Exhibit 2

E3 Study Report

Glendale Water and Power's Plan to Increase Solar Adoption and Develop Additional Distributed Energy Resources

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City of Glendale Water & Power
Your Trusted Community Utility

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Energy+Environmental Economics

Table of Contents

Objective Assessment of Costs and Benefits
E3 presents a non-technical assessment of the costs of achieving GWP's clean energy goals. This assessment does not specify who will bear these costs but focuses on outlining the various costs, benefits, and perspectives covered in the report.

Information for Decision-Makers
This report analyzes the adoption of various program portfolios and illustrates the trade-offs of different options. It provides essential information to enable community members, the City Council, and the Commission to make informed recommendations regarding the benefits, costs, and feasibility of alternative approaches to achieving GWP's clean energy goals and striking the right balance for the City.

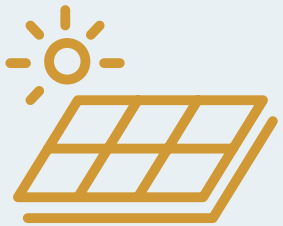
Program Design Alternatives
This report describes various program design alternatives rather than specific recommendations. Detailed technical analyses are included later in the report for those interested in the supporting data.

Glossary: Types of DERs (Distributed Energy Resources)

Load Reducing | Load Shifting | Load Increasing

Energy Efficiency

Electric Vehicles



Customer-Sited Solar

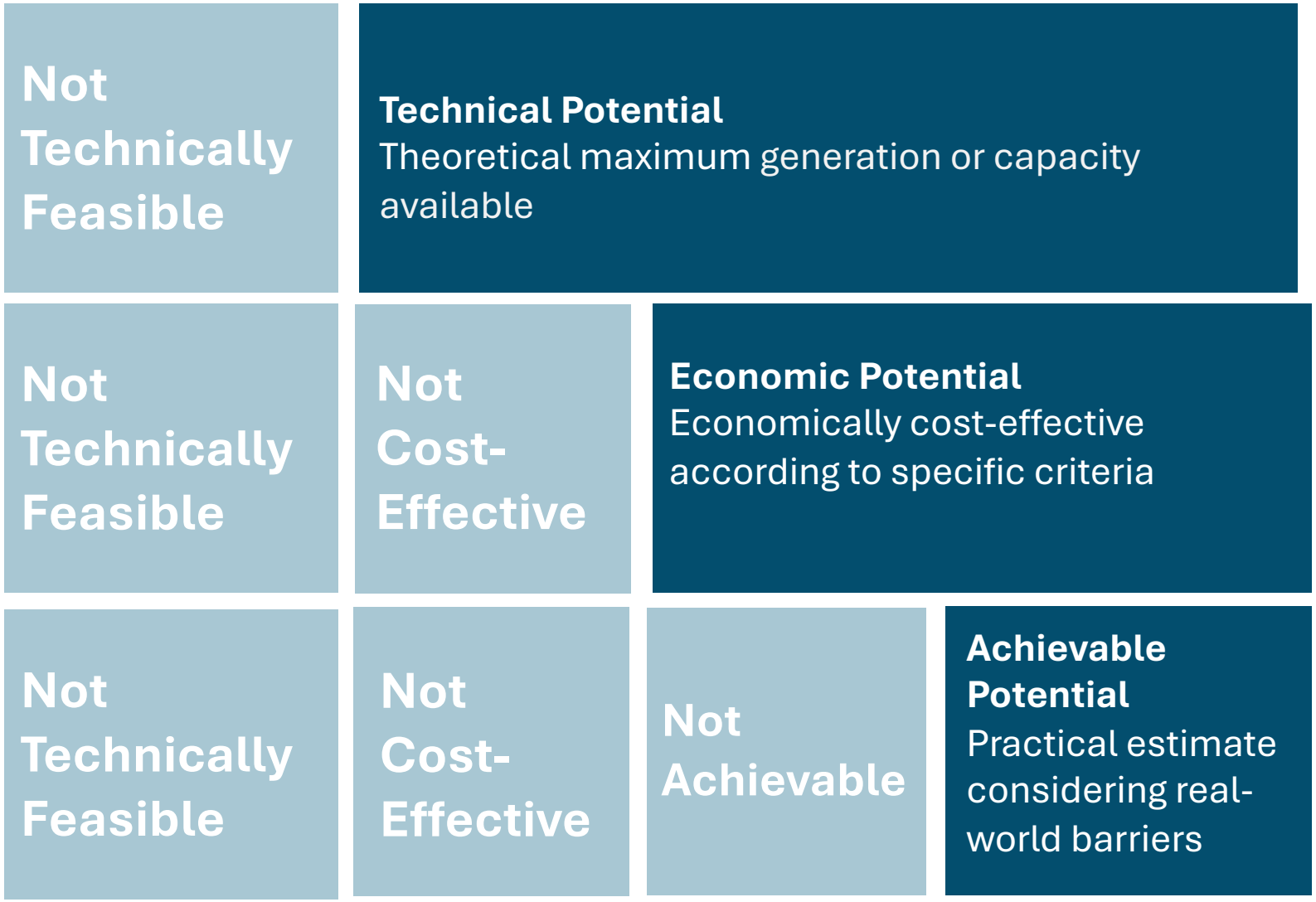
Flexible Loads

Energy Storage

Demand Response

And More...

Glossary: Levels of DER Potential



+ Technical Potential is a metric that quantifies the maximum generation or capacity available for a technology in each region and does not consider the economic or market viability.
+ Economic Potential applies a cost-effectiveness screen to each measure; only cost-effective measures are included in the economic potential (usually from total resource cost or societal perspectives).
+ Achievable Potential refines technical and economic potential by applying customer participation rates that account for real-world constraints, policy levers, and the likelihood of adoption.

Glossary: Other Acronyms

- ACC: Avoided Cost Calculator
- BESS: Battery Energy Storage System
- CAISO: California Independent System Operator
- CEC: California Energy Commission
- C&I: Commercial & Industrial
- CPUC: California Public Utilities Commission
- DR: Demand Response
- EE: Energy Efficiency
- ELCC: Effective Load Carrying Capability
- EV: Electric Vehicle
- FL: Flexible Load
- GWP: Glendale Water & Power
- IOU: Investor-Owned Utility
- LDEV: Light-Duty Electric Vehicle
- LOLH: Loss of Load Hours
- LOLP: Loss of Load Probability
- MF: Multi-Family
- PV: Photovoltaic
- RA: Resource Adequacy
- SF: Single-Family
- V1G: Vehicle-to-Grid, one-way power flow
- V2G: Vehicle-to-Grid, two-way power flow
- VGI: Vehicle Grid Integration

Section 1
Executive Summary

Energy+Environmental Economics

Introduction

Energy+Environmental Economics

Who is E3?

+ E3 is the largest consulting group focused on the clean energy transition in North America
+ E3 is a recognized thought leader on decarbonization and clean energy transition topics
+ E3 has four major practice areas covering energy systems from bulk grid to behind the meter

Climate Pathways / Policy Analysis

- Climate and energy policy analysis
- Long-term energy & climate scenarios
- Electrification and low-carbon fuels
- Future of gas

Asset Valuation & Strategy

- Asset valuation and due diligence
- Strategic advisory
- Energy market price forecasting
- Market design
- Transmission planning

Integrated System Planning

- Integrated resource planning for electric systems: reliability and resource mix
- Planning for utility and state RPS + GHG targets
- Utility planning and procurement decisions

DER / Electrification / Rates

- Valuation of DERs
- DER dispatch and asset optimization
- Rate design
- Grid modernization
- Building electrification
- Vehicle electrification

Economy-wide energy systems — Bulk grid power systems — Grid edge & behind-the-meter

Introduction and Objectives

City Council Resolution of August 2022

10% of GWP customer solar and energy storage adoption by 2027

Additional dispatchable and peak load reduction capacity of 100 MW

Category 1

Develop Plan to Increase Solar and Energy Storage Penetration and Develop Additional Distributed Energy Resources (DERs)

Category 2

Dispatchable Capacity and Demand Reduction Calculation

Category 3

Cost-Benefit Analysis

Under direction from the City Council, Glendale Water & Power issued an RFP focusing on three key categories of analytical support

GWP partnered with E3 to create an equitable solar and energy storage adoption plan with input from the community, focusing on community outreach and ensuring that multifamily and rental properties are thoroughly incorporated into the plan.

Category 1

Develop Plan to Increase Solar and Energy Storage Penetration and Develop Additional DERs

Develop a plan to achieve the goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027, and to develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW by December 31, 2027.

If the consultant concludes that date to be unattainable then a date identified soon thereafter.

The plan must include policies and incentives designed to be sufficient to ensure customers will adopt solar and energy storage at a rate that achieves the adoption and capacity goals stated above.

The plan must include an alternative approach with a mix of storage at customer sites and at GWP-controlled sites, rather than all storage being located at customer sites.

Potential Policies and Incentives

- Net Energy Metering (NEM)
- Upfront Rebates
- Feed-In-Tariff (FIT) Program
- Performance-Based Incentives
- Equity Strategies & Policies
- Community Solar Projects
- Energy Efficiency
- Demand Reduction

Category 2

Dispatchable Capacity and Demand Reduction Calculation

Calculate the estimated dispatchable capacity and demand reduction that can be achieved through the plan developed in Category 1.

Category 3

Cost-Benefit Analysis

Complete an analysis of the benefits and cost of the plan developed in Category 1, and the analysis must include:

- Direct and indirect economic benefits and costs, as well as environmental, societal, and other noneconomic benefits and costs; and direct and indirect impacts to low- and moderate-income (LMI) households.
- If the analysis concludes any negative impact, the consultant shall include program options to mitigate the impact.
- If the analysis concludes that there are any negative impacts on LMI households, the consultant shall include program options to fully mitigate the impact.

E3's analytical support focused on several research questions

How can local solar and distributed energy resources be effective, economic, and equitable parts of GWP's reliable, low-carbon resource portfolio?

Balancing Multiple Objectives

1. What is the potential for solar, energy storage, and other DER adoption in meeting the City Council's goals?

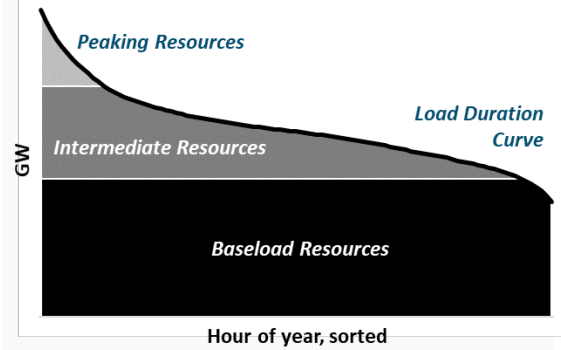
2. If the goals are not currently achievable, when can they realistically be met?

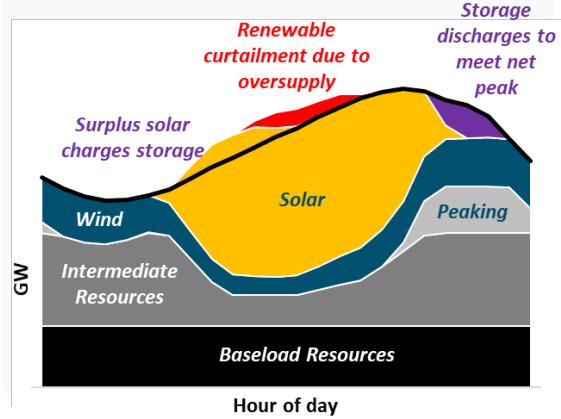
3. What policies and incentives are necessary to achieve the adoption and capacity goals and their cost/benefit implications?

4. How can policies and incentives be tailored to address the needs of low-income customers, residents in heavily pollution-burdened areas, multifamily properties, and rental properties?

5. What are the direct and indirect economic, environmental, societal, and other non-economic benefits and costs associated with solar, energy storage, and other DER adoption?

6. What are the direct and indirect impacts on low- and moderate-income (LMI) households resulting from these policies and incentives?





Revised Scope of Work

- **E3 submitted a proposed budget and scope of work that we felt most cost-effectively met Glendale's objectives, but did not provide all the deliverables requested (slide 10).**
- **In response to input from the community and City Council, scope of work was shifted to increase emphasis on community outreach and the number of stakeholder meetings. The shift in scope included:**
  - Reducing the level of effort for program design recommendations
  - Focusing on solar and storage and not evaluating other DERs in depth
- **E3 developed and recommended program options that would help the City achieve its goals in a more cost-effective and equitable manner than net energy metering (NEM) alone.**

Revised Scope of Work Completed by E3

1. Develop Plan to Increase Solar and Storage Adoption

- ✓ *Identify market segments and potential for solar and storage adoption*
- ✓ *Develop program design and incentive recommendations*
- ✓ *Perform community outreach and engagement*

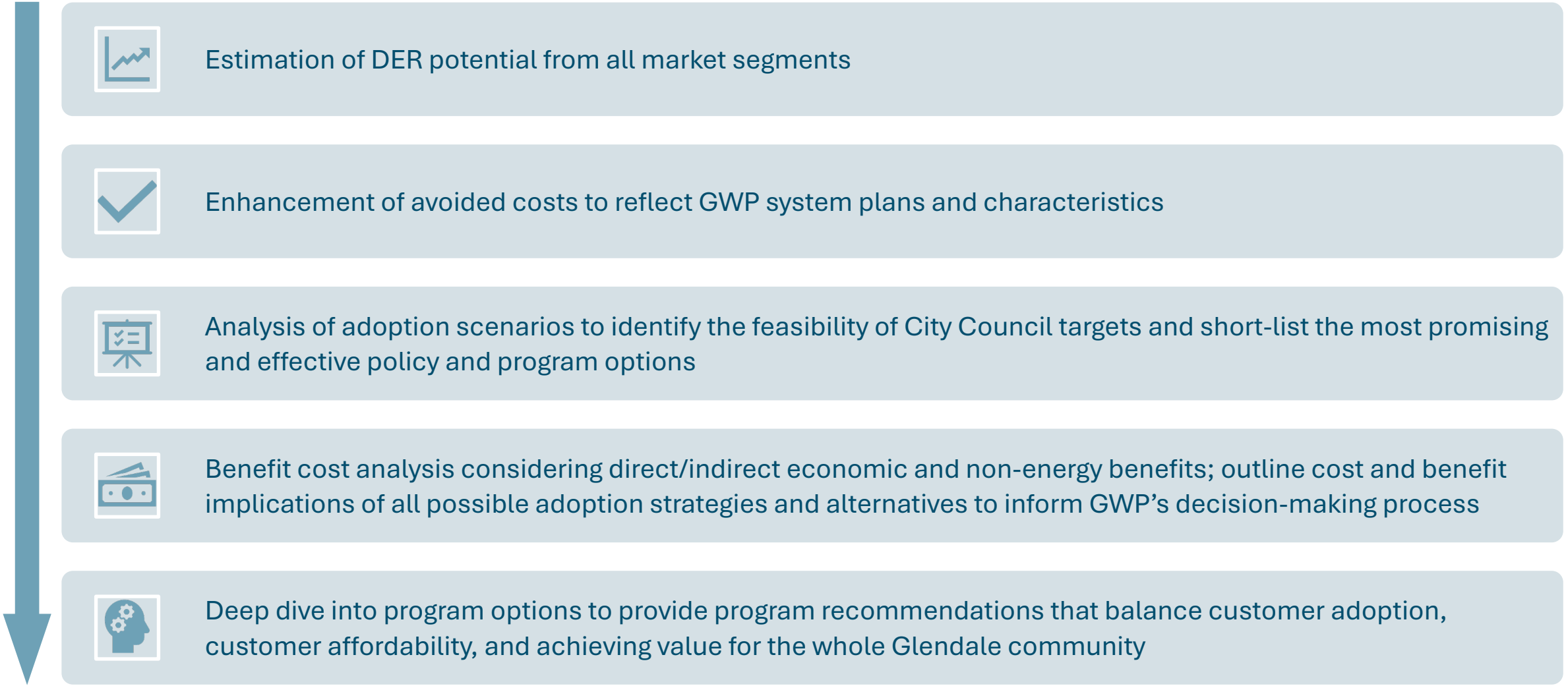
2. Evaluate Dispatchable Capacity and Peak Load Reduction Potential

- ✓ *Summarize program adoption potential and impacts*
- ✓ *Review GWP Integrated Resource Plan*
- ✓ *Summarize dispatchable capacity and peak load reduction potential*

3. Perform Cost-Benefit Analysis

- ✓ *Develop avoided costs for DER*
- ✓ *Perform cost-benefit analysis*

E3 designed the following workflow to support the adoption plan development



- Estimation of DER potential from all market segments
- Enhancement of avoided costs to reflect GWP system plans and characteristics
- Analysis of adoption scenarios to identify the feasibility of City Council targets and short-list the most promising and effective policy and program options
- Benefit cost analysis considering direct/indirect economic and non-energy benefits; outline cost and benefit implications of all possible adoption strategies and alternatives to inform GWP's decision-making process
- Deep dive into program options to provide program recommendations that balance customer adoption, customer affordability, and achieving value for the whole Glendale community

Utility Challenges and Opportunities

Energy+Environmental Economics

GWP faces many challenges in transitioning to a cleaner grid, and local clean energy resources could provide significant support

System Context and Challenges

Glendale's Clean Energy Vision

- 60% RPS by 2030 (CA regulatory requirement)
- 100% Clean Energy by 2035 (Glendale goal)

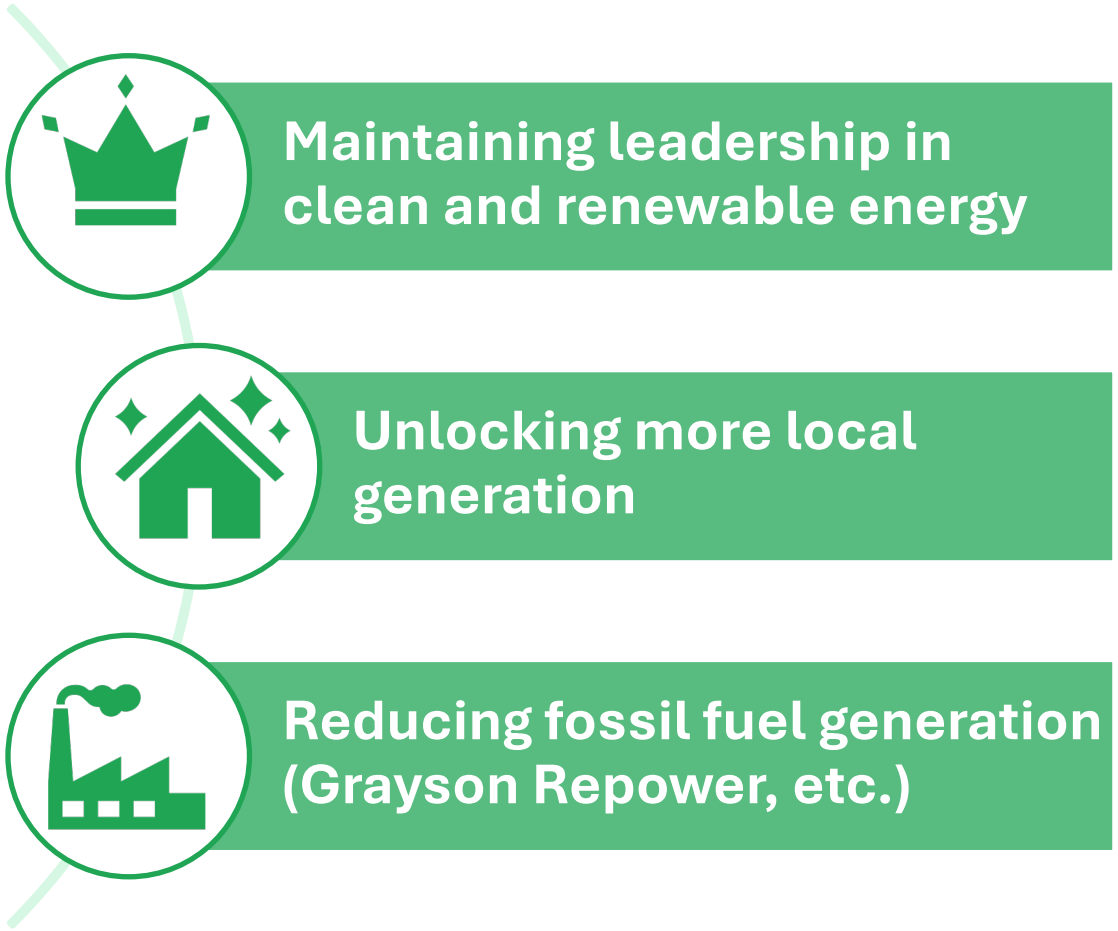
Transmission & Land Constraints

- Procuring new renewables outside of the City
- Procuring new renewables within the City

Integrated Resource Plan (IRP) Planning Challenges

- Integrating renewables, coal retirement, and hydrogen combustion turbine (CT) conversion
- Maintaining system reliability

Role of Local Clean Energy Resources

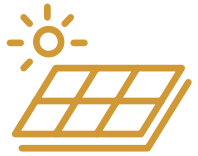


Turning potential into adoption requires a multifaceted approach to ensure equitable solar and DER adoption in Glendale

- Community Outreach
- Permitting, Interconnection, and Approval Rules & Process
- Program & Incentive Design
- Equity Strategies
- Additional DR, EV, and EE Strategies

These are the prerequisites for encouraging more adoption – incorporate community inputs and E3/Willdan project experience and expertise

Utilize modeling and scenario analysis to evaluate and identify effective, least-cost, and equitable strategies, along with improved and customized avoided cost valuation and cost-benefit analysis for GWP



Customer-Sited Solar

Energy Storage

Flexible Loads

Demand Response

Electric Vehicles

Energy Efficiency

Turning potential into adoption requires a multifaceted approach to ensure equitable solar and DER adoption in Glendale

Community Outreach

- Additional outreach on federal and state support (e.g., Inflation Reduction Act, Self-Generation Incentive Program, etc.)
- Propose adoption programs that use mechanisms that customers intuitively understand
- Comprehensive outreach and knowledge campaigns from GWP to inform and educate residents
- Intelligible program design

Permitting, Interconnection, and Approval Rules & Process

- Faster, easier, and scalable permitting, interconnection, and approval process

Program & Incentive Design

- Analysis of adoption scenarios to identify the feasibility of City Council targets
- Short-list the most effective policy and program options that move towards the targets with improved equity and lower costs
- Provide policy and program option alternatives to guide the direction for effective program design

Focus of this report

Equity Strategy

- Additional incentive and program considerations for low- to moderate-income (LMI) customers, disadvantaged communities (DACs), and pollution-burdened areas
- Balance expanding solar access with minimizing cost shifts to non-adopters via community solar, virtual solar, and financing programs

Focus of this report

Demand Response, Electric Vehicles, and Energy Efficiency

- Provide program and incentive options to further promote other DER technologies

Requires additional study

These are the prerequisites for encouraging more adoption – incorporate community inputs and E3/Willdan project experience and expertise

Utilize modeling and scenario analysis to evaluate and identify effective, least-cost, and equitable strategies, along with improved and customized avoided cost valuation and cost-benefit analysis for GWP.

