portfolios meet reliability criteria.
- The Time Coincident Portfolio has the most diverse resource mix, but it also includes significantly more capacity than other cases, which drives up its cost.

CleanPowerSF Portfolio Evaluation: Cleaner

Provide **Cleaner** Electricity Alternatives

- Portfolio Emissions
- Renewable Energy Content

- All portfolios achieve the City's goal of supplying 100% renewable energy and 100% greenhouse gas free electricity supply by 2030.
- The Accelerated Portfolio meets these goals 5 years sooner.

CleanPowerSF Portfolio Evaluation: Local Investment

Invest in **Local Renewable Projects** and **Local Jobs**

- $ Invested Locally
- MW Developed Locally
- Job Development Potential

- All of the portfolios include local investment in new renewable energy projects.
  - $186 million invested in projects within the 9 Bay Area Counties
  - Includes 81 MW of new solar and 27 MW energy storage
  - We estimate these projects will create 1,394 job-years
- Given that the Accelerated Portfolio is also the lowest overall cost, it provides the most financial flexibility for integrating additional local renewable energy projects over time.

CleanPowerSF Portfolio Evaluation: Rate and Financial Stability

*While Providing for Long-Term **Rate and Financial Stability***

- % Long-term Contracted
- Market Exposure (Net Market Purchases)

- All Portfolios feature at least 50% long-term contracts (10 years or more) with new renewable resources.
  - Time Coincident Portfolio is the most long-term contracted at 67% of total retail sales.
- The Base Case Portfolio and the Accelerated Portfolio feature the lowest market exposure from the standpoint of net market purchases.
  - The significant new capacity required in the Time Coincident Portfolio results in 40% market sales beginning in 2030, a significant market exposure.

Sensitivity Analysis Findings

- Requiring all new construction to be all-electric is not expected to produce significant additional electricity demand in San Francisco.
- However, meeting the Mayor's EV Roadmap goals is projected to have a significant impact on electricity demand.
  - If CleanPowerSF were to serve all of this load, it would represent a 46% increase in CleanPowerSF's demand by 2040.
  - Serving this additional demand would require 114 MW of additional renewable capacity in 2030 and 679 MW in 2040.

CONCLUSIONS AND RECOMMENDATIONS

38 MMT Preferred Portfolio Ranking
(1 = best, 3 = worst)

	Base Case	Accelerated Case	Time Coincident Case
Lead with Affordable Service			
Cost	**2**	**1**	**3**
Reliability	**2**	**2**	**1**
Risk	**1**	**2**	**3**
Provide Cleaner Energy Alternatives			
Emissions	**Equivalent**		
Renewable	**Equivalent**		
Invest in Local Projects and Jobs			
Local Investment	**Equivalent**		
Provide for Long-term Rate and Financial Stability			
% Long-term Energy	**Equivalent**		

Recommendation

Staff recommends the Commission adopt the Accelerated Case Portfolio because it best balances CleanPowerSF program goals:

- ✓ Affordable
  - The Accelerated Case has the lowest total portfolio costs
- ✓ Reliable
  - The Accelerated Case meets the annual reliability target
- ✓ Cleaner
  - The Accelerated Case achieves City's 100% renewable and GHG-free goals five years sooner
- ✓ Supports Local Investment
  - The Accelerated Case includes a comparable amount of local resource development
- ✓ Supports Rate and Financial Stability
  - The Accelerated Case provides long-term rate stability without over-building and creating unreasonable market risk

Next Steps

- Staff will present this recommendation to the Commission on August 25th.
- The Commission must approve a preferred portfolio for submission of the IRP Compliance Filing on September 1st.

APPENDIX

Key IRP Terms and Acronyms

Term (Acronym)	Meaning
Analytical Modeling	Mathematical technique used for simulating, explaining, and making predictions about a complex system
California Public Utilities Commission (CPUC)	State energy regulatory agency that oversees the IRP process for Investor Owned Utilities (IOU), Energy Service Providers (ESP) and Community Choice Aggregators (CCA)
Capacity	The maximum output that a generator can produce, it is typically expressed in terms of megawatts (MW) or kilowatts (kW)
Capacity Factor	A measure of how much energy is produced compared to the resource's maximum capacity over a set period time, expressed as a percentage
Demand	The amount of electricity usage met by a retail seller over a given period of time
Energy	The ability to do work
Energy Storage	A technology which captures energy produced at one time and discharges it for use at a later time
Hybrid Resources	A generator that consists of two or more paired resource types eg., solar plus battery storage

Key Terms and Acronyms

Term (Acronym)	Meaning
Integrated Energy Policy Report (IEPR)	A biennial report issued by the California Energy Commission that contains an assessment of major energy trends and issues facing California's electricity sector, including the demand forecast used in CleanPowerSF's Integrated Resource Plan
Integrated Resource Planning	A process that evaluates future electricity demand and resource options over a long time horizon, typically 20 years, and optimizes the resource mix that meets set criteria at the lowest cost
Investment Tax Credit (ITC)	A federal tax credit available to investment in solar power facilities and co-located energy storage facilities
Job-years	A job creation metric which is equivalent to one full time job (2,080 working hours) for one year
Load Serving Entity (LSE)	A retail seller of electricity
Long-duration Energy Storage	Battery storage of various technology types which can discharge for 8 hours or more
Megawatt (MW)	1,000,000 watts (a unit of power demand or generating capacity)
MMT CO2	Million metric tons of carbon dioxide
Portfolio	A collection of power supply resources used to serve electricity demand

Key Terms and Acronyms

Term (Acronym)	Meaning
Preferred Portfolio	Of the portfolios modeled, the one which best meets program goals and regulatory requirements that is approved and submitted to the California Public Utilities Commission
Reference System Plan	The Integrated Resource Plan developed by the California Public Utilities Commission that includes the CPUC's view of the optimal mix of resources for the state over the IRP planning horizon for all retail sellers subject to its jurisdiction
Renewable Portfolio Standard (RPS)	California State program that requires a minimum amount of electricity in retail seller portfolios to come from eligible renewable energy resources
Resource Adequacy (RA)	A capacity-based regulatory program intended to ensure that there are sufficient electricity generating resources to support reliable grid operation under peak demand conditions
Sensitivity Analysis	Analysis of the impact to the portfolio caused by a change to a variable in the analytical model
System Power	Electric generation supplied by the grid at a particular time that is not associated with a specific generating facility