Summary of Findings and Recommendations

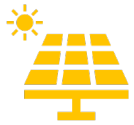
Energy+Environmental Economics

Encouraging customer adoption of solar and storage must be balanced against other municipal utility objectives

Under NEM, customer adoption of solar and storage provides limited grid value and increases rates for all customers

+ **NEM compensation for customer-owned solar will increase GWP electric rates for all customers by 6% in 2030 ($0.02/kWh)**
+ **Customer solar adoption under NEM is predominately by single-family homeowners**
+ **Customer-owned solar and storage under NEM provides limited peak capacity reduction**
  - The effective capacity of **solar** and **storage** is less than **10%** and **50%** of the installed capacity, respectively

Findings: Achieving the adoption goals by 2027 is not feasible



Achieving a goal of 10% customer solar adoption by 2027 is not feasible. The goal is theoretically feasible by 2030 with a significant increase in utility costs and effort, but real-world barriers remain.

Achieving a goal of 10% customer storage adoption in the near future is not feasible.

Achieving a goal of 100 MW of reliable peak load reduction with DERs is not feasible.

Industry studies suggest that achievable potential is 20%-40% of the technical potential.

Recommendations

- Set an adoption goal in terms of MW of installed capacity rather than a percentage of customers.
- Perform additional analyses of realistically achievable potentials for customer-owned, community, and utility-scale solar and storage.
- Develop an integrated resource plan with the potential and MW targets for each resource type.

Findings: Adoption of customer-owned solar and storage increases GWP rates

The scenarios achieving 10% solar adoption would result in a projected net cost of $23-$45 million to GWP ratepayers from 2024 to 2027.

The resulting rate increase would be 6-11% by 2030, with a low- and moderate-income (LMI) customer monthly bill increase of $4-$6.

Recommendations

- Implement a Net Billing Tariff to reduce the cost shift.
- Develop and implement non-bypassable charges and fixed customer charges to reduce the cost shift.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement a Net Billing Tariff.

Findings: Current customer-owned solar and storage adoption is predominately by single-family homeowners above the median income

Customer solar adoption in Glendale to date is above 10% for single-family homes and below 1% for renters and LMI customers.

84% of customer solar adoption is in households above the median income.

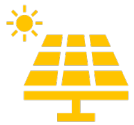
88% of customer solar adoption is by property owners.

90% of customer solar adoption is in single-family homes.

Recommendations

- Allow lower cost community solar and storage to count towards achieving the adoption goal.
- Evaluate virtual solar programs that renters and LMI customers can subscribe to.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement virtual solar programs.

Findings: Customer-owned solar and storage provides limited reliable peak capacity reduction



The effective capacity of customer-owned solar is less than 10% of the installed capacity.

The effective capacity of customer-owned storage is less than 50% of the installed capacity.

The maximum projected reliable peak load reduction from customer-owned solar and storage is 10 MW by 2027.

When including other DERs such as demand response, managed electric vehicle charging, and energy efficiency, the maximum projected reliable peak load reduction is 44 MW by 2027.

Recommendations

- Implement TOU rates that encourage customer storage adoption and dispatch for peak capacity reductions.
- Study and expand demand response, electric vehicle, energy efficiency, utility dispatchable DER, and other programs for peak load reductions.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement TOU rates and utility dispatchable DER.

Findings: Additional costs not included in this study will be required

- Achieving the 10% customer solar adoption goal by 2030 will require increasing the pace of annual adoption from 438 customers last year to over 1,000 customers per year.
- Community feedback requested enhanced customer outreach and support as well as a streamlined permitting process.
- Additional overhead and incentives will be needed to reach renters, LMI, and DAC customers that face larger barriers to solar and storage adoption.
- Changes to GWP billing and metering systems will be required.

Recommendations

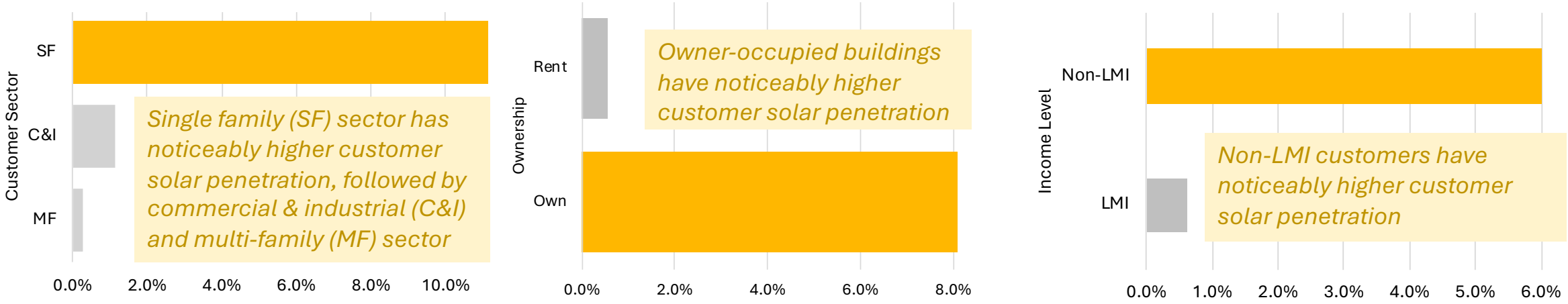
- Evaluate Glendale-specific program elements that will be the most effective for increasing DER adoption by renter, LMI, and DAC customers.
- Evaluate the cost and feasibility of necessary changes to GWP's billing and metering systems.
- Consider the cost of additional program overhead and customer outreach.

Current Solar and Storage Adoption Status

Energy+Environmental Economics

Glendale's current solar and storage penetration pattern skews towards single-family, owner-occupied, and non-LMI households

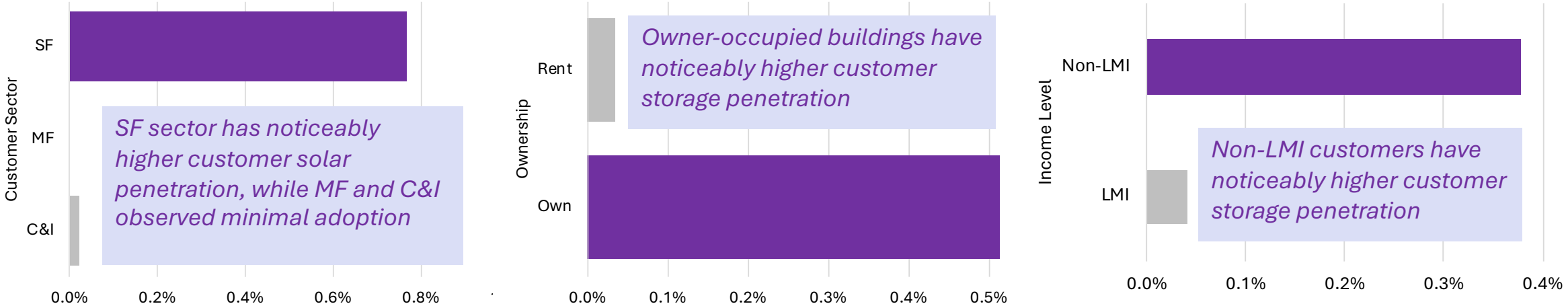
- Glendale has 2,900 customer-sited solar systems totaling 28 MW, most of which are owner-occupied, single-family, non-LMI households. Solar penetration is currently at 3.25% and solar system installations in Glendale have been increasing every year, despite the end of the solar incentive program in 2022.



Adoption Level (% of Total GWP Electric Customers)

Glendale's current solar and storage penetration pattern skews towards single-family, owner-occupied, and non-LMI households

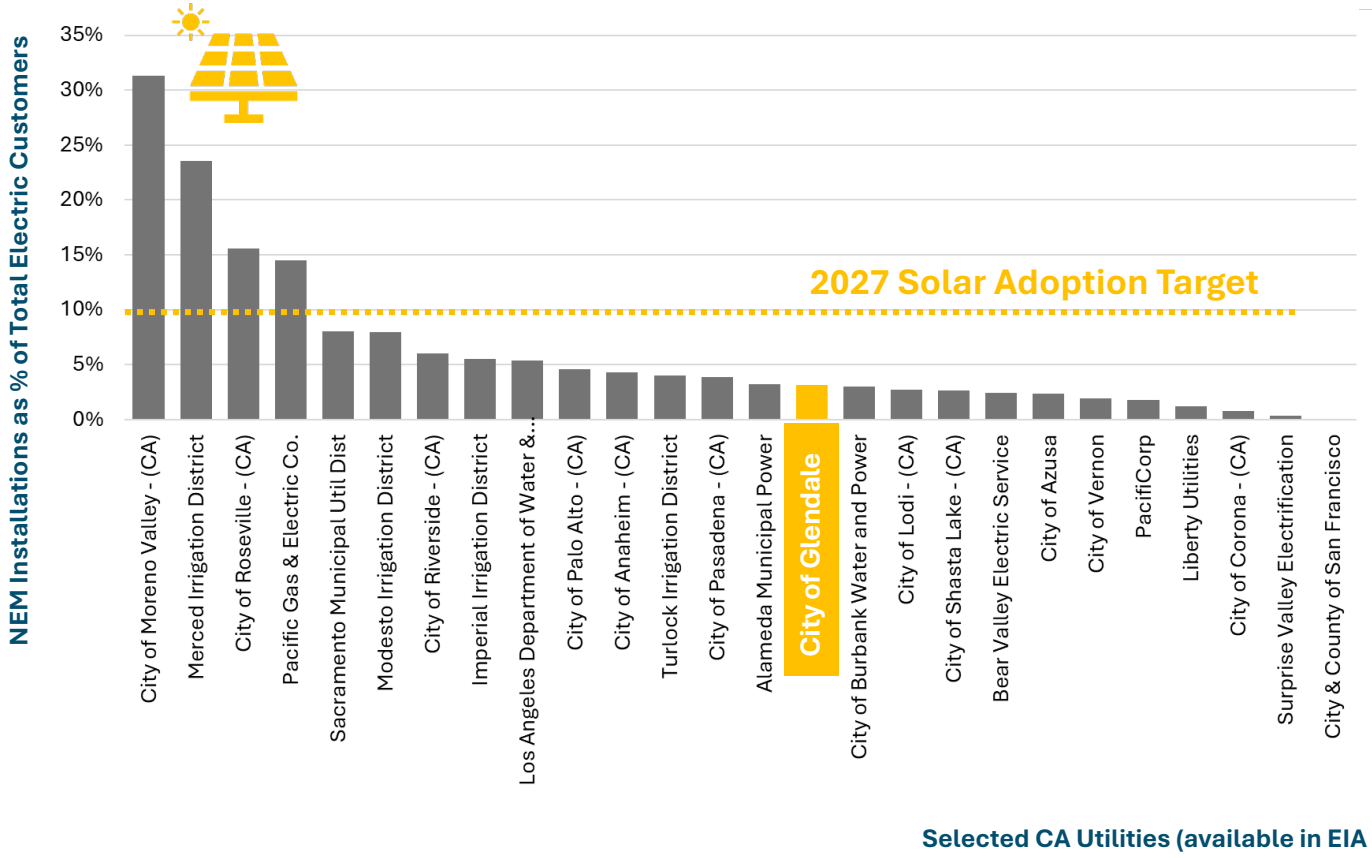
- Glendale has less than 200 customer-sited storage systems, totaling 3 MWh. Most of these systems are owner-occupied, single-family, non-LMI households, with just one large system from commercial customers and none from multi-family residences, reflecting adoption barriers for renter and LMI customers.

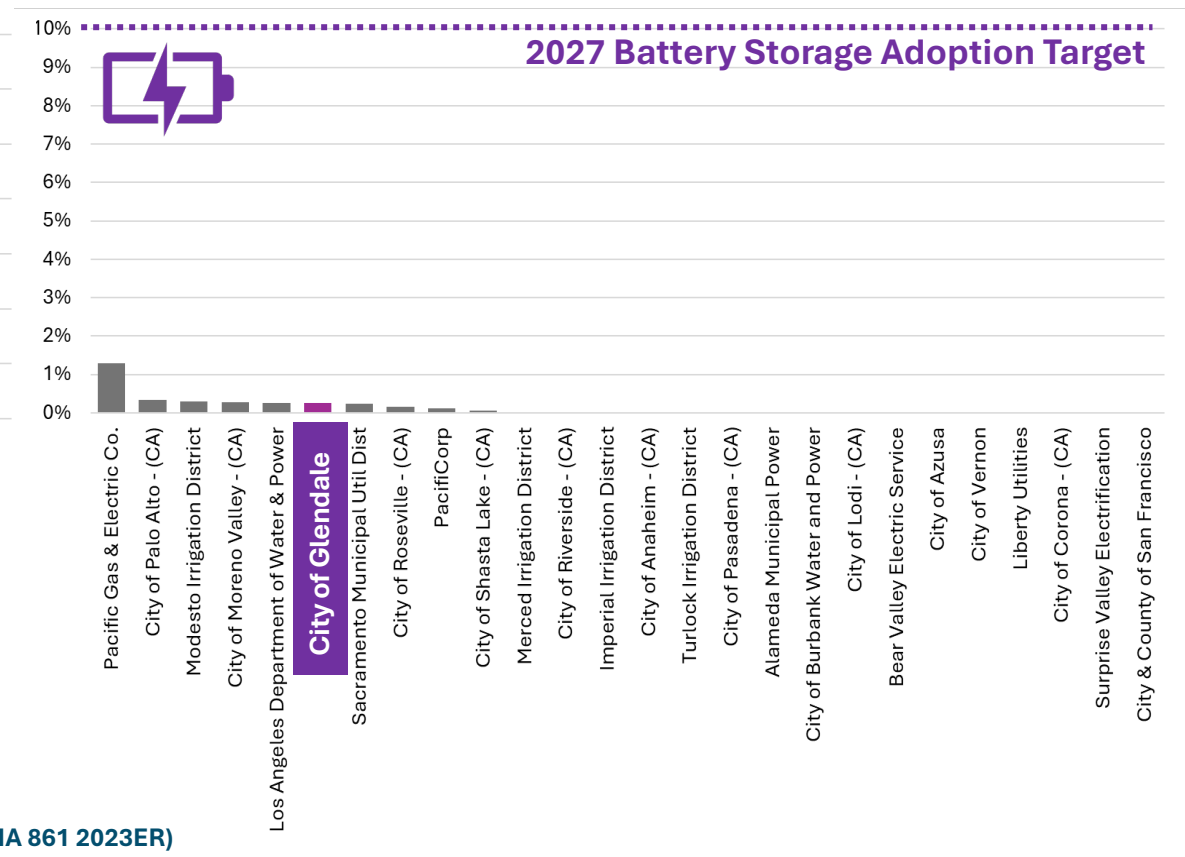


A 10% adoption target for customer solar and storage is ambitious, and could require significant investments

- Compared to peer utilities in the LA region and California, GWP ranked average for solar adoption and top-tier for storage adoption (as a percentage of total electric customers).
- However, the 10% adoption targets by 2027 - if considered as separate goals for solar and storage - are ambitious for **most** California utilities, given current adoption levels.
- Meeting these targets may require **significant investments** to accelerate DER adoption within the limited timeframe.

Utility	Solar Adoption (% of total electric customer)	Battery Storage (% of total electric customer)
City of Burbank Water and Power	3.0%	0.0%
City of Pasadena	3.9%	0.0%
Los Angeles Department of Water & Power	5.4%	0.3%
City of Glendale	3.1%	0.2%

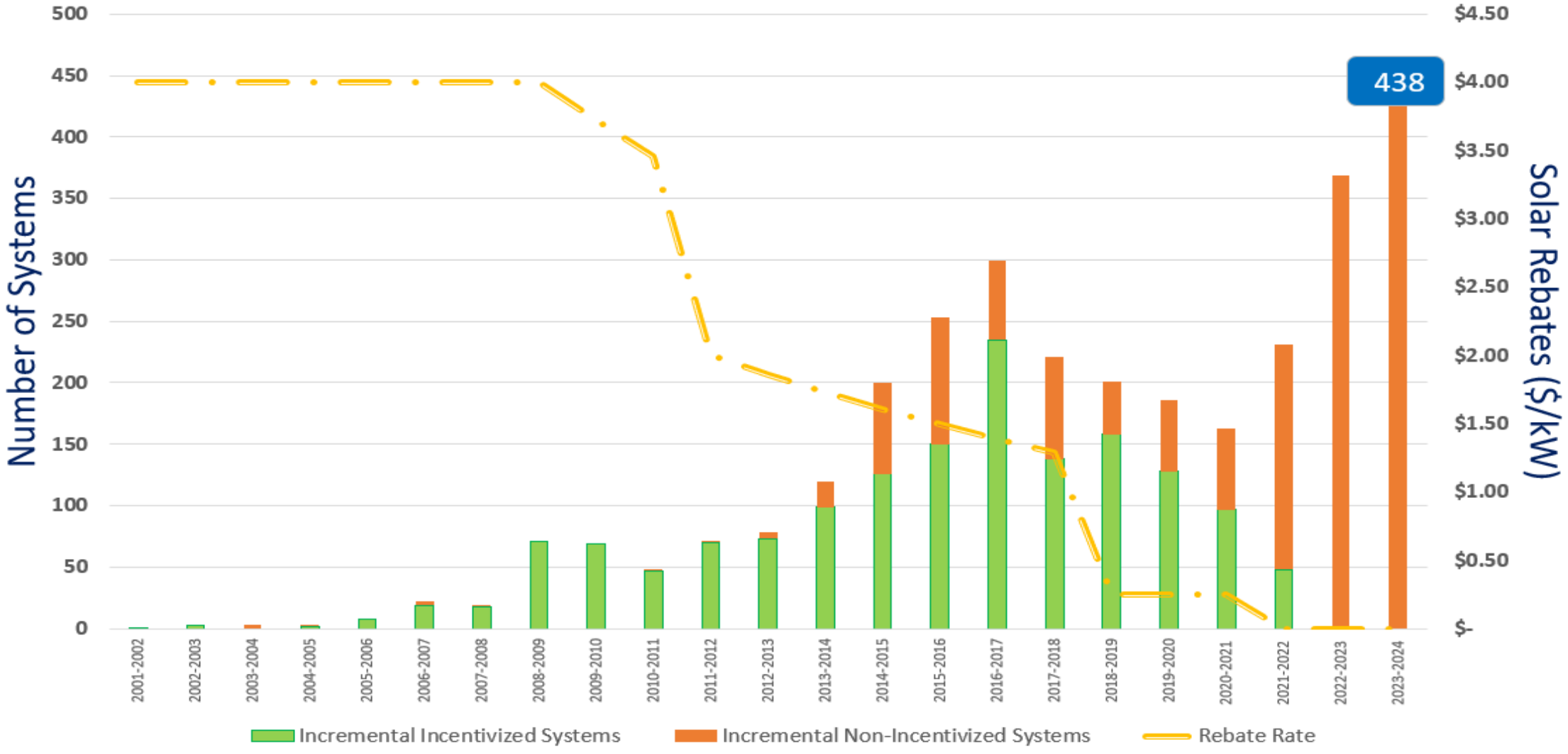




Selected CA Utilities (available in EIA 861 2023ER)

Utility-level net metering solar and storage installation and customer count data collected and derived from EIA Form 861 2023 early release version: https://www.eia.gov/electricity/data/eia861/

Solar Adoption and Rebate Trends: 2001 - 2024



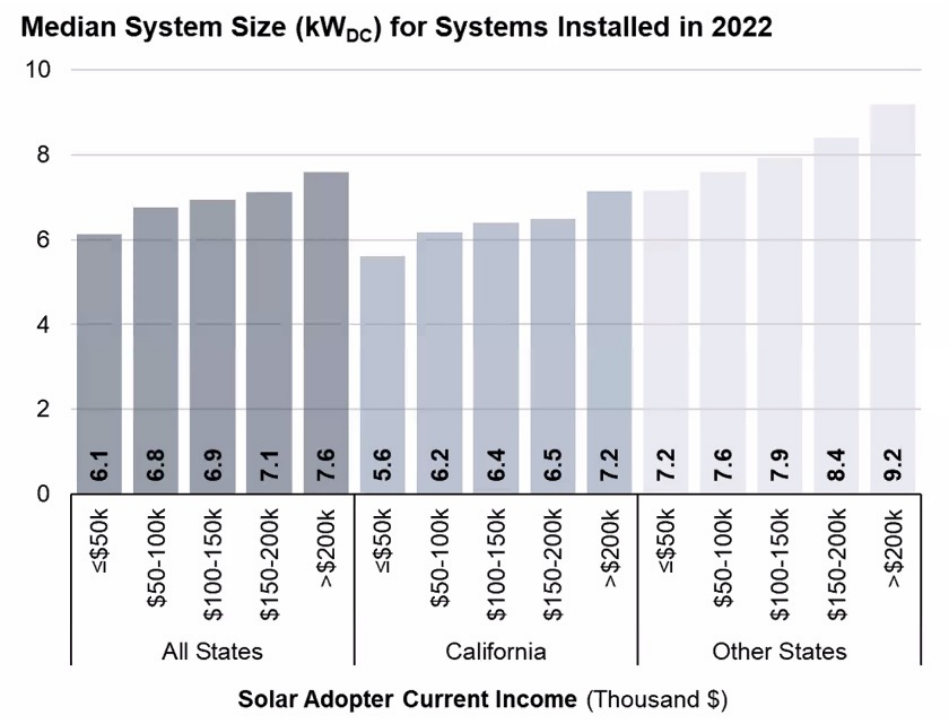
Customer Demographics

Energy+Environmental Economics

Understanding the demographics of residential adopters in California provides crucial context for shaping GWP's future in solar and storage

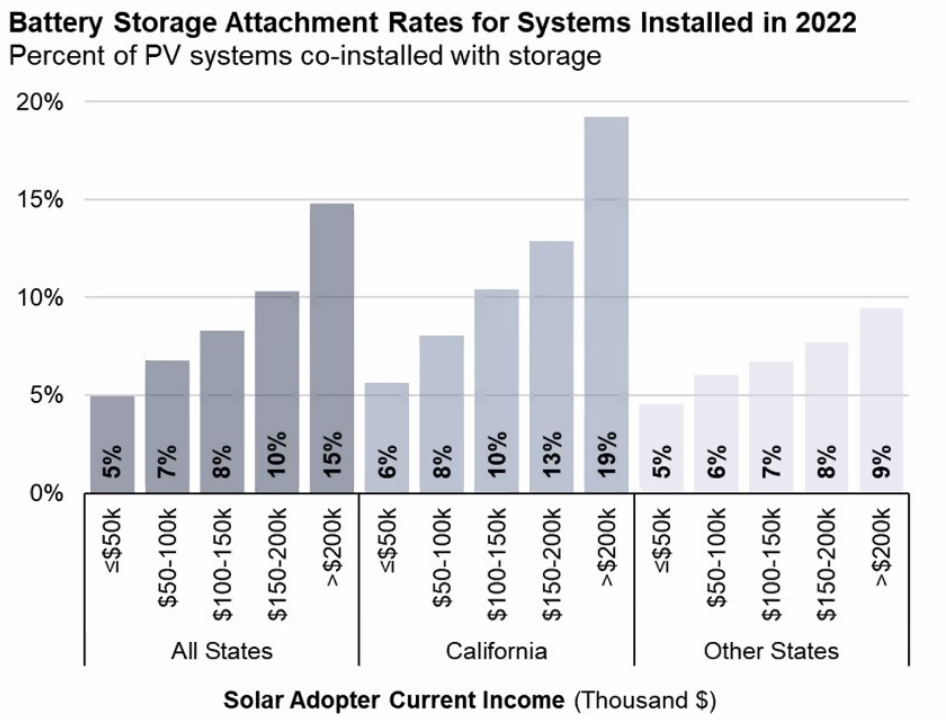
+ Higher income customers tend to adopt larger systems.

- California residents tend to install smaller systems than other states, with median sizes ranging from 5.6-7.2 kW-DC across income levels.



+ Higher income customers are more likely to adopt paired batteries.

- California residents tend to adopt paired batteries at a higher rate than other states, with attachment rates ranging from 6%-19% across income levels.

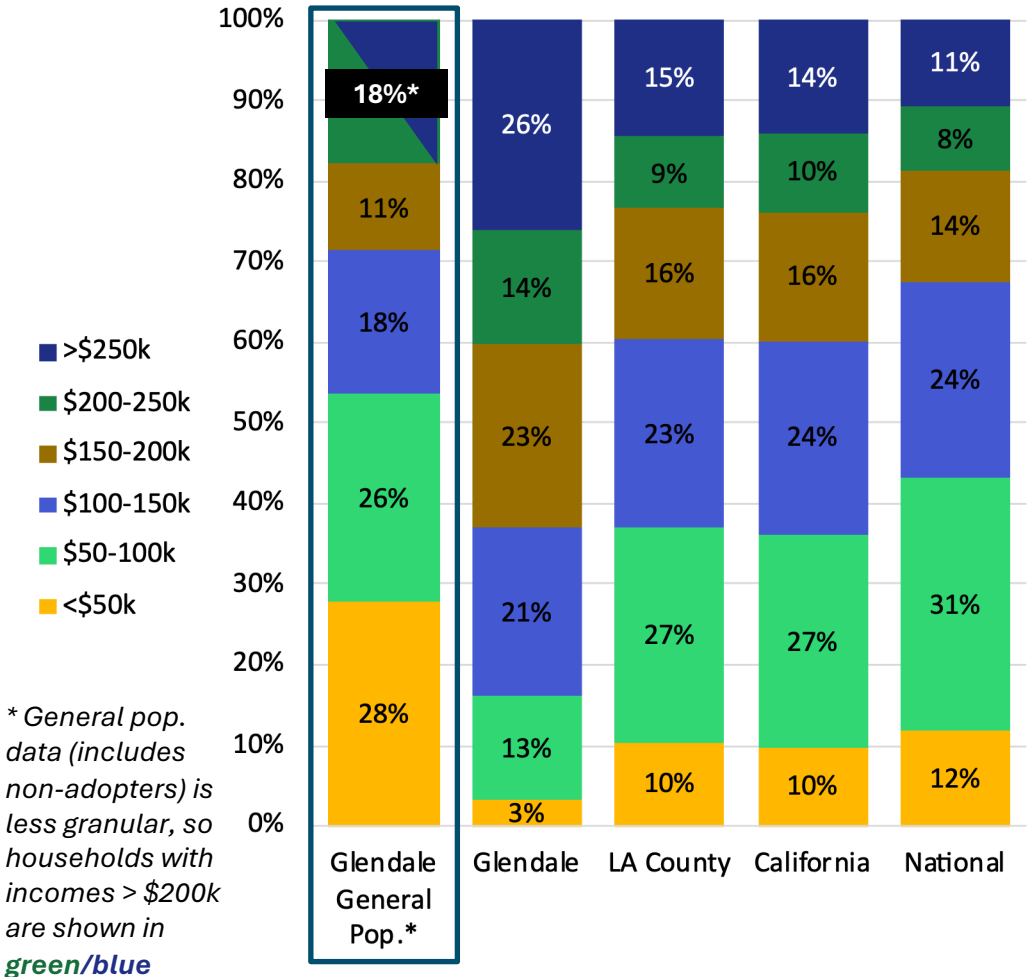


Source: Lawrence Berkeley National Laboratory

Glendale's solar adopters have higher incomes than the county, state, and national averages

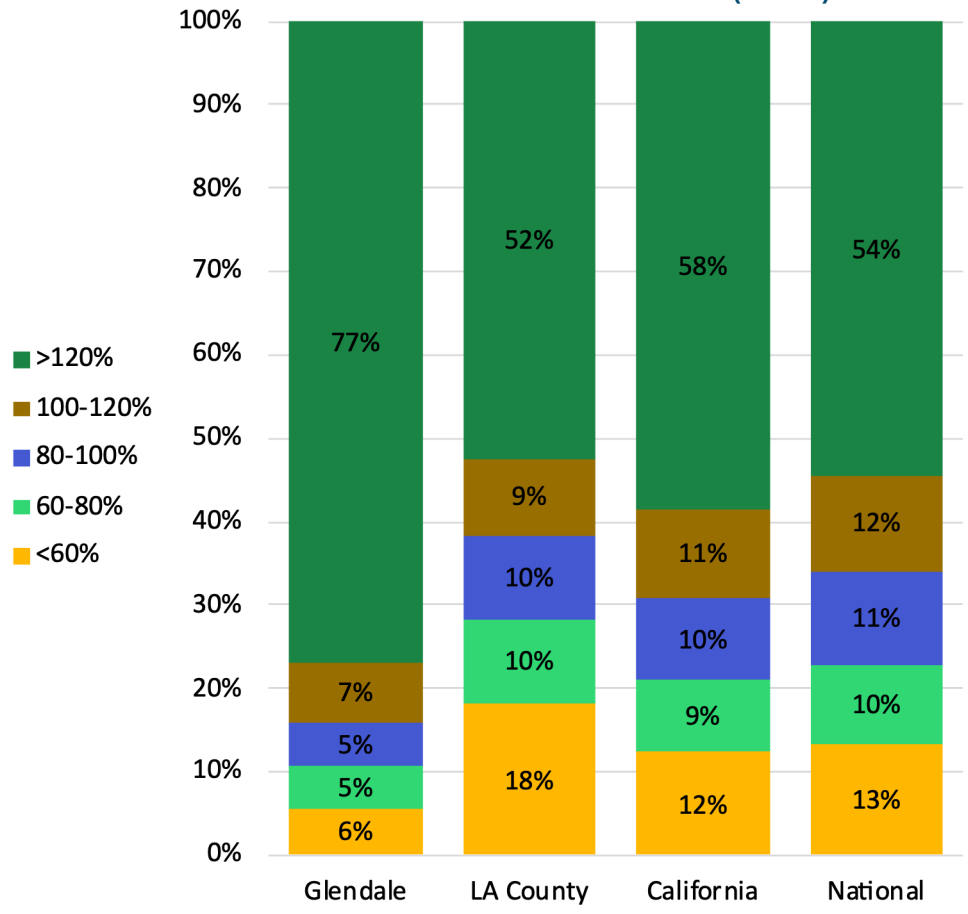
LBNL Income Demographics of GWP Solar Adopters: Raw Income, Area Median Income

Share of 2016-2022 Solar Adopters by Income



** General pop. data (includes non-adopters) is less granular, so households with incomes > $200k are shown in **green/blue***

Share of 2016-2022 Solar Adopters by County Area Median Income (AMI)



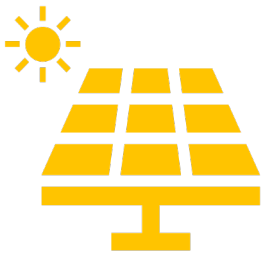
Source: Lawrence Berkeley National Laboratory (LBNL)

Impact of Net Energy Metering (NEM) and Net Billing Tariff (NBT) on GWP Rates

Energy+Environmental Economics

Compensation for rooftop solar increases retail rates for all GWP customers

Solar Benefits



Not Utility Costs ← Environmental & Societal*

Avoided by Customer Solar ← *Some* Transmission & Distribution

Avoided by Utility-Scale Solar ← Energy, GHG, *Some* Capacity

NEM 1.0 Bill Savings

Utility Costs Not Avoided by Solar → **NEM 1.0 Cost Shift** → **Rate Increase**

Utility Costs Avoided by Solar

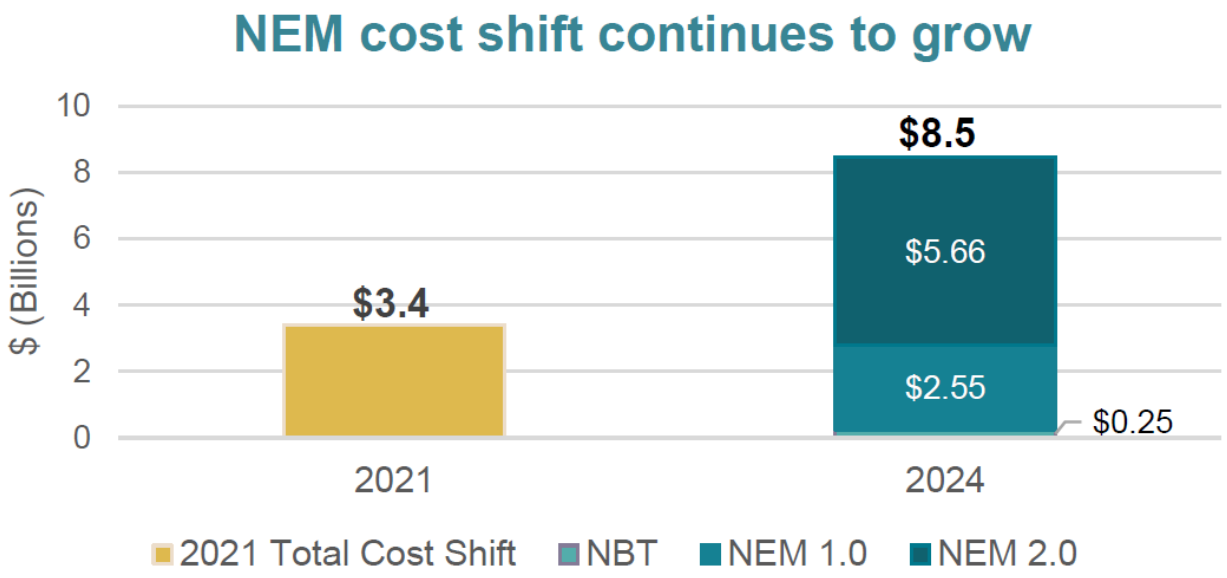
NBT Bill Savings

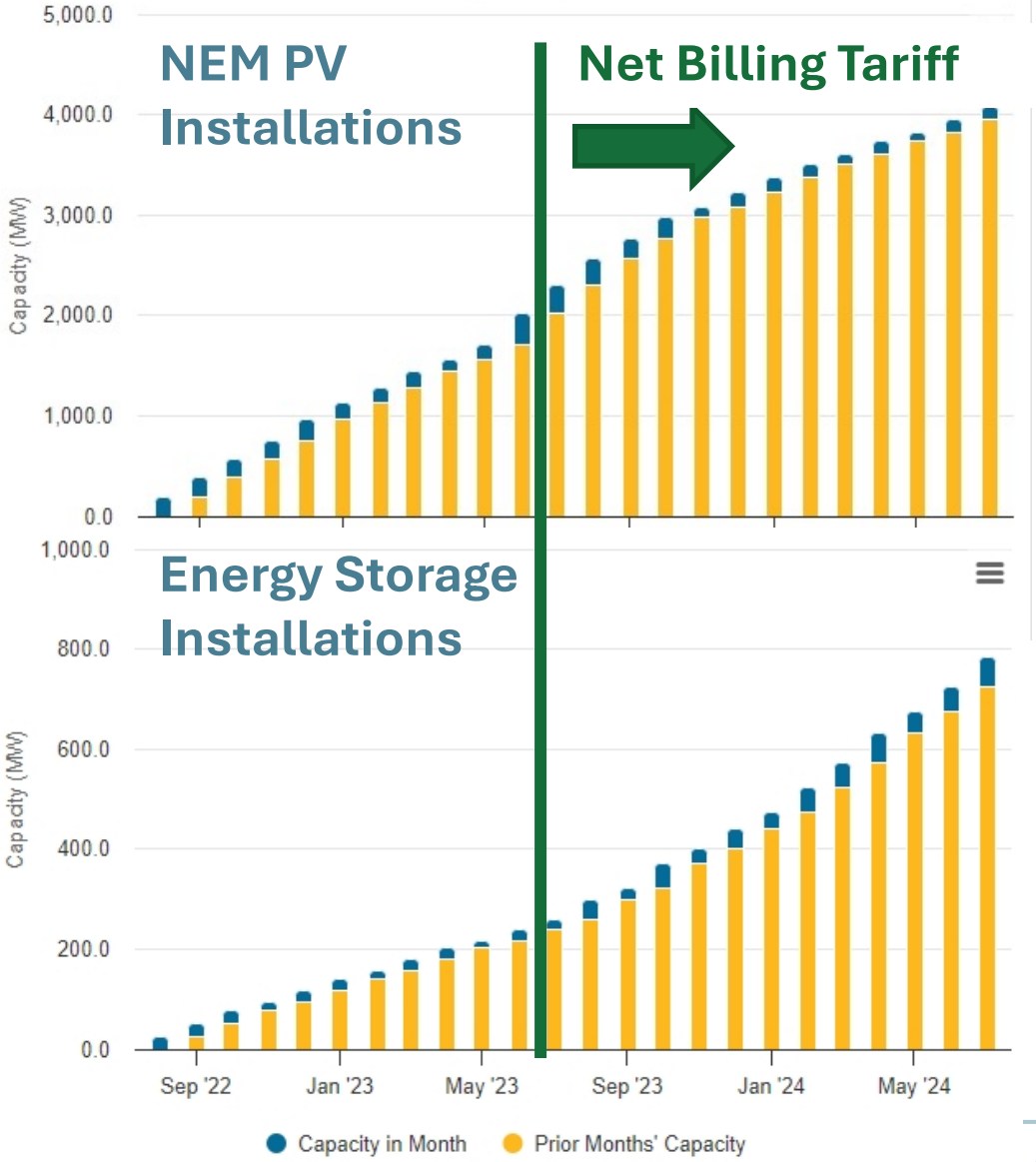
Utility Costs Not Avoided by Solar → **NBT Cost Shift** → **Rate Increase**

Utility Costs Avoided by Solar

**Also provided by lower cost community and utility-scale solar*

California's NEM Cost Shift and Solar Adoption Post NBT



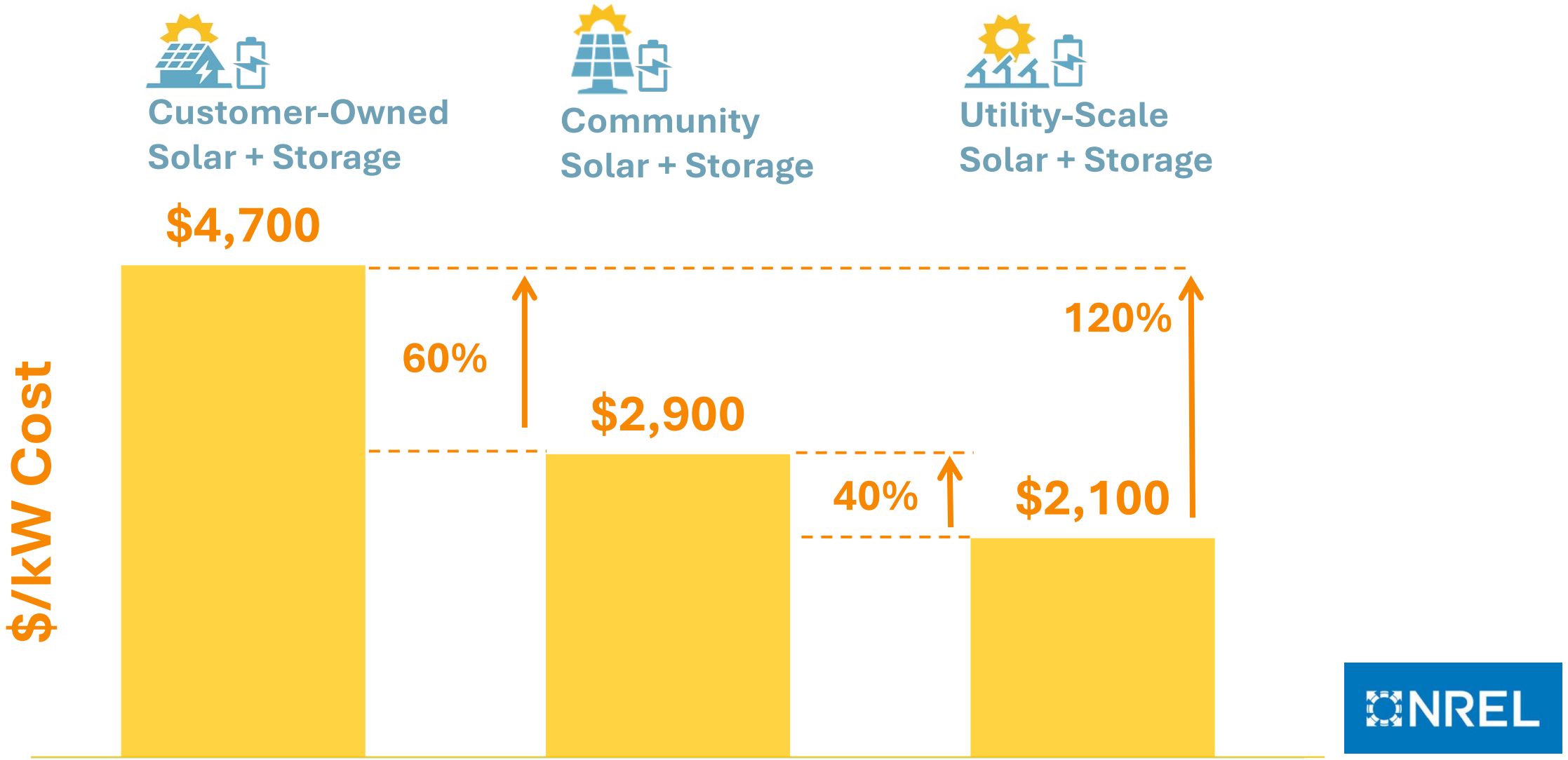


Source: https://www.californiadgstats.ca.gov/charts/

Multiple types of solar and storage installations are available for GWP, with different cost implications

- Hillside solar is not considered by GWP.
- Community solar in practice can involve large rooftop installations as well.

Customer-owned solar and storage is more expensive; lower cost alternatives provide similar environmental benefits



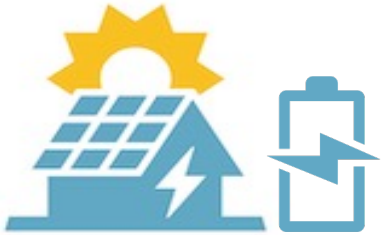
- *Modeled Market Price (MMP) Benchmarks from NREL Q1 2023*

Additional benefits for community and customer-owned solar over utility-scale solar exist, but do not outweigh the cost premium

Community

+ Community Solar

- Transmission & Distribution (T&D) Investment Reduction
- T&D Line Loss Reduction
- Reduced Land Use Impacts
- Local Reliability, Resilience
- Local Jobs



Customer-Owned

+ Rooftop Solar

- All Benefits of Community Solar

Plus

- Customer Reliability
- Increased Home Value
- Others

Technical Potential Analysis

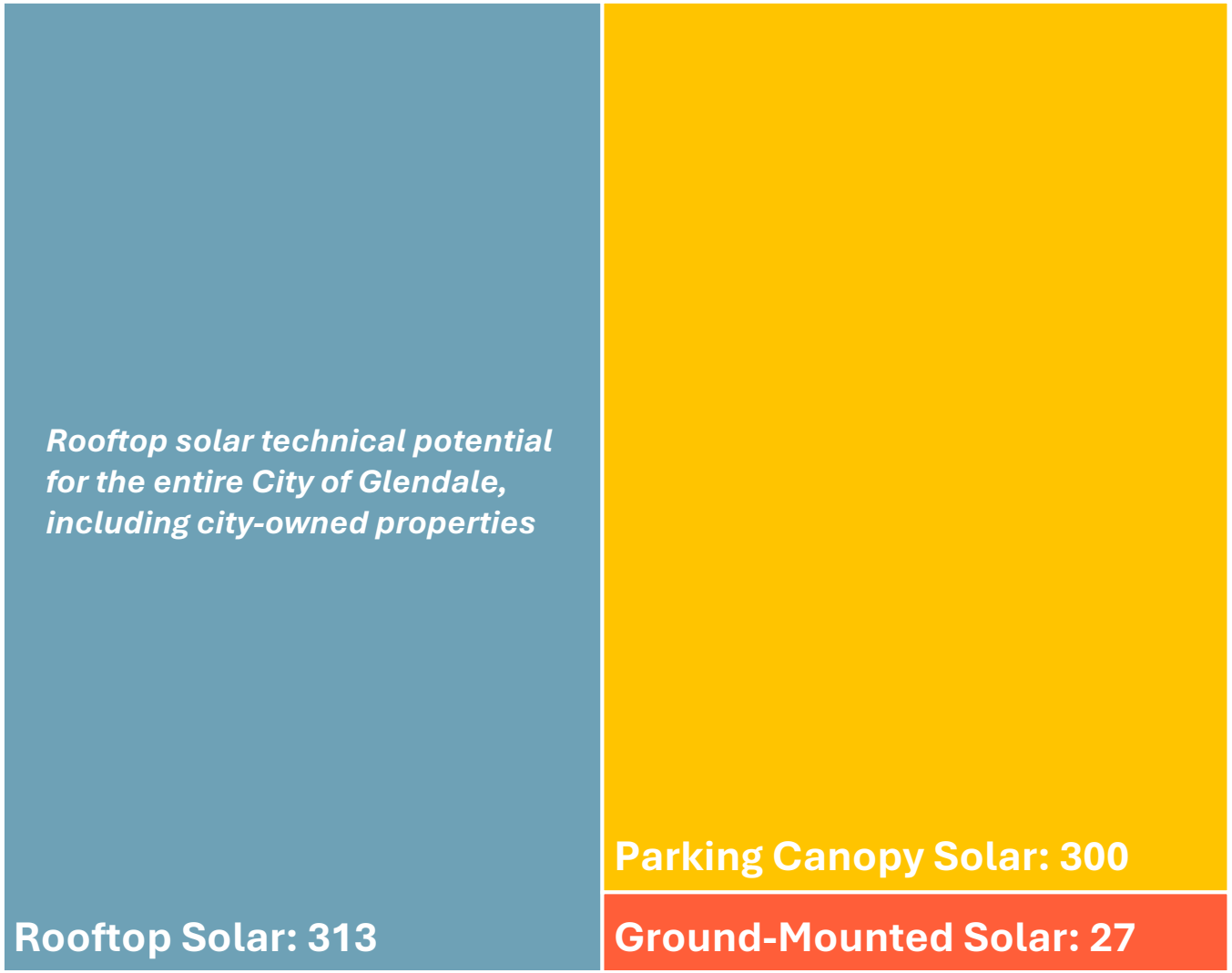
Energy+Environmental Economics

Technical Potential of Rooftop, Parking Canopy, and Ground-Mounted Solar in the City of Glendale

+ **Rooftop Solar: 313 MW**
+ **Parking Canopy Solar: approx. 300 MW**
+ **Ground-Mounted Solar: approx. 27 MW**

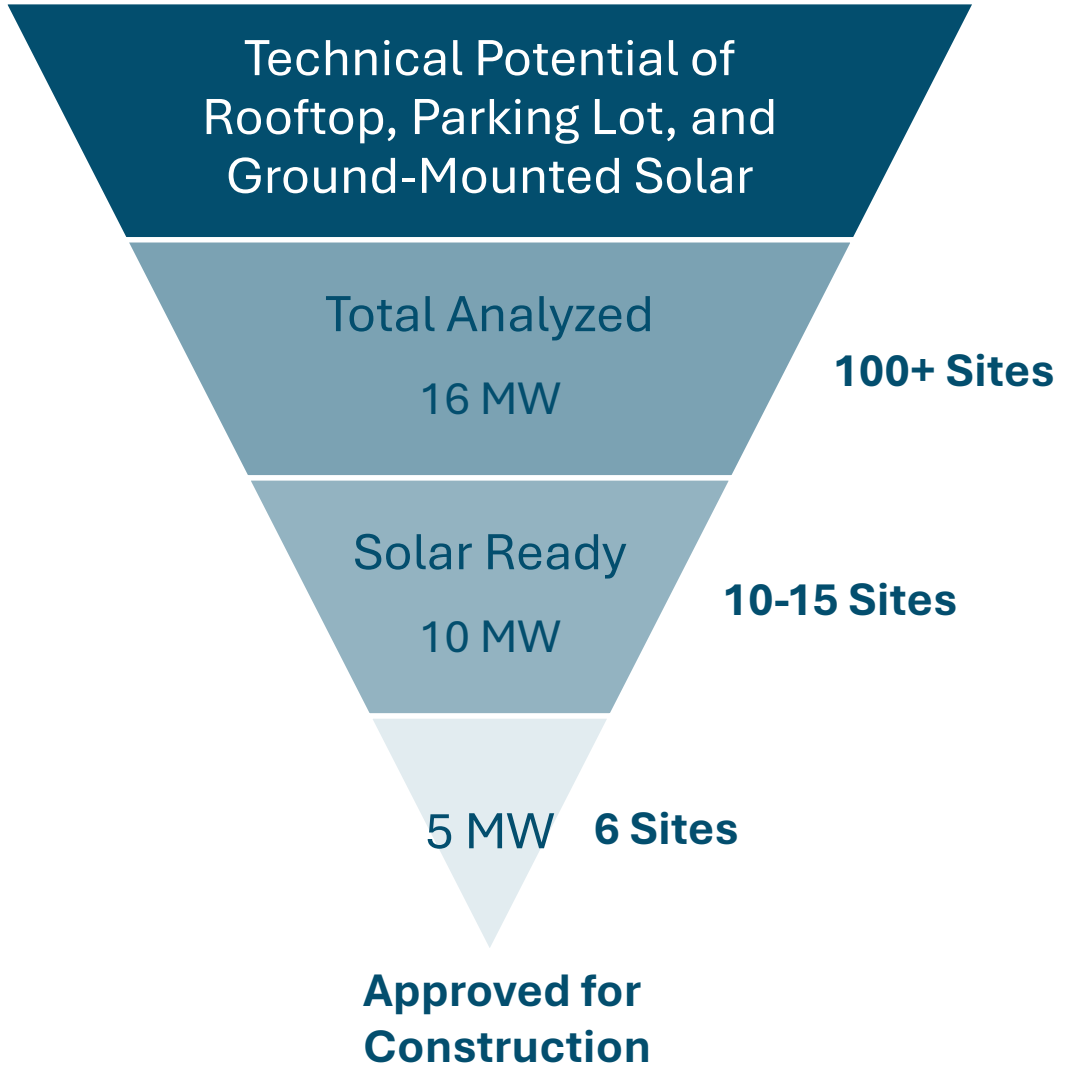
Technical potential is a metric that quantifies the maximum generation or capacity available for a technology in a given region and does not consider the economic or market viability.

Variations in the definition of technical potential and assumptions in filtering criteria may impact results substantially.



Achievable solar and storage potential for city-owned properties must account for additional real-world constraints

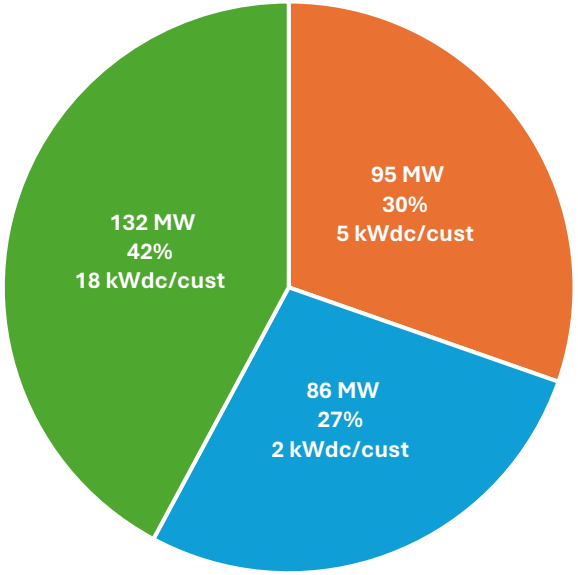
+ **GWP conducted site-specific analyses on over 100 city-owned properties for potential large-scale rooftop, parking canopy, and ground-mounted solar projects**
  - Over 60 sites are deemed feasible
+ **Most sites are filtered out due to their project size of less than 100 kW each and various other developmental constraints, for example:**
  - Not solar ready
  - Solar not advised by property owners
  - Historical or community use
  - Pending roof, structural, reconstruction, ADA, and feeder upgrades
+ **GWP has identified 10-15 large city-owned sites for developing solar projects**
  - Collectively 10 MW of solar capacity
  - Six projects approved for construction (5 MW)

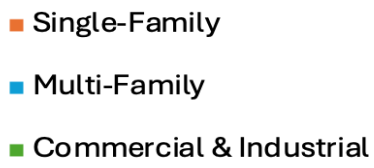


- *Additional sites evaluated after the initial round of solar site analysis were not included.*

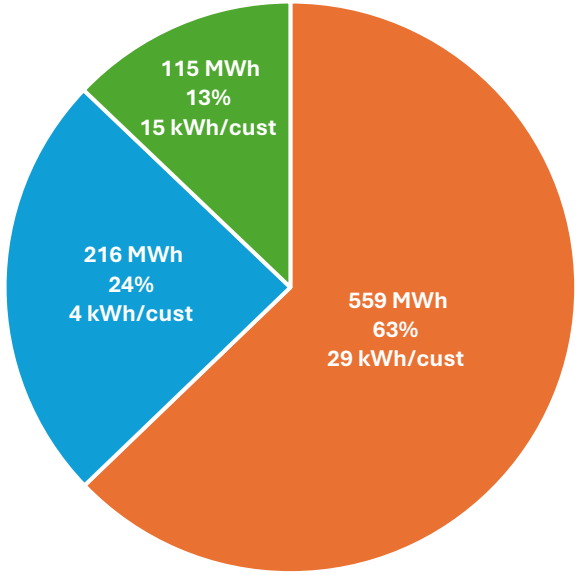
Rooftop Solar and Customer Battery Storage Technical Potential in Glendale (E3 Mid-Case)

Rooftop Solar Potential in Glendale
For Mid-Case





Battery Storage Potential in Glendale
For Mid-Case



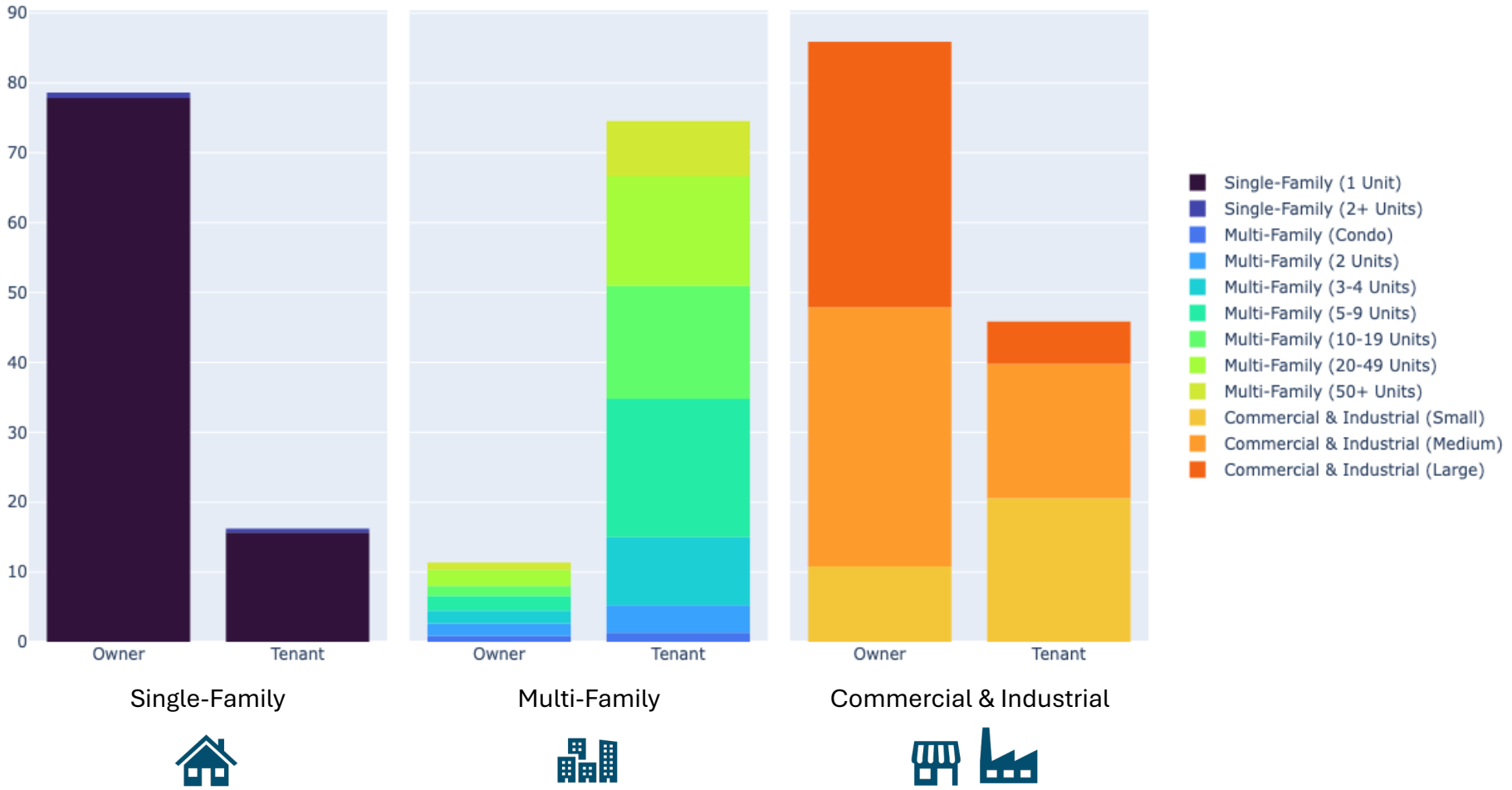
+ **75% of total roof space (based on building footprint) is considered developable for rooftop solar**
  - Accounts for setback factor required by LA County, as well as potential obstructions; based on research conducted for NREL's LA100 study
+ **Solar potential based on 110% of customer's annual load**
  - Assuming 20% capacity factor (DC), based on default system parameters from NREL's PVWatts tool for Glendale
  - Module power density of 160 W/m^2 (approximately 14.86 W/sq. ft.), in line with NREL REPLICA estimate for flat roofs
+ **Number of buildings suitable for solar adjusted to 79.25%**
  - Based on Project Sunroof data for Glendale; accounts for factors such as structural stability of roof and electrical code compliance
+ **Storage potential aligns with maximum DER ratings allowed by GWP for solar and storage systems**
  - Assume only customers with non-zero solar technical potential are considered eligible to install storage
  - Minimum storage potential is 30 kWh; if solar potential exceeds 10 kW, maximum storage potential of 110% of the historical average daily usage

Note: These figures represent the theoretical maximum of solar and storage capacity under applicable policies and other constraints. In the adoption analysis, systems were sized based on customer needs.

E3 estimates identify 313 MW GWP solar potential from all market segments (E3 Mid-Case)

Solar Potential by Sector, Ownership Status, and Building Type

For Mid-Case, in MW



Single-Family

Multi-Family

Commercial & Industrial

Key Observations

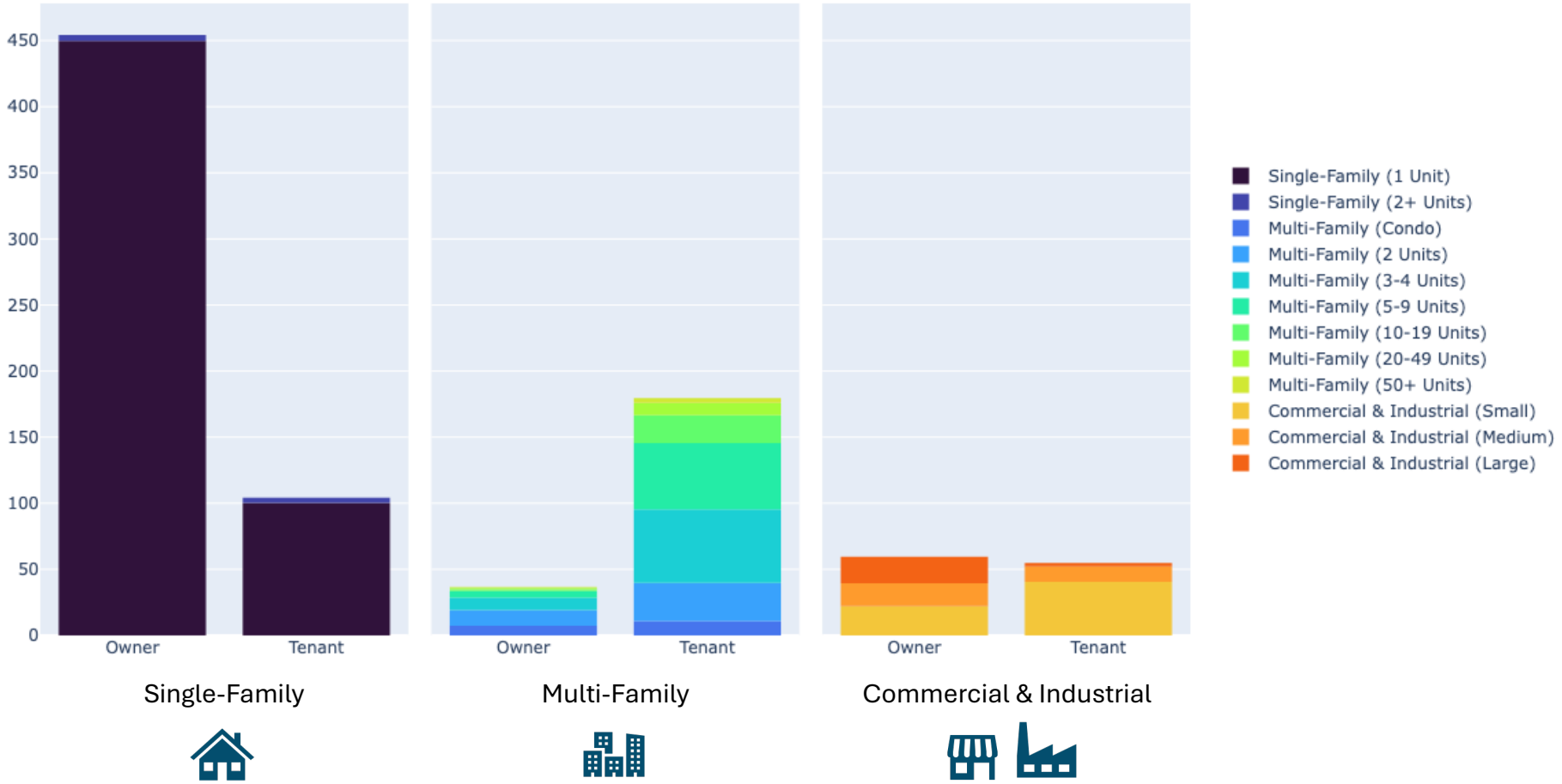
- Single-Family: **Owner-occupied single-family residences show the greatest potential for adoption.**
- Multi-Family: **Multi-family rental properties follow closely behind but face challenges due to ownership dynamics and split incentives between owners and tenants. Addressing these issues could unlock significant potential.**
- Commercial & Industrial: **While comprising fewer customers, these sectors have larger average installation sizes, making them significant contributors to achieving the 100 MW DER capacity target.**

* Omits sites that could not be categorized

E3 estimates identify 900 MWh GWP storage potential from all market segments (E3 Mid-Case)

Storage Potential by Sector, Ownership Status, and Building Type

For Mid-Case, in MWh



Single-Family | Multi-Family | Commercial & Industrial

Key Observations

- **Single-Family:** **Owner-occupied single-family residences show the greatest potential for adoption. Customers with less than 10 kW solar systems can install up to 30 kWh battery storage systems.**
- **Multi-Family:** **Multi-family rental properties follow closely behind but face challenges due to ownership dynamics and split incentives between owners and tenants. Addressing these issues could unlock significant potential.**
- **Commercial & Industrial:** **For large solar systems (>10 kW), maximum storage potential is up to 110% of the historical average daily usage, which constrains the potential from the C&I sectors.**

* Omits sites that could not be categorized

Scenario Overview

Energy+Environmental Economics

E3 evaluated four program scenarios to identify target feasibility and show trade-offs in adoption, equity, and costs

Scenario 1: Continue NEM

Scenario 2: Targeted LMI/DACs & MF Adoption

Scenario 3: Balanced

Scenario 4: Widespread Adoption

Program & Incentive Design

- **NEM Compensation**
- **Additional Incentives**

Address Additional Barriers

- **Access for Renter and LMI Customers**
- **Provide More Utility Support**

- *Low and Moderate Income (LMI)*
- *Disadvantaged Communities (DACs)*
- *Multi-family (MF)*

The scenarios outline different pathways towards Glendale's DER adoption target

		NEM Compensation	Additional Incentives*	Renter and LMI Customer Barriers	Other Utility Support
Reference	**S0** Business as Usual	Net energy metering at retail rates	Federal and state	Persist	At the Current Level
Evaluate Adoption Strategies	**S1** Continue Current NEM	Net energy metering at retail rates	Federal and state	Persist	Optimistic outlook on enhanced community outreach and support, along with improved permitting processes starting early 2025
	S2 Targeted LMI MF Adoption	Net energy billing at avoided costs	Federal and state, utility direct install for LMI/DAC MF customers	Optimistic outlook for providing renter and LMI customer solutions starting early 2025	
	S3 Balanced	Net energy billing above avoided costs but below retail rates	Federal and state, 7-yr payback utility incentive for LMI/DAC MF buildings		
	S4 Widespread Adoption	Net energy metering at retail rates	Federal and state, 5-yr payback utility incentive for all MF customers		
Hypothetical Feasibility	**S5** Direct Install	Net energy metering at retail rates	Federal and state, and direct install for MF renter LMI/DAC customers	Persist	At the Current Level

Additional incentives is a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP. Assuming receipt of GWP incentives requires customers dispatch battery storage against utility signals to maximize community benefits.

How we interpret the City Council's resolution is important

In August 2022, the Glendale City Council passed a resolution expressing their intent to adopt policies and practices aimed at achieving the goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027, and to develop additional demand management measures with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

At least 10% of GWP customers adopt solar and energy storage systems by 2027

Key Clarification Question: Which systems qualify for the 10% adoption target?

Possible Interpretations

- **Eligible systems include customer-sited solar, solar + storage, and/or standalone storage systems**
- **Achieve the resolution by December 31st, 2027**
- **Eligible GWP electric customer adoption includes:**

Expanded Eligibility Criteria

1. Rooftop solar owned, financed, or leased by single-family and commercial & industrial customers (one system for one electric customer)
2. Rooftop solar owned, financed, or leased by multi-family property owners/managers and commercial & industrial customers under virtual solar programs and shared among tenants and unit owners (one system for multiple electric customers)
3. Subscribers of off-site solar solutions like community solar, solar share, and green rate options (one project for numerous electric customers)

Develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW

Key Clarification Question: 100 MW nameplate or effective capacity?

Possible Interpretations

- **Achieve the resolution by December 31st, 2027**
- **Eligible demand management measures include solar, storage, electric vehicles, energy efficiency, and/or demand response (both load shedding and load shifting)**
- **Focused on additional measures and exclude existing capacity**
- **Peak dispatchable capacity: battery storage and EVs with bidirectional charging/discharging capability (V2G)**
- **Peak load-reducing capacity: solar, EV managed charging (V1G), energy efficiency, and demand response which either shave load during peak periods or shift load to off-peak periods**
- **Capacity measured by nameplate capacity or effective capacity (kW)**

- *In general, Effective Capacity = Nameplate Capacity * ELCC*
- *Effective Load Carrying Capability (ELCC) measures a resource's contribution to reliability based on the incremental quantity of load that can be satisfied by adding the resource to the grid*

Qualitative screening analysis prioritizes program and policy options crucial for achieving City Council targets over others

+ Program proposals ranked by overall qualitative performance
+ Reasonable DER compensation levels that mitigate cost shifts are preferred

Priority Level

Program Ideas	Involved Technologies	Overall Priority	Low Administrative Cost	Correctly Values DER Compensation	Program Matureness	Promote Adoption (Solar/Storage Penetration)	Promote Adoption (DER Capacity)	Ease of Implementation
Outreach, Education, & Support	All	High	High	None	High	High	High	High
Net Metering	Solar, Storage	High	High	Low	High	High	High	Mid
Base Rebate	Solar, Storage	High	Mid	Low	High	High	High	High
Net Billing	Solar, Storage	High	High	High	Mid	Mid	Mid	Mid
Community Solar	Solar, Storage	High	Mid	High	Mid	High	Mid	Mid
Streamline Permitting Process	Solar, Storage	High	Mid	None	Mid	High	High	Mid
Feed-in Tariff	Solar	High	Mid	High	High	Low	High	Mid
VNEM	Solar, Storage	High	Mid	Low	Mid	High	Mid	Mid
Performance-based Incentive	Storage	Mid	Low	High	Mid	Mid	Mid	Mid
Load Shedding DR	All	Mid	Mid	High	High	Low	Low	Mid
TOU	All	Mid	Low	None	High	Mid	High	Low
Buy-all, Sell-all	Solar, Storage	Low	High	High	Low	Low	Low	Mid
VPP	All	Low	Low	High	Low	Low	Mid	Low
Load Shifting DR	All flexible loads	Low	Low	High	Low	Low	Mid	Low
VGI	EVs	Low	Low	High	Low	None	Low	Low

Detailed Scenario Analysis

Energy+Environmental Economics

The performance of each scenario should be comprehensively evaluated using different metrics to assess adoption, equity, and costs

+ Scenarios are shaped by stakeholder inputs, policy directions, and the balancing of multiple GWP objectives.
+ Each proposed program portfolio should be evaluated based on its effectiveness in addressing these values from various perspectives.

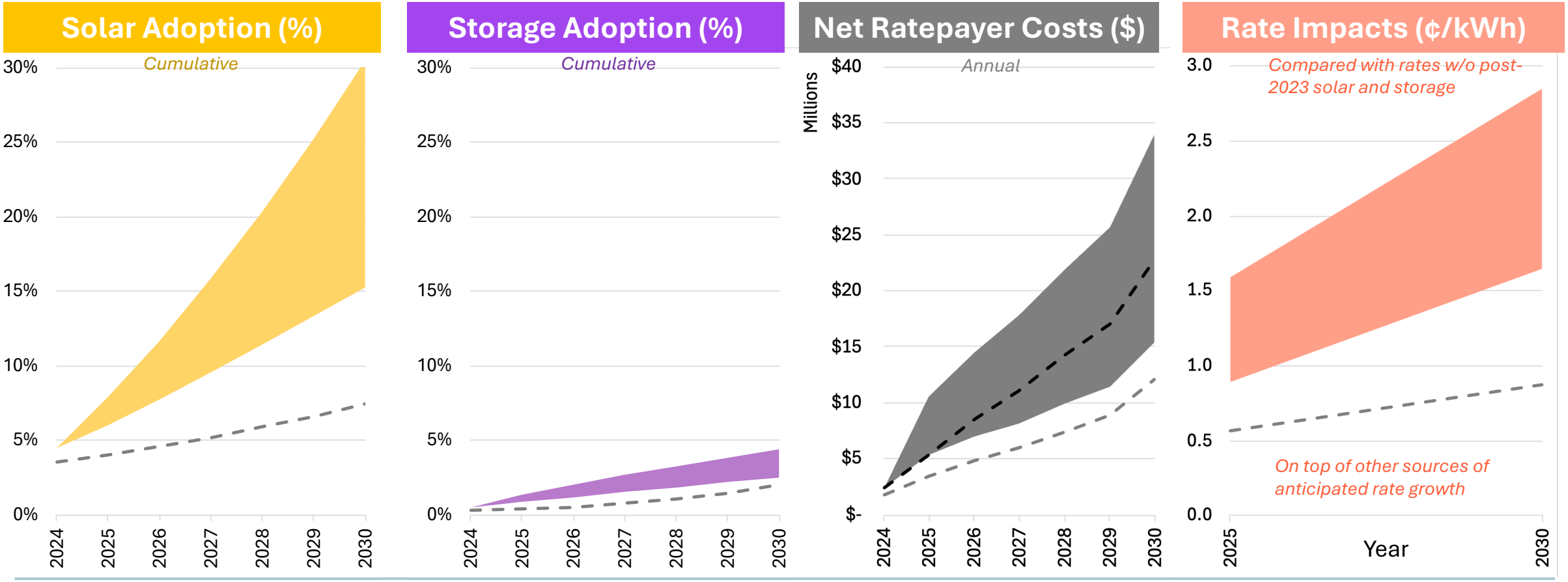
Key Scenario Performance Metrics

- Adoption
- Ratepayer Impact
- Rate & Bill Impact
- Distributional Equity Impact
- Others

Balancing Multiple Objectives

Adoption scenarios project *theoretical upper bounds* for adoption, resulting in net ratepayer costs and rate impacts

- The adoption scenarios project upper bounds for solar adoption by 2027. The adoption level results will be further limited by implementation barriers, customer adoption behavior, and other financial and non-economic barriers that customers face.
- All proposed strategies impose more costs on GWP ratepayers and lead to further increases in retail rates.
- There are alternatives to current NEM that can still promote local solar and storage but also reduce costs to GWP ratepayers.



Metrics of Success by Adoption Scenario

- Scenarios are shaped by stakeholder input, policy directives, and GWP's goals. Each scenario's proposed program portfolio was evaluated based on how effectively it addresses these values from various perspectives.
- Continuing the current NEM structure may lead to higher costs. However, a strategically planned program and incentive portfolio could drive greater solar and storage adoption, improve distributional equity, and reduce ratepayers' costs.

	Solar Adopter Impacts		Distributional Equity Impacts		Societal and Ratepayer Impacts			GWP Impacts
	Increased Adoption	Adopter Financial Value	Renter Adoption	LMI Customer Adoption	Minimize Cost Shift	Net Economic Societal Benefit	Reduction of GHG Impacts	Ease of Implementation
S1 Continue Current NEM	Mid	Very High	Low	Low	Very Low	High	Mid	Mid
S2 Targeted LMI MF Adoption	High	High	High	High	Mid	High	High	Low
S3 Balanced	High	High	High	High	Low	High	High	Low
S4 Widespread Adoption	Very High	Very High	High	High	Very Low	High	Very High	Very Low

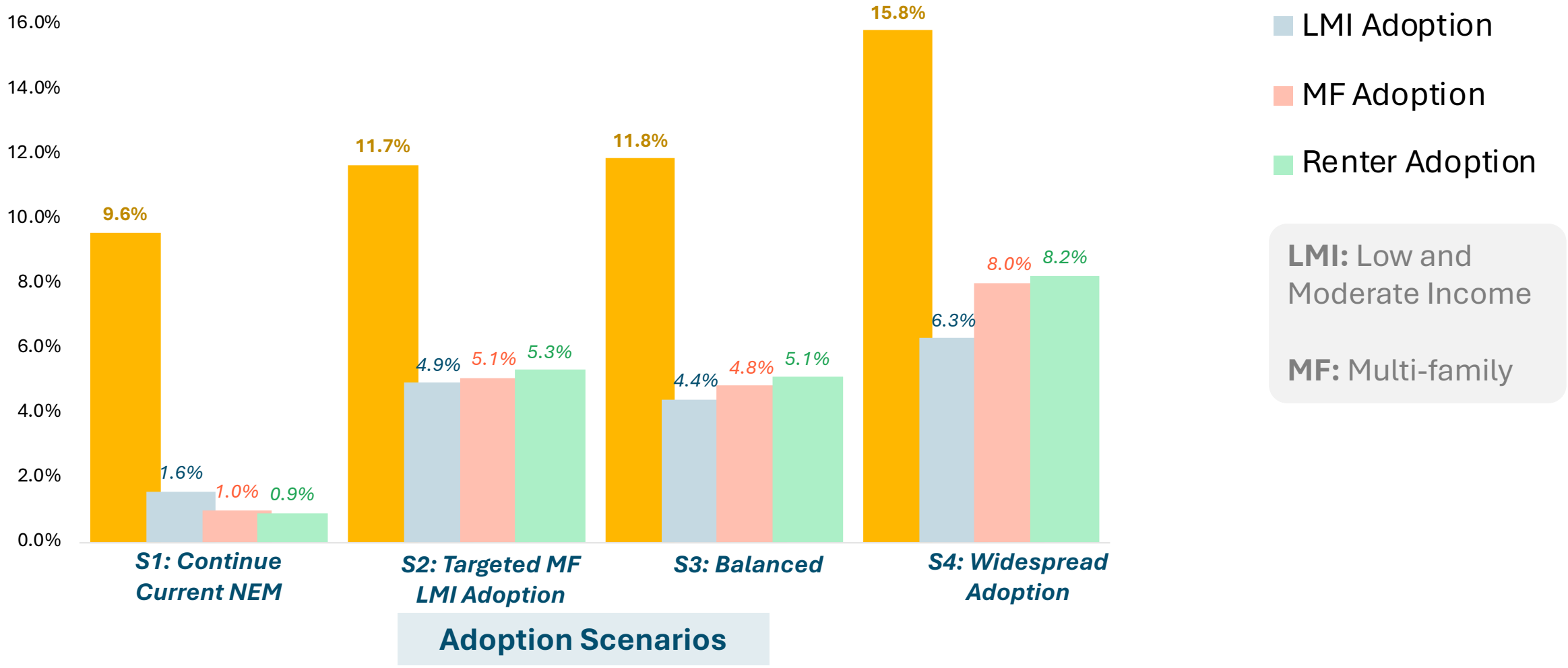
Customer Adoption Projections

Energy+Environmental Economics

2027 Customer Adoption by Scenario – Solar

Including solar-only and solar + storage systems, cumulative adoption by 2027

Solar Adoption (% of Total GWP Electric Customers)



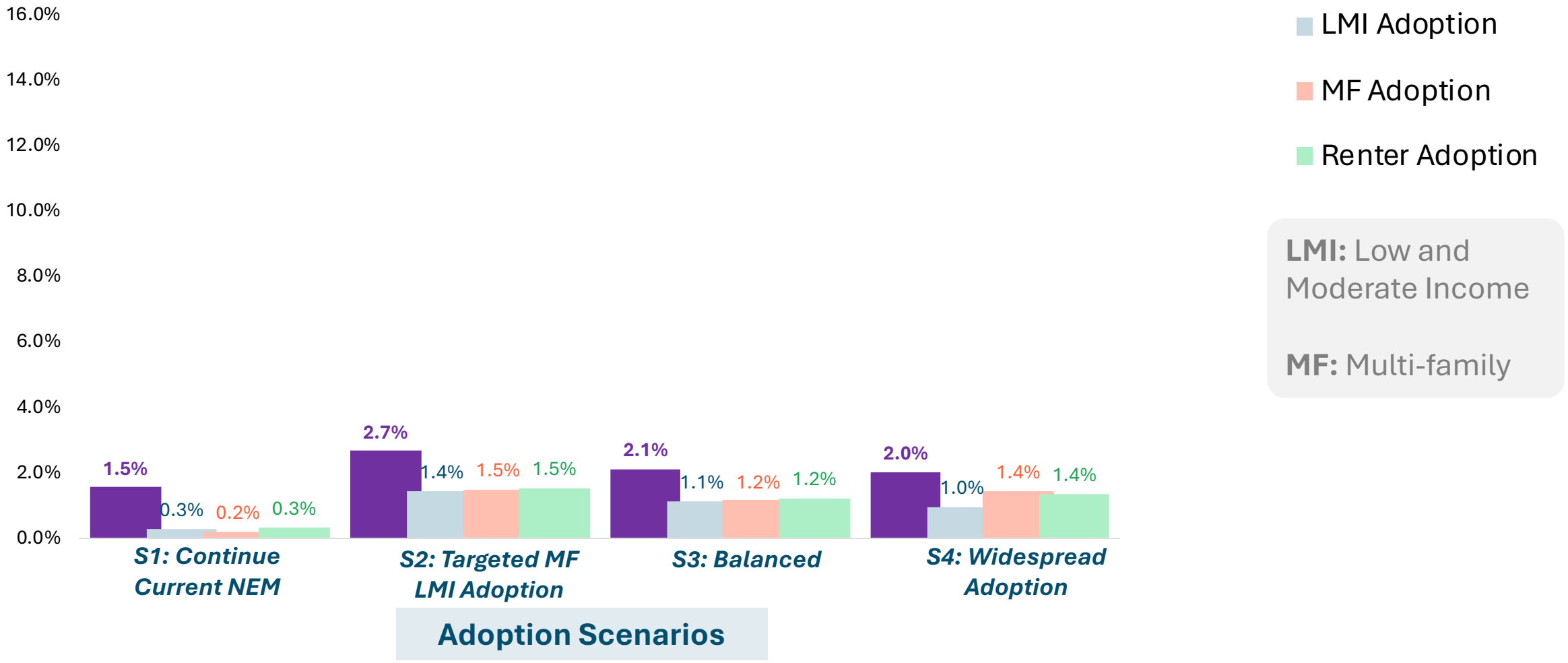
LMI: Low and Moderate Income

MF: Multi-family

2027 Customer Adoption by Scenario – Battery Storage

Including solar + storage systems, cumulative adoption by 2027

Battery Storage Adoption (% of Total GWP Electric Customers)



LMI: Low and Moderate Income

MF: Multi-family

Strategically planned program and incentive portfolios could achieve higher solar and storage adoption with lower impacts on GWP ratepayers

Program & Incentive Design

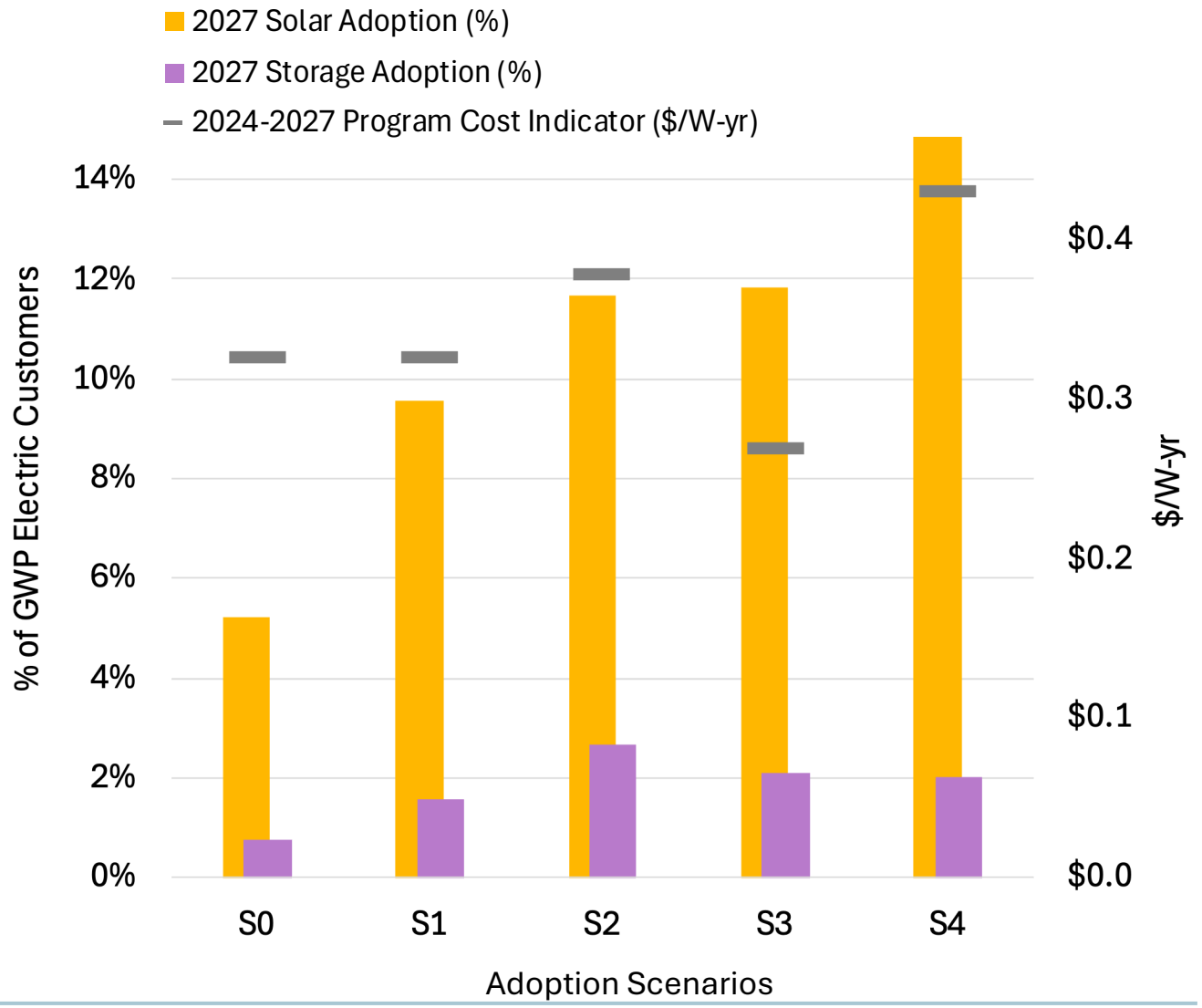
- NEM Compensation
- Additional Incentives

Address Additional Barriers

- Access for Renter and LMI Customers
- Provide More Utility Support

The 2024-2027 Program Cost Indicator ($/W-yr) is calculated as:

$$\frac{\sum_{2024}^{2027}(\text{Bill Savings} + \text{GWP Incentives} - \text{System Benefits})}{\sum_{2024}^{2027}\text{Installed Capacity of Customer Solar and Storage}}$$



Economic Analysis: Scenario Comparison

Energy+Environmental Economics

Cost-Effectiveness and Cost Test Perspectives

- **The CPUC defines "cost-effective" and "cost-effectiveness" as a set of well-defined "cost tests in the California Standard Practice Manual (SPM)"***
- **These cost tests provide a methodological framework to examine the benefits and costs of a particular measure from different perspectives and have become a standard in many other jurisdictions**

Cost Test	Primary Question
PCT Participant Cost Test	Net benefit for customers who adopt solar?
RIM Ratepayer Impact Measure	Will utility rates increase or decrease?
PACT Program Administrator Cost Test	Will utility costs increase or decrease?
TRC Total Resource Cost Test	Net benefits to City of Glendale?
SCT Societal Cost Test	Net benefit to society as a whole?

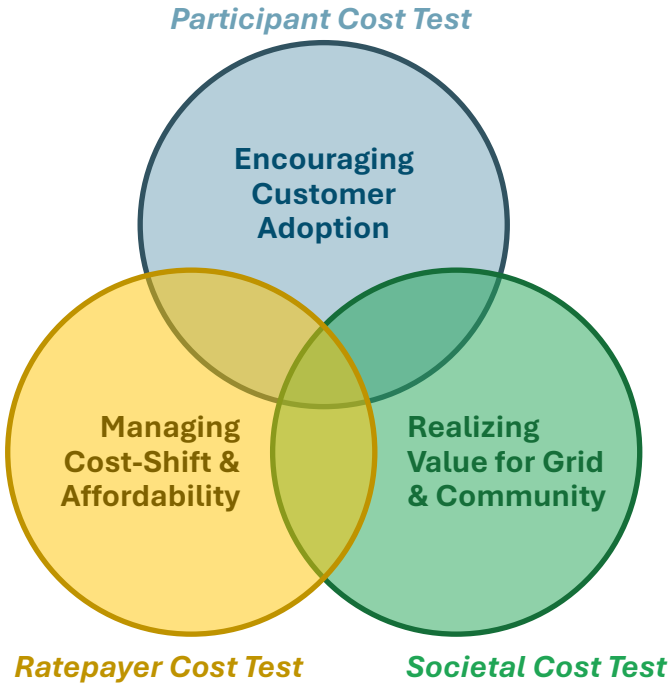
* California Standard Practice Manual

Benefits and Costs Components by Cost Test Perspective

N/A
Cost
Benefit

Note: Administrative costs were not included in the cost tests. When interpreting the results, please consider these additional costs from both the ratepayer and administrator perspectives to ensure that all program implementation expenses are fully accounted for.

Component	Participant Cost Test (PCT)	Ratepayer Impact Measure (RIM)	Societal Cost Test (SCT)
Bill Savings	+	–	
Upfront Costs	–		–
Fixed Operations and Maintenance Costs	–		–
Federal and State Incentives	+		+
GWP Incentives	+	–	
Utility Avoided Costs		+	+
Resiliency Benefits	+		
Additional Societal Benefits			+



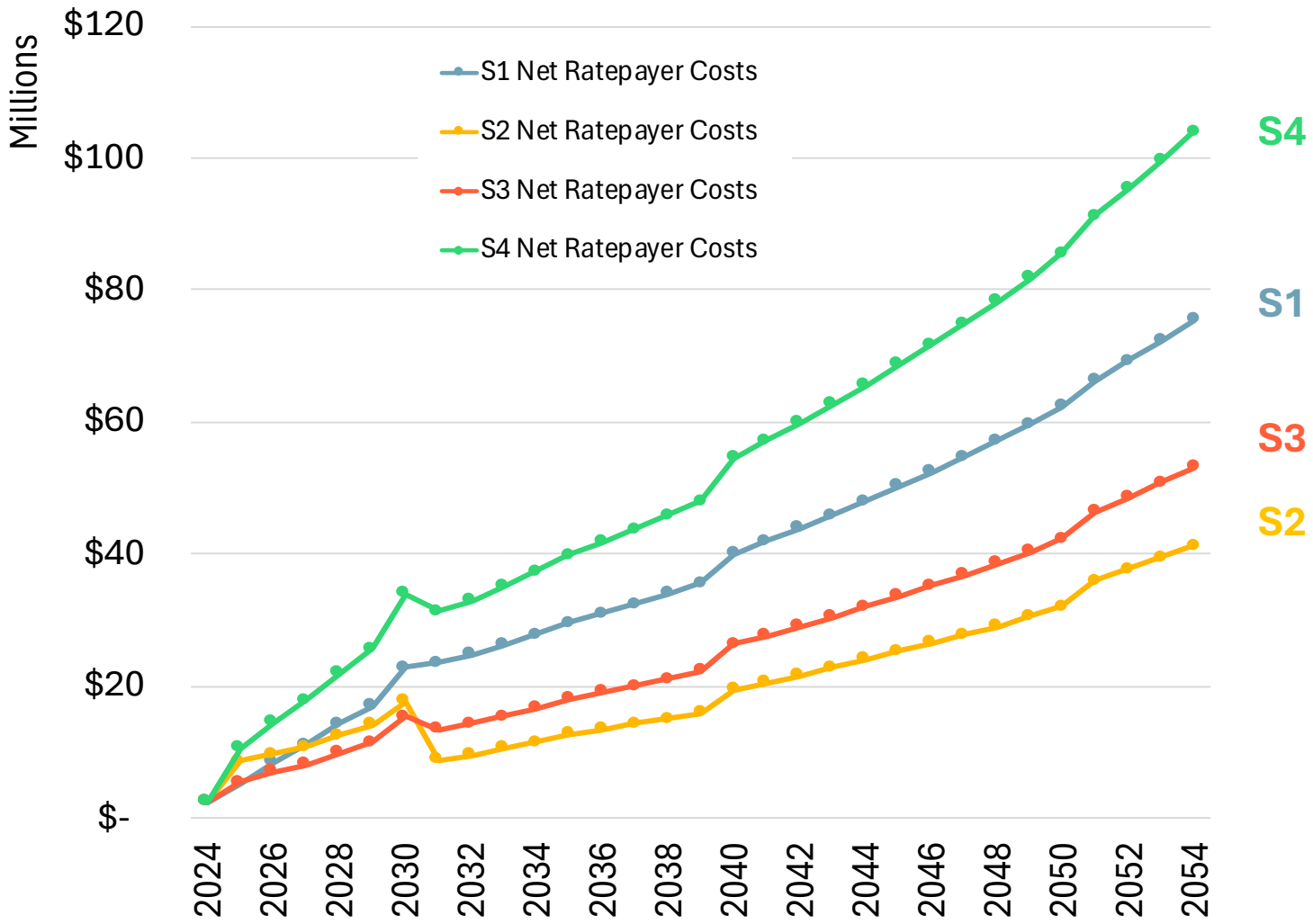
Economic Analysis of Scenarios: Cost Test Scores

$$\frac{Benefits}{Costs} \geq 1.0$$

	Participant Cost Test	Societal Cost Test	Ratepayer Impact Measure
S1 Continue Current NEM	3.04	1.87	0.28
S2 Targeted LMI/MF Adoption	2.16	2.09	0.45
S3 Balanced	2.25	2.11	0.39
S4 Widespread Adoption	3.04	2.17	0.29

Annual Net Ratepayer Costs

+ All scenarios have annual net ratepayer costs that increase GWP rates due to accelerating DER adoption



Key Takeaways: Cost and Benefit Analysis

Participant Perspective

- In all scenarios, solar and solar + storage provide net benefits over the system's lifetime
- Net benefits are driven by high bill savings under various billing mechanisms, even under net billing
- Despite lifetime savings, high upfront costs of solar and solar + storage may still pose barriers to adoption

Societal Perspective

- Solar and solar + storage provide net benefits to society across all scenarios

Ratepayer Perspective

- All adoption scenarios have net ratepayer costs, meaning compensation provided to solar and solar + storage customers higher than the cost savings for GWP
- A strategically planned program and incentive portfolio can achieve higher solar and storage adoption with lower impacts on GWP ratepayers

Findings and Recommendations

Energy+Environmental Economics

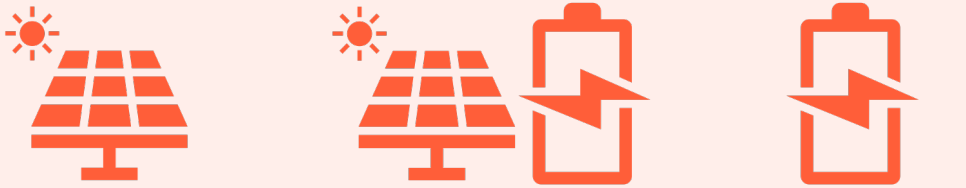
Clarifications on how to correctly interpret the City Council's adoption targets are necessary

At least 10% of GWP customers adopt solar and energy storage systems by 2027

10% adoption target for solar + storage systems vs. 10% for either solar or solar + storage systems?

Develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW

Which systems qualify?

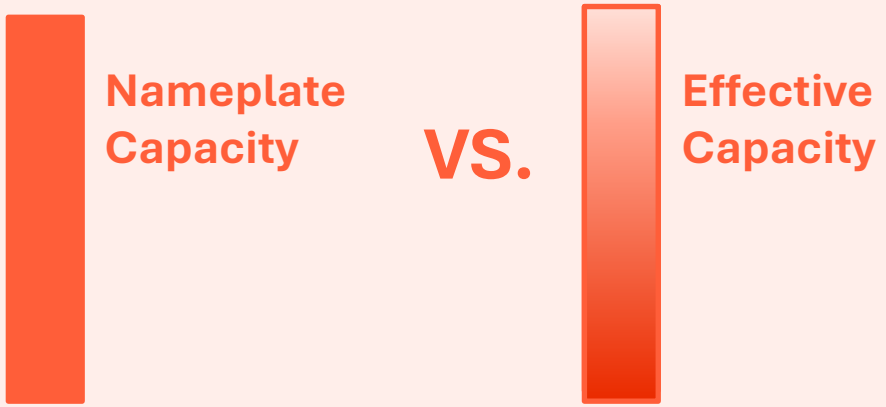


Standalone Solar

Solar + Storage

Standalone Storage

100 MW nameplate or effective capacity?



Findings: Achieving the adoption goals by 2027 is not feasible

Achieving a goal of 10% customer solar adoption by 2027 is not feasible. The goal is theoretically feasible by 2030 with a significant increase in utility costs and effort, but real-world barriers remain.

Achieving a goal of 10% customer storage adoption in the near future is not feasible.

Achieving a goal of 100 MW of reliable peak load reduction with DERs is not feasible.

Industry studies suggest that achievable potential is 20%-40% of the technical potential.

Recommendations

- Set an adoption goal in terms of MW of installed capacity rather than a percentage of customers.
- Perform additional analyses of realistically achievable potentials for customer-owned, community, and utility-scale solar and storage.
- Develop an integrated resource plan with the potential and MW targets for each resource type.

Findings: Adoption of customer-owned solar and storage increases GWP rates

The scenarios achieving 10% solar adoption would result in a projected net cost of $23-$45 million to GWP ratepayers from 2024 to 2027.

The resulting rate increase would be 6-11% by 2030, with a low- and moderate-income (LMI) customer monthly bill increase of $4-$6.

Recommendations

- Implement a Net Billing Tariff to reduce the cost shift.
- Develop and implement non-bypassable charges and fixed customer charges to reduce the cost shift.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement a Net Billing Tariff.

Findings: Current customer-owned solar and storage adoption is predominately by single-family homeowners above the median income

Customer solar adoption in Glendale to date is above 10% for single-family homes and below 1% for renters and LMI customers.

84% of customer solar adoption is in households above the median income.

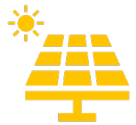
88% of customer solar adoption is by property owners.

90% of customer solar adoption is in single-family homes.

Recommendations

- Allow lower cost community solar and storage to count towards achieving the adoption goal.
- Evaluate virtual solar programs that renters and LMI customers can subscribe to.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement virtual solar programs.

Findings: Customer-owned solar and storage provides limited reliable peak capacity reduction



The effective capacity of customer-owned solar is less than 10% of the installed capacity.

The effective capacity of customer-owned storage is less than 50% of the installed capacity.

The maximum projected reliable peak load reduction from customer-owned solar and storage is 10 MW by 2027.

When including other DERs such as demand response, managed electric vehicle charging, and energy efficiency, the maximum projected reliable peak load reduction is 44 MW by 2027.

Recommendations

- Implement TOU rates that encourage customer storage adoption and dispatch for peak capacity reductions.
- Study and expand demand response, electric vehicle, energy efficiency, utility dispatchable DER, and other programs for peak load reductions.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement TOU rates and utility dispatchable DER.

Findings: Additional costs not included in this study will be required

Achieving the 10% customer solar adoption goal by 2030 will require increasing the pace of annual adoption from 438 customers last year to over 1,000 customers per year.

Community feedback requested enhanced customer outreach and support as well as a streamlined permitting process.

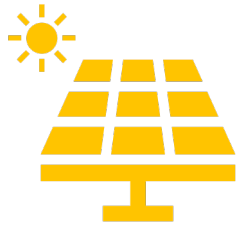
Additional overhead and incentives will be needed to reach renters, LMI, and DAC customers that face larger barriers to solar and storage adoption.

Changes to GWP billing and metering systems will be required.

Recommendations

- Evaluate Glendale-specific program elements that will be the most effective for increasing DER adoption by renter, LMI, and DAC customers.
- Evaluate the cost and feasibility of necessary changes to GWP's billing and metering systems.
- Consider the cost of additional program overhead and customer outreach.

Options for Program Improvements: Rooftop Solar Compensation



Compensation Rates

Shift solar and storage compensation to a net billing tariff structure.

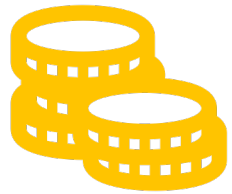
Align export compensation with GWP avoided costs.

Require TOU rates for solar and storage program enrollment.

Program Sizing Constraints

Expand total program size by allowing more customers to be subscribed to the customer generation tariff.

Relax constraints on system sizing.



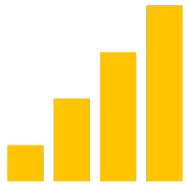
Retail Rate Reform for All Customers

Promote or mandate a switch from flat rates to TOU rates.

Consider non-bypassable and fixed charges to minimize cost shifts.

Align TOU rate peak and off-peak periods with underlying system costs.

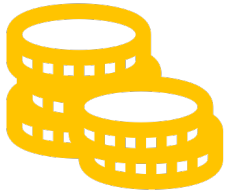
Options for Program Improvements: Feed-in-Tariff



Program Sizing Constraints

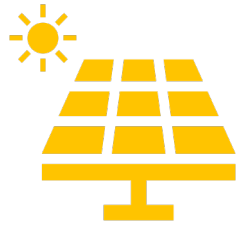
Expand total program size beyond 4.2 MW.

Remove the 1.4 MW constraint on system sizing.



Long-Term Rate Guarantees

Consider long-term rate guarantees. GWP's current feed-in-tariff only locks in compensation for a single year, preventing developers from conducting economic analyses over the resource's lifetime.



Location-Specific Incentives

Consider incentivizing the usage of underutilized space for solar, including carports (parking canopies), landfills, and other large flat surfaces. This could be in the form of an adder to the feed-in-tariff or an upfront rebate.

Section 2
Introduction

Energy+Environmental Economics

Who is E3?

Thought Leadership, Fact Based, Trusted

130+ full-time consultants

30+ years of deep expertise

Engineering, Economics, Mathematics, and Public Policy Degrees


San Francisco


New York

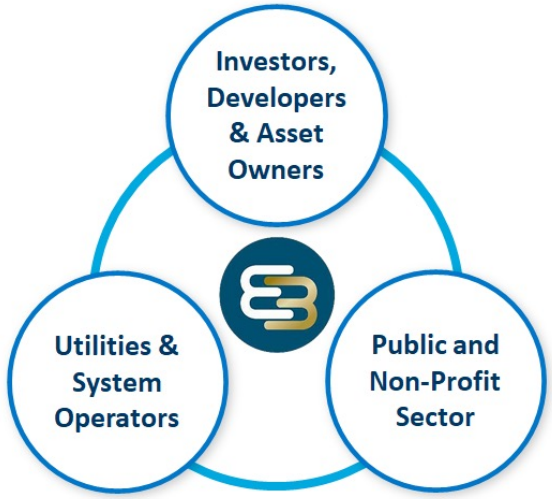

Boston


Calgary


Denver

E3 Clients

300+ projects per year across our diverse client base



Recent Examples of E3 Projects

Market price forecasts for every U.S. market (wholesale and retail), supporting billions of dollars of capital deployment;

Buy-side diligence support on several successful investments in electric utilities (~$15B in total);

Assessment of east coast and west coast offshore wind opportunities (multiple clients);

Hydrogen policy and market support for State of Colorado, Mitsubishi Americas, ACORE, and multiple developer and utility clients;

Supporting investment in several stand-alone energy storage platforms and individual assets across North America (15+ GW | ~$5B);

Evaluation of electric vehicle and V2G markets in North America for several large automakers;

Supporting NYSERDA across Climate Leadership and Community Protection Act topics;

Supporting investment in 5+ GW of community solar and distributed energy resource projects;

Supporting several electric vehicle infrastructure and automakers with strategy.

Who is E3?

+ E3 is the largest consulting group focused on the clean energy transition in North America
+ E3 is a recognized thought leader on decarbonization and clean energy transition topics
+ E3 has four major practice areas covering energy systems from bulk grid to behind the meter

Climate Pathways / Policy Analysis

- Climate and energy policy analysis
- Long-term energy & climate scenarios
- Electrification and low-carbon fuels
- Future of gas

Asset Valuation & Strategy

- Asset valuation and due diligence
- Strategic advisory
- Energy market price forecasting
- Market design
- Transmission planning

Integrated System Planning

- Integrated resource planning for electric systems: reliability and resource mix
- Planning for utility and state RPS + GHG targets
- Utility planning and procurement decisions

DER / Electrification / Rates

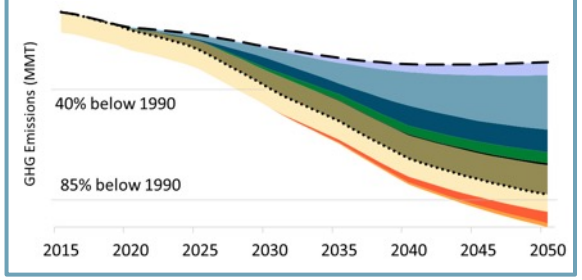
- Valuation of DERs
- DER dispatch and asset optimization
- Rate design
- Grid modernization
- Building electrification
- Vehicle electrification

Economy-wide energy systems — Bulk grid power systems — Grid edge & behind-the-meter

E3's comprehensive modeling toolkit positions E3 well to study future energy system dynamics

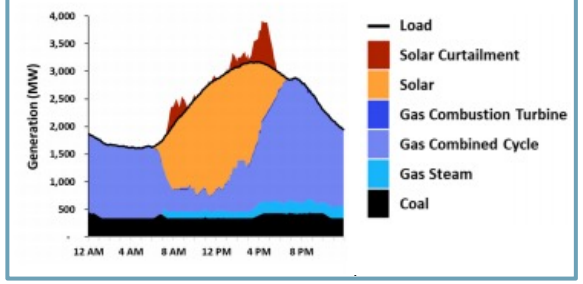
PATHWAYS

Economy-wide accounting of energy supplies and demands under deep decarbonization scenarios



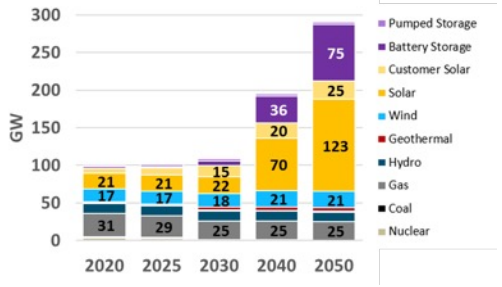
Production Simulation
(AuroraXMP and PLEXOS)

Detailed operational simulations of system dispatch and flexibility needs



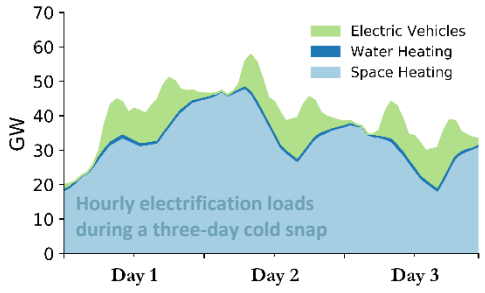
RESOLVE

Optimal capacity expansion model for electric systems



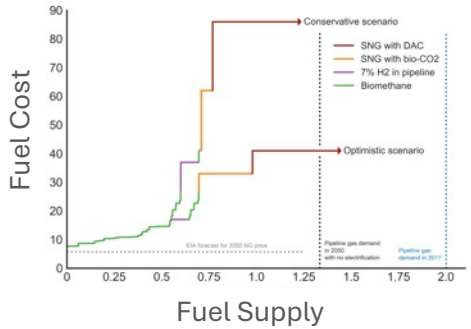
RESHAPE & EVGrid

Hourly simulations of electric loads for specific end uses



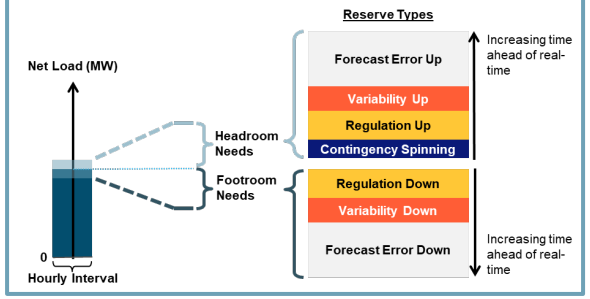
Low-Carbon Fuels and Future of Gas

Role of fuels in deep decarbonization



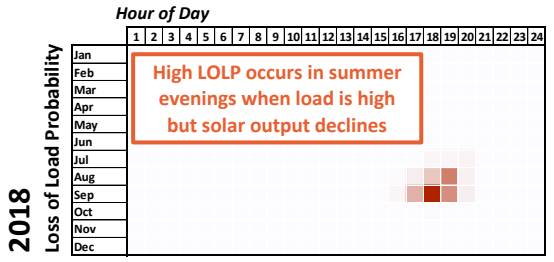
RESERVE

Dynamic operating reserves for renewable integration



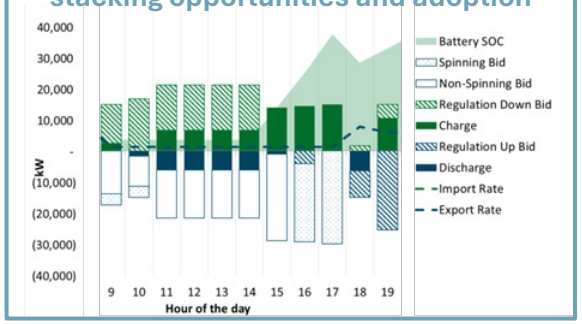
RECAP

Loss of load probability simulation to measure resource adequacy



RESTORE & IDSM

DER Toolkit for optimizing DER value stacking opportunities and adoption



Economy-wide energy systems — Bulk grid power systems — Grid edge & behind-the-meter

Glendale's City Council resolution outlines its clean energy commitment

Context & Background

+ **Glendale has set ambitious clean energy goals to establish itself as a leader in clean energy and is committed to maintaining its position as a leader in local clean and renewable energy**

+ **Grayson Repowering Project & Pursuit of Cleaner Alternatives:**
  - Glendale approved the Grayson Repowering Project, including environmentally superior alternatives.
  - Project Alternative 7 features five reciprocating internal combustion engines (RICEs) totaling 93 MW and 75 MW/300 MWh energy storage systems.
  - Glendale seeks cleaner alternatives to minimize the need for RICEs.

+ **Rooftop Solar and Battery Storage:**
  - Glendale aims to enhance residents' rooftop solar access and encourage additional installations.
  - Battery storage, located at customer or city sites, will provide significant local clean energy resources.
  - Glendale recognizes load growth from electrification and seeks to evaluate the co-benefits of solar and storage systems with electrification efforts.

+ **Demand Reduction and Load Shifting:**
  - Glendale plans to reduce electricity demand and shift energy use to off-peak hours, enhancing system reliability.

City Council Resolution

+ **Glendale intends to:**
  - Maximize the use of clean and renewable energy to serve the community.
  - Achieve 100% clean energy by 2035.

+ **The Glendale City Council passed a resolution expressing their intent to adopt policies and practices aimed at:**
  - Achieving the goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027.
  - Developing additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

+ **Staff is directed to:**
  - Engage with a consultant to develop the adoption plan.
  - Calculate the estimated dispatchable capacity and demand reduction.
  - Determine the benefits and costs of the plan, including direct/indirect economic, environmental, societal, and other non-economic benefits and costs.

Under direction from the City Council, Glendale Water & Power issued an RFP focusing on three key categories of analytical support

GWP partnered with E3 to create an equitable solar and energy storage adoption plan with input from the community, focusing on community outreach and ensuring that multifamily and rental properties are thoroughly incorporated into the plan.

Category 1

Develop Plan to Increase Solar and Energy Storage Penetration and Develop Additional DERs

Develop a plan to achieve the goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027, and to develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW by December 31, 2027.

If the consultant concludes that date to be unattainable then a date identified soon thereafter.

The plan must include policies and incentives designed to be sufficient to ensure customers will adopt solar and energy storage at a rate that achieves the adoption and capacity goals stated above.

The plan must include an alternative approach with a mix of storage at customer sites and at GWP-controlled sites, rather than all storage being located at customer sites.

Potential Policies and Incentives

- Net Energy Metering (NEM)
- Upfront Rebates
- Feed-In-Tariff (FIT) Program
- Performance-Based Incentives
- Equity Strategies & Policies
- Community Solar Projects
- Energy Efficiency
- Demand Reduction

Category 2

Dispatchable Capacity and Demand Reduction Calculation

Calculate the estimated dispatchable capacity and demand reduction that can be achieved through the plan developed in Category 1.

Category 3

Cost-Benefit Analysis

Complete an analysis of the benefits and cost of the plan developed in Category 1, and the analysis must include:

- Direct and indirect economic benefits and costs, as well as environmental, societal, and other noneconomic benefits and costs; and direct and indirect impacts to low- and moderate-income (LMI) households.
- If the analysis concludes any negative impact, the consultant shall include program options to mitigate the impact.
- If the analysis concludes that there are any negative impacts on LMI households, the consultant shall include program options to fully mitigate the impact.

Revised Scope of Work

- **E3 submitted a proposed budget and scope of work that we felt most cost-effectively met Glendale's objectives, but did provide all the deliverables requested in the RFP.**
- **In response to input from the community and City Council, proposed work was shifted to increase emphasis on community outreach and the number of stakeholder meetings, with no increase in the overall budget. The shift in scope included:**
  - Reducing the level of effort for program design recommendations
  - Focusing on solar and storage and not evaluating other DER in depth
- **E3 developed and recommended program options that would help the City achieve its goals in a more cost-effective and equitable manner than net energy metering (NEM) alone.**

Key Tasks

1. Develop Plan to Increase Solar and Storage Adoption

- ✓ *Identify market segments and potential for solar and storage adoption*
- ✓ *Develop program design and incentive recommendations*
- ✓ *Perform community outreach and engagement*

2. Evaluate Dispatchable Capacity and Peak Load Reduction Potential

- ✓ *Summarize program adoption potential and impacts*
- ✓ *Review GWP Integrated Resource Plan*
- ✓ *Summarize dispatchable capacity and peak load reduction potential*

3. Perform Cost-Benefit Analysis

- ✓ *Develop avoided costs for DER*
- ✓ *Perform cost-benefit analysis*

E3's analytical support focused on several research questions

How can local solar and distributed energy resources be effective, economic, and equitable parts of GWP's reliable, low-carbon resource portfolio?

Balancing Multiple Objectives

1. What is the potential for solar, energy storage, and other DER adoption in meeting the City Council's goals?

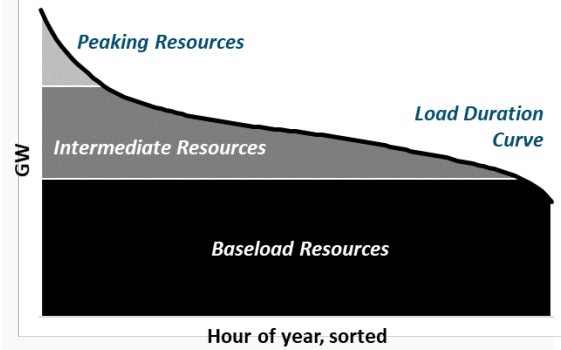
2. If the goals are not currently achievable, when can they realistically be met?

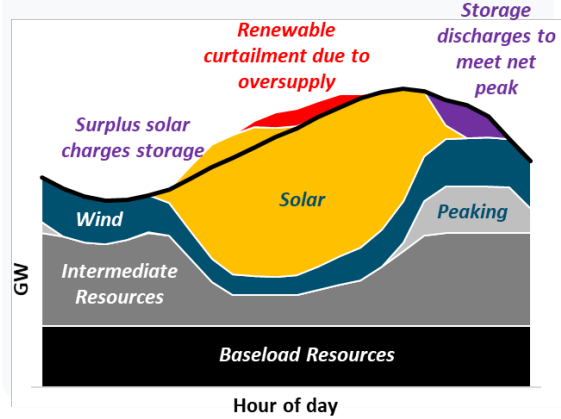
3. What policies and incentives are necessary to achieve the adoption and capacity goals and their cost/benefit implications?

4. How can policies and incentives be tailored to address the needs of low-income customers, residents in heavily pollution-burdened areas, multifamily properties, and rental properties?

5. What are the direct and indirect economic, environmental, societal, and other non-economic benefits and costs associated with solar, energy storage, and other DER adoption?

6. What are the direct and indirect impacts on low- and moderate-income (LMI) households resulting from these policies and incentives?





E3's project leadership team drew expertise from across the firm with expert support from Willdan and Dakota Communications

KEY PERSONNEL

Eric Cutter
Partner
Project Lead

Jun Zhang
Sr. Mng. Consultant
Project Manager

Lindsay Bertrand
Sr. Mng. Consultant
Asst. Project Manager

*Dec 2023
*Feb-Mar 2024

Patrick Burgess
Vice President
Willdan DER Lead

Rosie Kang
Vice President

Jonathan Baty
Associate Vice President
Primary Engineer

Ben Laboy, PE
Senior Project Engineer

Max DeLoach
Market Analyst

Rick Taylor
Partner
Outreach Support Lead

Jad Hagekhalil
Project Assistant
Outreach Support

Fangxing Liu
Senior Consultant
Demand Impact Lead

Brendan Mahoney
Senior Consultant
Project Analyst

Sierra Spencer
Managing Consultant
Cost Benefit Lead

Hannah Platter
Consultant
Project Analyst

Parker Wild
Consultant
Project Analyst

ADVISORY SUPPORT

Arne Olson
Senior Partner
Senior Advisor

Snuller Price
Senior Partner
Senior Advisor

Mike Sontag
Associate Director
Project Advisor

Charlie Duff
Managing Consultant
Project Advisor

Tara Katamay-Smith
Senior Consultant
Project Advisor

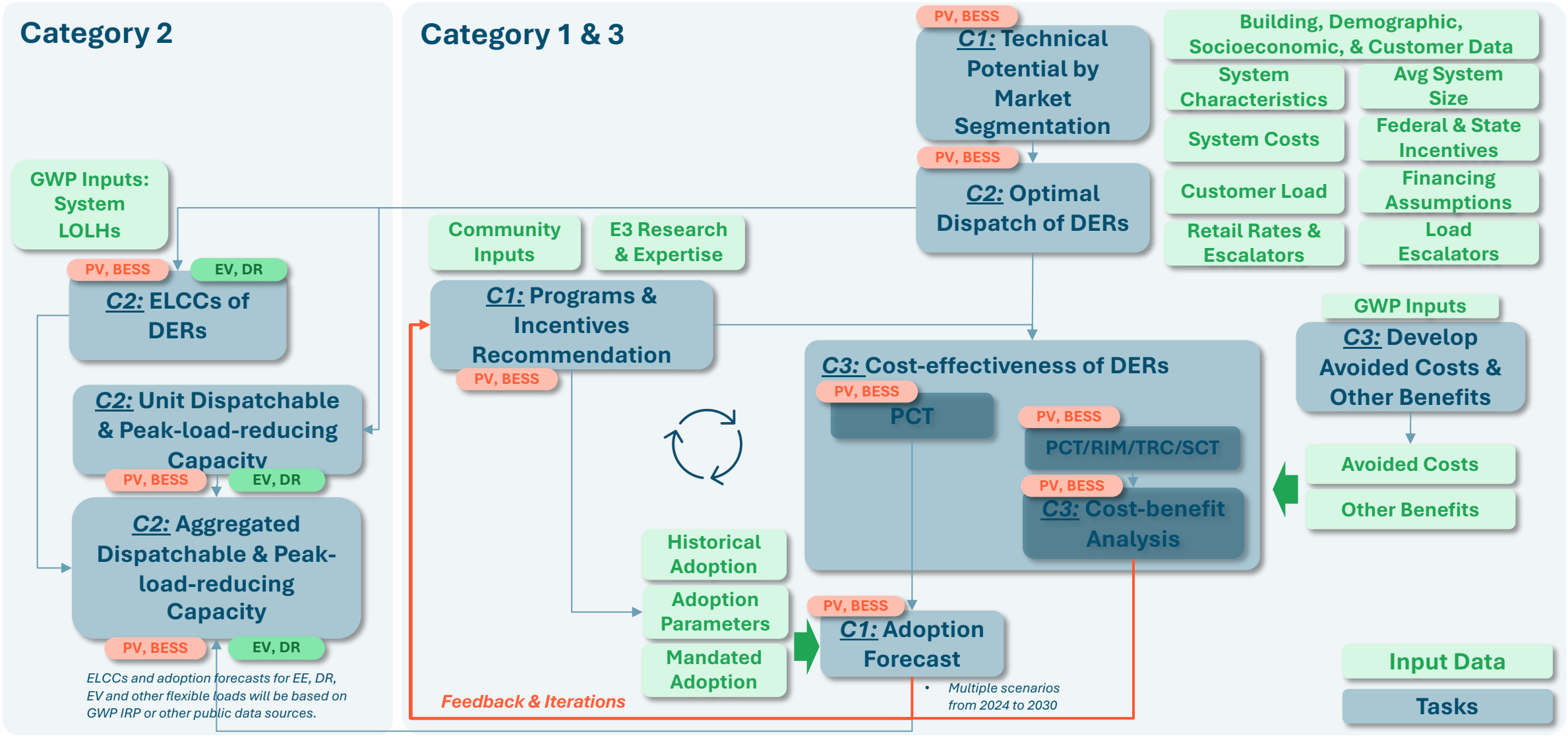
Category 1 | *Category 2* | *Category 3*

WILLDAN

DAKOTA communications
public affairs • public relations • marketing
strategic communications • crisis management

Energy+Environmental Economics

E3 employed an integrated analysis workflow because these categories are inherently interdependent and interactive with each other

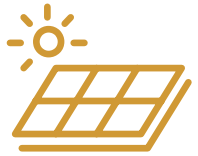


Turning potential into adoption requires a multifaceted approach to ensure equitable solar and DER adoption in Glendale

- Community Outreach
- Permitting, Interconnection, and Approval Rules & Process
- Program & Incentive Design
- Equity Strategies
- Additional DR, EV, and EE Strategies

These are the prerequisites for encouraging more adoption – incorporate community inputs and E3/Willdan project experience and expertise

Utilize modeling and scenario analysis to evaluate and identify effective, least-cost, and equitable strategies, along with improved and customized avoided cost valuation and cost-benefit analysis for GWP



Customer-Sited Solar

Energy Storage

Flexible Loads

Demand Response

Electric Vehicles

Energy Efficiency

Turning potential into adoption requires a multifaceted approach to ensure equitable solar and DER adoption in Glendale

Community Outreach

- Additional outreach on federal and state support (e.g., Inflation Reduction Act, Self-Generation Incentive Program, etc.)
- Propose adoption programs that use mechanisms that customers intuitively understand
- Comprehensive outreach and knowledge campaigns from GWP to inform and educate residents
- Intelligible program design

Permitting, Interconnection, and Approval Rules & Process

- Faster, easier, and scalable permitting, interconnection, and approval process

Program & Incentive Design

- Analysis of adoption scenarios to identify the feasibility of City Council targets
- Short-list the most effective policy and program options that move towards the targets with improved equity and lower costs
- Provide policy and program option alternatives to guide the direction for effective program design

Focus of this report

Equity Strategy

- Additional incentive and program considerations for low- to moderate-income (LMI) customers, disadvantaged communities (DACs), and pollution-burdened areas
- Balance expanding solar access with minimizing cost shifts to non-adopters via community solar, virtual solar, and financing programs

Focus of this report

Demand Response, Electric Vehicles, and Energy Efficiency

- Provide program and incentive options to further promote other DER technologies

Requires additional study

These are the prerequisites for encouraging more adoption – incorporate community inputs and E3/Willdan project experience and expertise

Utilize modeling and scenario analysis to evaluate and identify effective, least-cost, and equitable strategies, along with improved and customized avoided cost valuation and cost-benefit analysis for GWP.

E3 designed the following workflow to support the adoption plan development

Estimation of DER potential from all market segments

Enhancement of avoided costs to reflect GWP system plans and characteristics

Analysis of adoption scenarios to identify the feasibility of City Council targets and short-list the most promising and effective policy and program options

Benefit cost analysis considering direct/indirect economic and non-energy benefits; outline cost and benefit implications of all possible adoption strategies and alternatives to inform GWP's decision-making process

Deep dive into program options to provide program recommendations that balance customer adoption, customer affordability, and achieving value for the whole Glendale community

Section 3

Community Outreach & Engagement

Energy+Environmental Economics

GWP held five community meetings to gather input and feedback, and to share information with the community

Stakeholder Participation

- Following a resolution by the Glendale City Council, GWP established new goals for solar and energy storage installations, aligning with clean energy targets.
- To achieve and analyze the feasibility of these goals, GWP contracted E3 to lead research and analysis efforts, with the goal of presenting an adoption plan to the Glendale City Council in September 2024.
- E3 and GWP prioritized engaging renters, multi-family homes, low-income customers, and pollution-burdened customers in their research and creation of adoption scenarios.
- E3 and GWP hosted a total of five community meetings, four in person and one virtual, to provide stakeholders with an overview of Glendale's solar and energy landscape and gather direct feedback from the community.
- The first three meetings introduced key energy concepts and solicited initial feedback, while the last two meetings presented preliminary research findings and potential solar and DER adoption scenarios.

Stakeholder Outreach

- GWP made extensive efforts to inform residents and businesses about the community meetings through multiple channels.
- These included two bill inserts in customers' bi-monthly bills, direct mail reminders, a dedicated webpage, press releases, social media posts, email blasts, and a text message blast to over 40,000 GWP customers.
- Additionally, an online survey with over 20 questions was distributed to gather input from those unable to attend the meetings.
- The survey received over 100 detailed responses, helping E3 and GWP understand customer priorities for the solar and energy storage plan.

Community Meeting Participation

- GWP and its consultants held a total of five community meetings to increase attendee knowledge on solar and energy storage in Glendale, discuss the resolution's benefits and challenges, and gather feedback.
- Each meeting included a presentation followed by discussions at four key topic stations. The meetings concluded with a Q&A session and an invitation for attendees to submit comment cards.
- The first two meetings were held in person, with over 50 and 40 attendees respectively, while the third meeting, a Zoom Webinar, had over 70 attendees, making it the most attended.
- The last two meetings, which focused on presenting preliminary research findings and potential adoption scenarios, featured an extended Q&A session instead of discussion stations.
- Feedback from the meetings led to a streamlined presentation emphasizing clear graphics and key points.
- PDF versions of the presentations for all five meetings are available on GWP's Solar and Energy Storage Plan's dedicated webpage.

- *Press coverage of the third community meeting:*
- https://glendalenewspress.outlooknewspapers.com/2024/03/18/glendale-water-and-power-talks-highlight-solar-panel-costs-permits

GWP held five community meetings to gather input and feedback, and to share information with the community

- **Meetings 1-3 took place before the plan design phase of the project, with the goal of informing residents on the project, and gathering feedback to incorporate into the plan design phase.**
- **Meetings 4-5 took place during the plan design phase of the project, with the goal of providing information and progress about the plan, gather feedback, and understand other areas of concern from the community.**

Meeting 1	Meeting 2	Meeting 3	Meeting 4	Meeting 5
Wednesday, February 28th	Saturday, March 2nd	Monday, March 11th	Wednesday, May 15th	Thursday, May 30th
Adult Recreation Center 201 E Colorado St, Glendale, CA 91205	Sparr Heights Community Center 1613 Glencoe Way, Glendale, CA 91208	Zoom/Webinar	Adult Recreation Center 201 E Colorado St, Glendale, CA 91205	Sparr Heights Community Center 1613 Glencoe Way, Glendale, CA 91208
6:00 – 8:00 PM	10:00 AM – 12:00 PM	6:00 – 8:00 PM	6:00 – 8:00 PM	6:00 – 8:00 PM
In-Person	In-Person	Zoom/Webinar	In-Person	In-Person

Community Meetings 1-3: community input collections via discussion stations and interactive discussions

Infographics were developed to better inform residents and collect their input

Understanding Barriers to DER Adoption

Environmental Justices & Equity

Community Meetings 1-3: community input collections via discussion stations and interactive discussions

Infographics were developed to better inform residents and collect their input

Affordability and Cost Shifts

AFFORDABILITY AND COST SHIFTS

PLAN COMPONENTS

- Consideration of incentives and rebates to improve affordability of adopting DERs
- Policies aimed at low- and moderate-income customers
- The plan aims to minimize the impact on cost shifts to low-income customers

The plan considers multiple objectives:

AFFORDABILITY AND DER COSTS

Metrics: Energy affordability can be measured by **energy burden**, the percentage of household income spent on energy bills

Barriers: While DERs can reduce energy bills for participants, they can also be associated with high upfront costs that present a barrier to adoption

What are your concerns about energy affordability and other costs as solar and other DERs are adopted?

OPPORTUNITIES

- DERs can reduce energy bills for residents and business owners
- Utility incentives can further reduce a customer's energy bill via bill credits
- Federal, state, and utility incentives can reduce the upfront costs associated with installing DERs
- Financing and leasing options can help improve the economics for some customers
- Community solar could have the potential to provide affordable options for low-to-moderate income customers, assuming available space

What other programs and incentives could improve affordability and increase DER adoption?

COST SHIFTS

- DERs can reduce loads which provides electricity system cost savings for the utility, otherwise known as "utility avoided costs"
- DERs may result in reductions in utility revenues due to reduced bill payments resulting from customer compensation (net energy metering or other incentives)
- If customer compensation is greater than utility system cost savings, rates need to increase to recover utility costs, resulting in a cost shift from participants to non-participants

Cost Shift = $$ (difference)

Energy+Environmental Economics

Further Questions?
Reach us at: solar-der@glendaleca.gov

C&I Customers Plays a Vital Role in DER Adoption

COMMERCIAL AND INDUSTRIAL DER ADOPTION PLAYS A VITAL ROLE

ENERGY EFFICIENCY

Energy Efficiency is the FIRST FUEL in California – make it work for you!

Glendale Water and Power's Business Energy Upgrade program serves customers with the direct installation of energy efficiency measures:

- Lighting
- Refrigeration
- Heat Pump Water Heaters
- Custom Measures

What measures could we add that would help your business?
An Energy Services Representative (ESR) can show you how to participate!

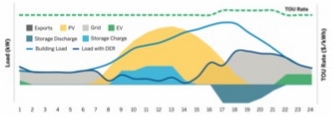
SOLAR AND STORAGE

- Coupling batteries with solar ensures energy is available after the sun sets
- Federal tax credits are available for both solar and storage, with a bonus credits for energy communities or projects in low-to-moderate income communities
- There are federal and GWP electric vehicle (EV) incentives available for installing workplace chargers, enabling EVs to charge during the workday when solar energy is abundant
- Larger solar and storage systems are more cost effective

Workplace charging under solar shade canopies makes good use of parking lots and upper decks of parking garages

DEMAND MANAGEMENT

- When you use energy is as important as how much you use
- Managing demand reduces demand charges and creates capacity for other electrical end uses
- Using energy during off peak periods reduces energy costs with time of use (TOU) rates



The figure above shows an example dispatch and load shape of a customer with solar, storage, and an electric vehicle (EV). The storage is charged from solar to avoid exports and maximize bill savings under net energy metering. Storage is discharged at the beginning of the on-peak TOU period, and the EV begins charging at the start of the nighttime off-peak period. The customer load with DERs is significantly reduced throughout the on-peak TOU period.

Figure reference: Olson et. al. 2021. "Rate Design for the Energy Transition: Getting the Most out of Flexible Loads as a Changing Grid." A White Paper from the Retail Pricing Task Force. Reston, VA: Energy Systems Integration Group. https://www.esig.energy/aligning-retail-pricing-with-grid-needs

Energy+Environmental Economics

Further Questions?
Reach us at: solar-der@glendaleca.gov

Community meetings had great turnout and local press coverage

Glendale Local Press Coverage

Glendale News-Press

NEWS ▾ BUSINESS ▾ CHARITIES & FUNDRAISERS EVENTS ▾ SCHOOLS & YOUTH

Home › City News › Glendale Water and Power Talks Highlight Solar Panel Costs, Permits

Glendale Water and Power Talks Highlight Solar Panel Costs, Permits

By **Kennedy Zak** March 18, 2024 0

Facebook Twitter WhatsApp

Glendale Water and Power's first community meeting on solar adoption was held on Feb. 28 at the city's Adult Recreation Center, where residents shared their thoughts with city staff and consultants. - Photo courtesy Glendale Water and Power

Community Meeting #1

Presenter: Jun Zhang

Community Meeting #5

Presenter: Eric Cutter

Collecting Community Input

- **40,000** customers surveyed
- **100+** unique responses received

- **Online survey respondent priorities:**
  - Affordability and reliability
  - Community solar projects to assist renters and low-income households
  - Rebates, net metering, and bill transparency
  - More education and outreach
  - Regulatory and approval process clarity

Collecting Community Input

- **Comment Cards**
- **Emails**
- **In-Person Notes**

+ Upfront rebates for mitigating initial costs
+ Net metering for solar and storage
+ Expedited and streamlined approval process
+ More guidance on federal and state resources
+ More guidance and support in solar and DER adoption process

Addressing Community Input

- Solar & battery storage contractors on GWP website
- Number of installations completed

www.glendaleca.gov/SolarContractors

KNOW BEFORE YOU BUY

CALIFORNIA SOLAR CONSUMER PROTECTION

CONSIDER YOUR PURCHASE OPTIONS

SOLAR & ENERGY STORAGE CONTRACTORS

SOLAR ENERGY SYSTEMS TAX CREDIT

LEARN SOLAR TECHNOLOGY BASICS

NET ENERGY METERING (NEM) PROGRAM

METERING, MONITORING, & MAINTENANCE

Section 4

DER Technical Potential and Market Segmentation in Glendale

Energy+Environmental Economics

Section 4.1
Overview

Energy+Environmental Economics

Multiple types of solar and storage installations are available for GWP, with different cost implications

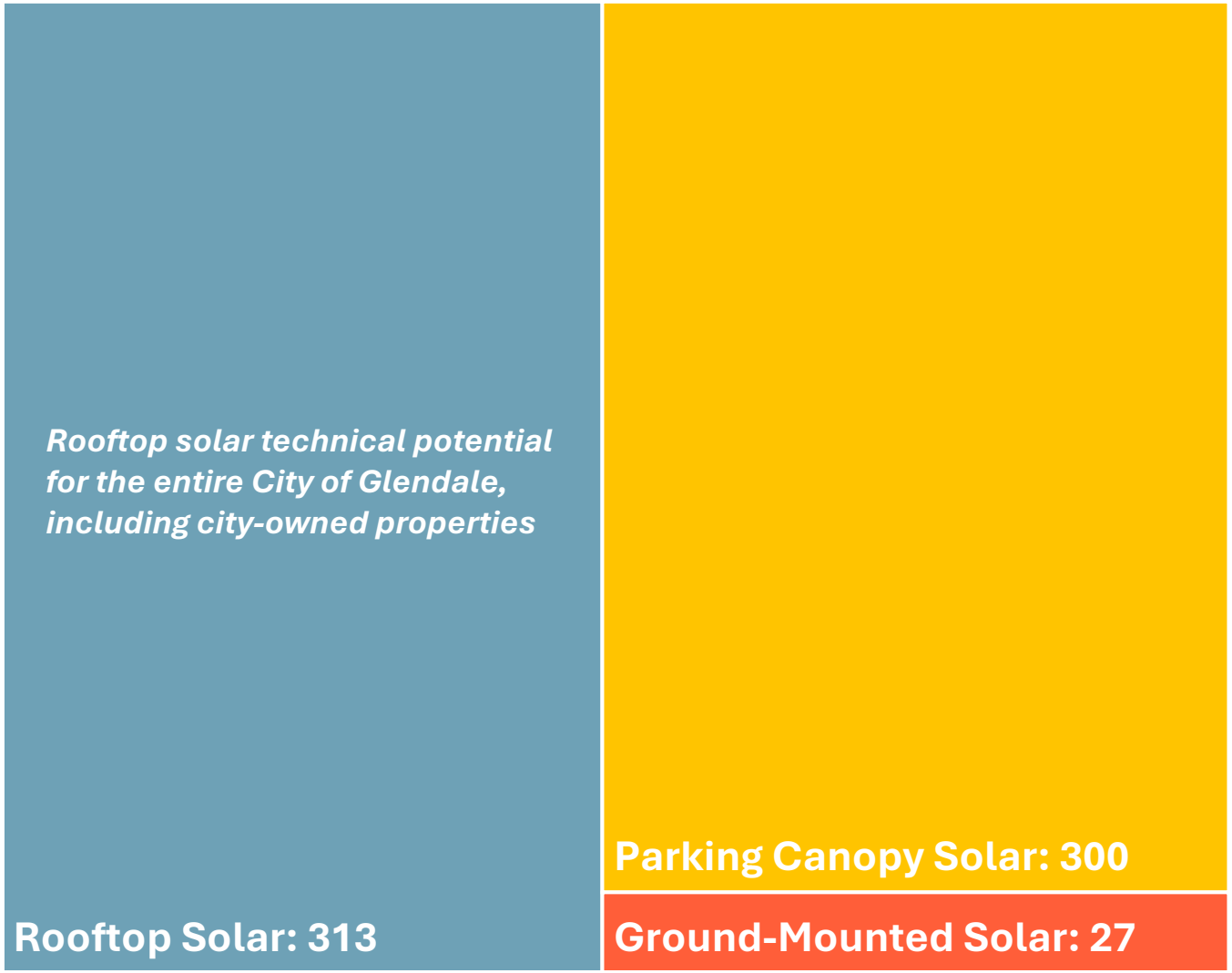
- Hillside solar is not considered by GWP.
- Community solar in practice can involve large rooftop installations as well.

Technical Potential of Rooftop, Parking Canopy, and Ground-Mounted Solar in the City of Glendale

+ **Rooftop Solar: 313 MW**
+ **Parking Canopy Solar: approx. 300 MW**
+ **Ground-Mounted Solar: approx. 27 MW**

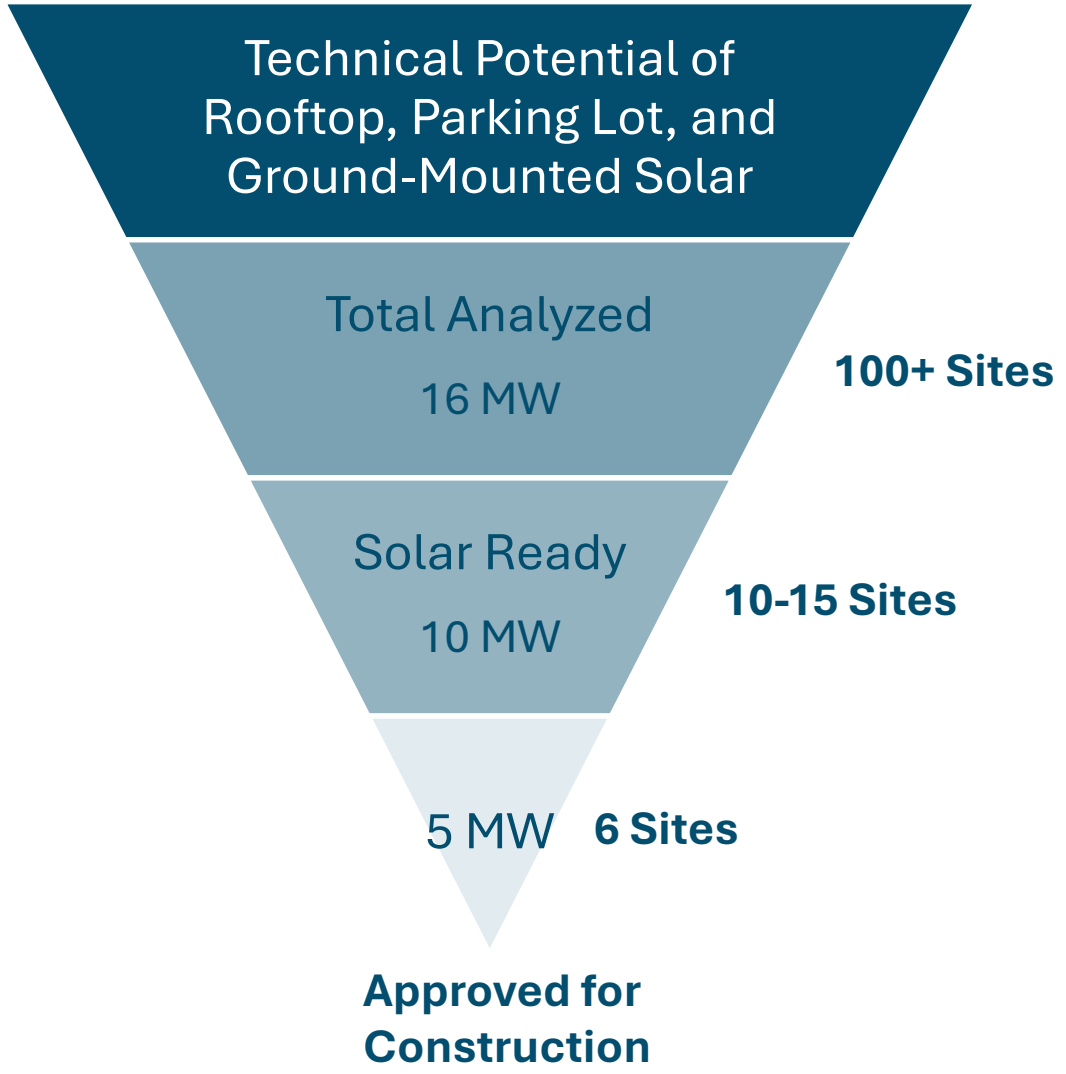
Technical potential is a metric that quantifies the maximum generation or capacity available for a technology in a given region and does not consider the economic or market viability.

Variations in the definition of technical potential and assumptions in filtering criteria may impact results substantially.



Achievable solar and storage potential for city-owned properties must account for additional real-world constraints

+ **GWP conducted site-specific analyses on over 100 city-owned properties for potential large-scale rooftop, parking canopy, and ground-mounted solar projects**
  - Over 60 sites are deemed feasible
+ **Most sites are filtered out due to their project size of less than 100 kW each and various other developmental constraints, for example:**
  - Not solar ready
  - Solar not advised by property owners
  - Historical or community use
  - Pending roof, structural, reconstruction, ADA, and feeder upgrades
+ **GWP has identified 10-15 large city-owned sites for developing solar projects**
  - Collectively 10 MW of solar capacity
  - Six projects approved for construction (5 MW)



- *Additional sites evaluated after the initial round of solar site analysis were not included.*

Section 4.2

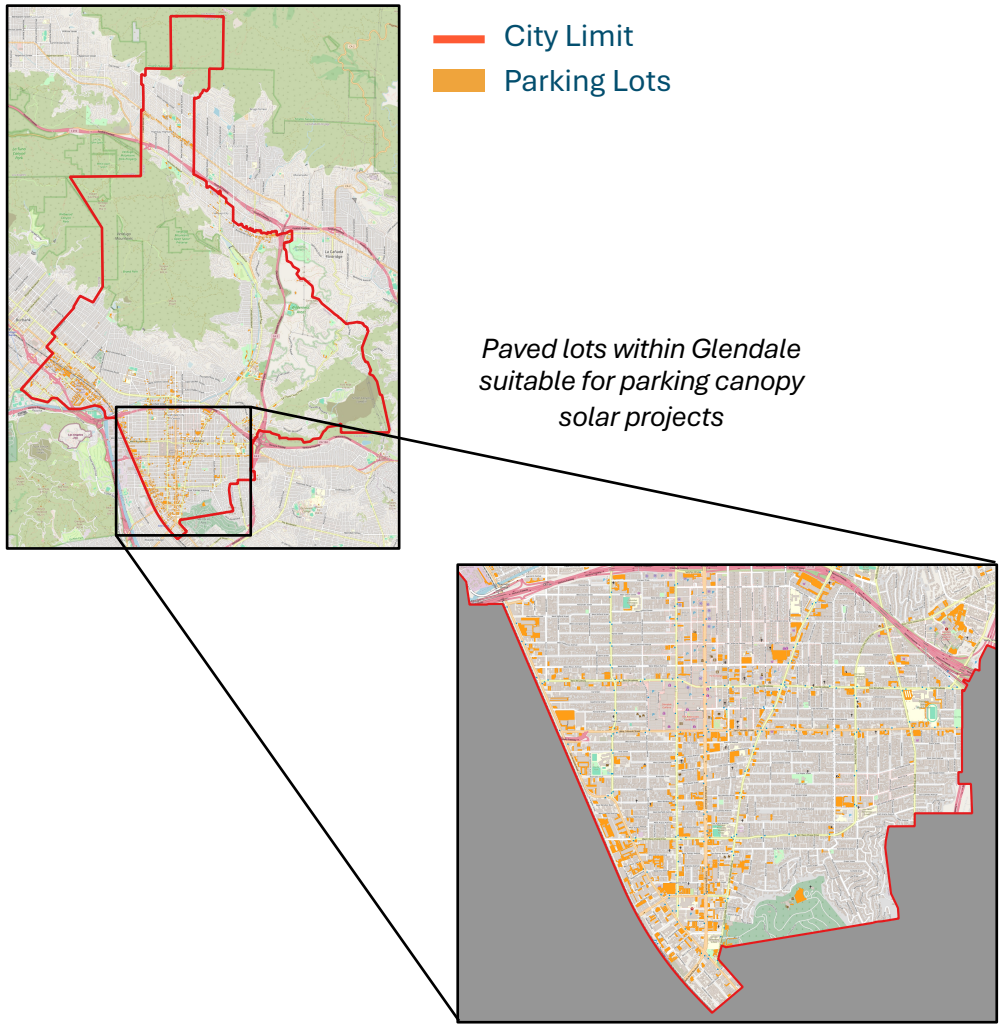
Parking Canopy & Ground-Mounted Solar

Energy+Environmental Economics

Technical Potential Methodology - Parking Canopy Solar

Parking canopy solar technical potential refers to the maximum generation capacity that can be sited on developable parking lot canopies in a region assuming economics and grid integration are not a constraint. Variations in the definition of technical potential may impact results substantially.

+ **E3 identified the boundary of non-residential parking lots 5,000 sq. ft. or greater within the City of Glendale, including city-owned parking lots**
  - Used LARIAC orthogonal imagery* from 2014, similar to NREL's LA100 study, and included paved areas on C&I and government properties (excluding sidewalks, structures, landscaping, etc.)
+ **Assuming 125 W/m^2 of parking lot area (approximately 11.6 W/ft^2), E3 identified sites capable of siting a solar canopy of 100 kW or more.**
  - Approximately 3.5 kW/parking space accounts for partial coverage and CA laws prohibiting construction over rights-of-way
  - Minimum system size derived from E3's experience working with GWP and many other developers of commercial-scale, front-of-the-meter systems
+ **Sites meeting this criteria were included in the estimate of parking canopy technical potential, which totals approximately 300 MW.**
  - Approximately 1,000 paved parking lots sites totaling 2.42 km^2 (3% of Glendale's city area, approximately 26 million sq. ft.)



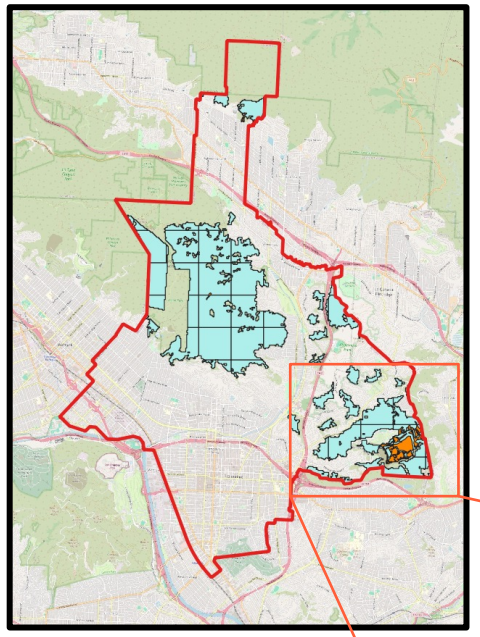
Paved lots within Glendale suitable for parking canopy solar projects

*For more information about the GIS data, please visit: https://egis-lacounty.hub.arcgis.com/datasets/lacounty::parking-lots-2014-from-lariac/about

Technical Potential Methodology - Ground-Mounted Solar

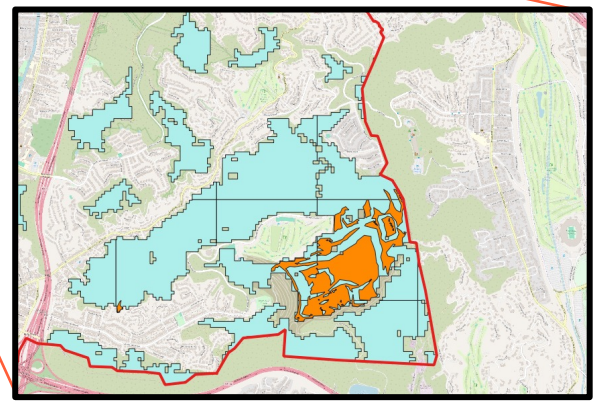
Ground-mounted solar technical potential refers to the maximum generation capacity that can be sited on developable lands in a region assuming economics and grid integration are not a constraint. Variations in the definition of technical potential may impact results substantially.

+ **E3's analysis leverages a dataset of candidate project areas identified for a recent study that estimates urban ground-mounted solar resource potential in the western United States (Wu et. al., 2023*)**
  - Encompass residential, commercial, and other non-residential urban land uses
  - Locations with imperviousness >= 1% (i.e., buildings, roads, parking lots, etc.), parks and landmarks, wetlands, bodies of water, and forested areas were excluded
  - Without additional constraints, more than 870 MW of technical potential exists within the City of Glendale, mostly located in the Verdugo Mountains
- **Applied additional filters:**
  - Limited terrain slope to less than 18% (~10 degrees), as this is more likely to be developed
  - Excluded protected areas (PAD-US 4.0), as these areas have existing restrictions on energy development
+ **Sites capable of supporting >= 100 kW of ground-mounted solar were included in the estimate of technical potential, which amounts to nearly 27 MW, primarily in the Scholl Canyon landfill**
  - Totaling 0.56 km^2 (0.7% of Glendale's city area, approximately 6 million sq. ft.)



Ground-mounted solar technical potential with basic exclusions (i.e., prior to the application of slope constraint, 100 kW minimum project size, etc.) shown in blue

Sites satisfying all siting criteria shown in orange (see below)



The majority of technical potential is located in the Scholl Canyon landfill

** Wu, Grace, et al. "Minimizing Habitat Conflicts in Meeting Net-Zero Energy Targets in the Western United States." Proceedings of the National Academy of Sciences 120, no. 4 (January 19, 2023). https://doi.org/10.1073/pnas.2204098120.*

Section 4.3

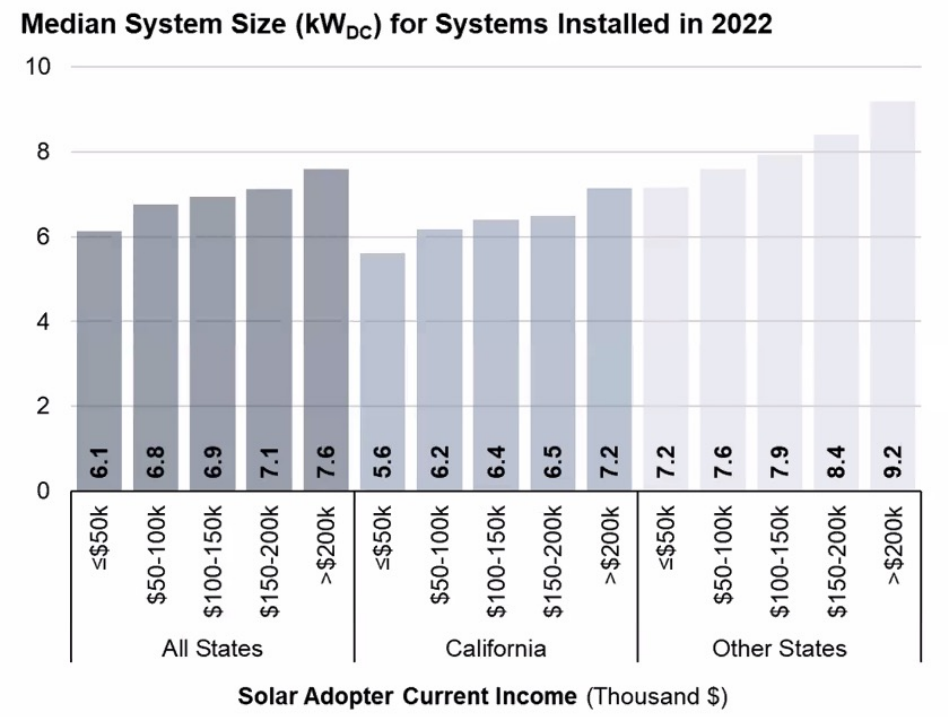
Rooftop Solar & Customer Battery Storage

Energy+Environmental Economics

Understanding the demographics of residential adopters in California provides crucial context for shaping GWP's future in solar and storage

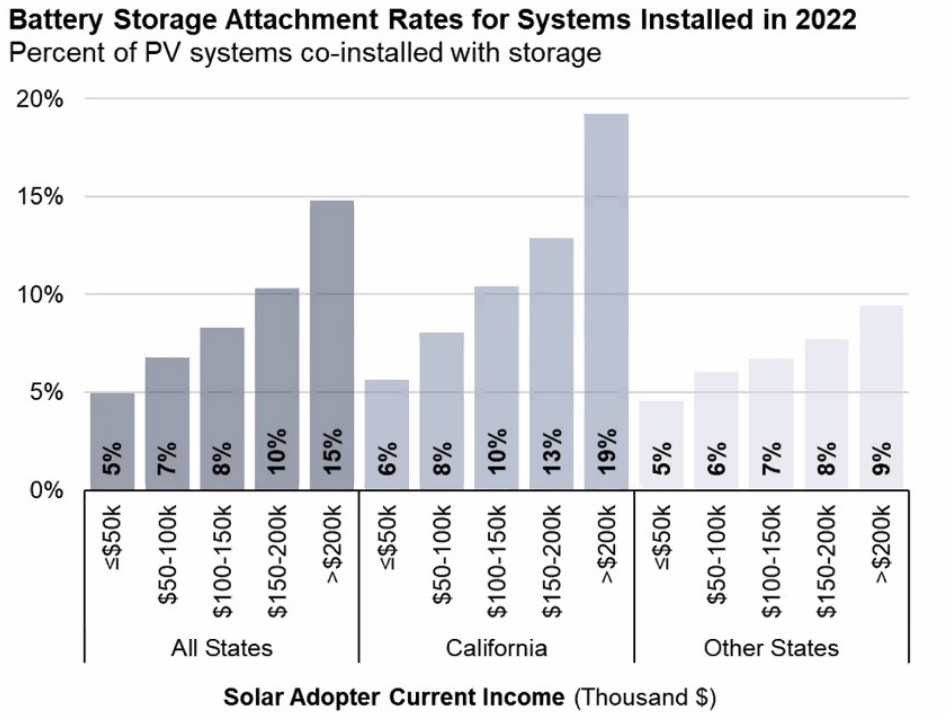
+ Higher income customers tend to adopt larger systems.

- California residents tend to install smaller systems than other states, with median sizes ranging from 5.6-7.2 kW-DC across income levels.



+ Higher income customers are more likely to adopt paired batteries.

- California residents tend to adopt paired batteries at a higher rate than other states, with attachment rates ranging from 6%-19% across income levels.

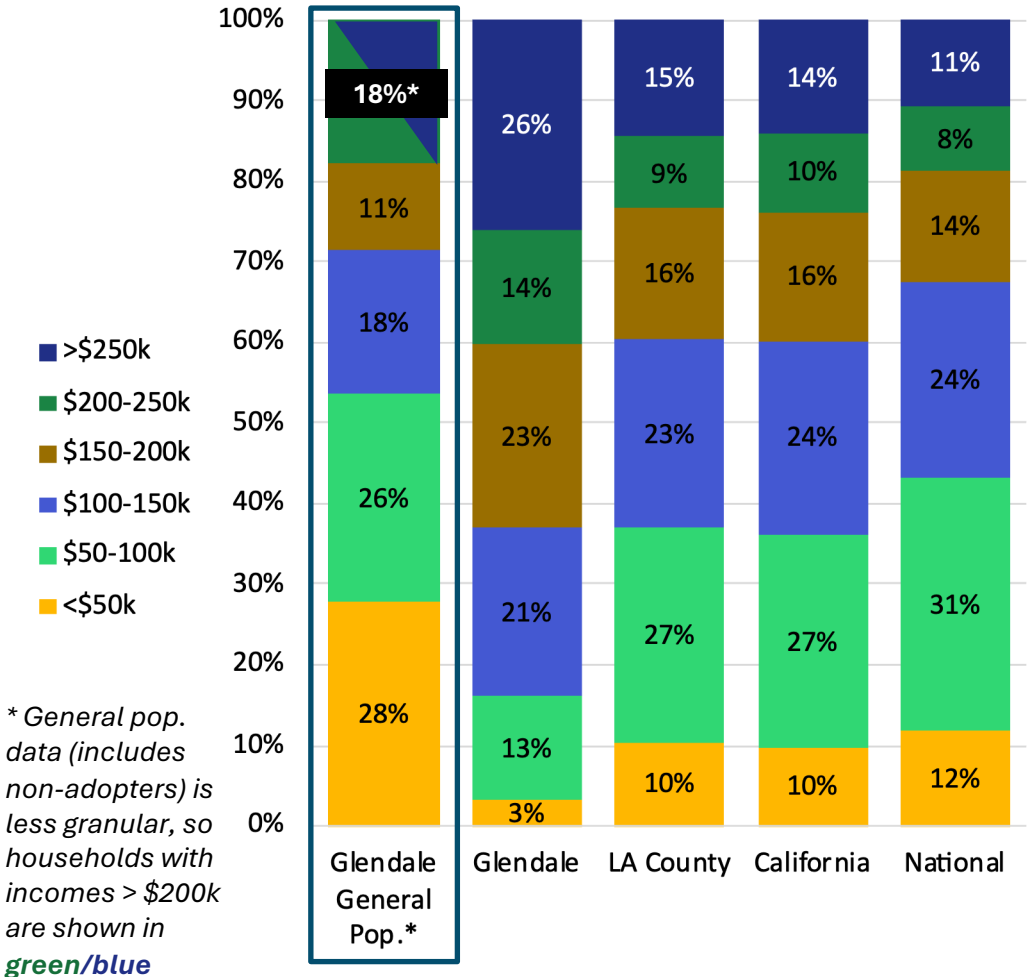


Source: Lawrence Berkeley National Laboratory

Glendale's solar adopters have higher incomes than the county, state, and national averages

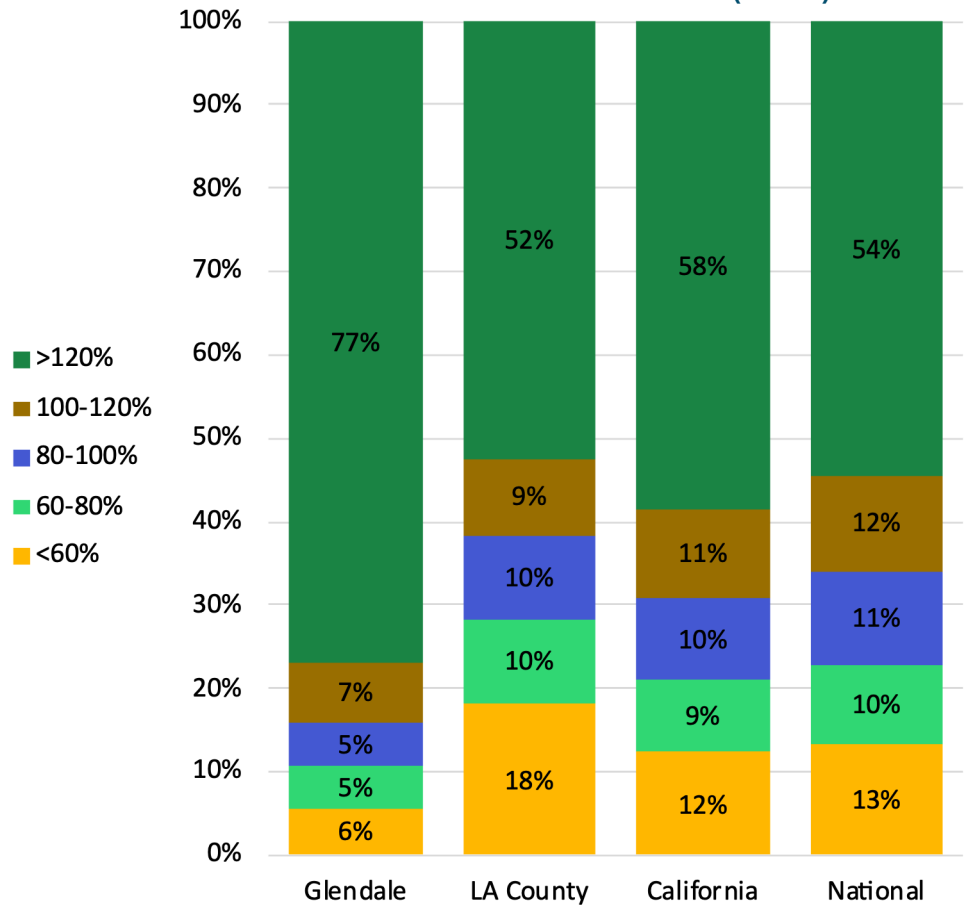
LBNL Income Demographics of GWP Solar Adopters: Raw Income, Area Median Income

Share of 2016-2022 Solar Adopters by Income



** General pop. data (includes non-adopters) is less granular, so households with incomes > $200k are shown in **green/blue***

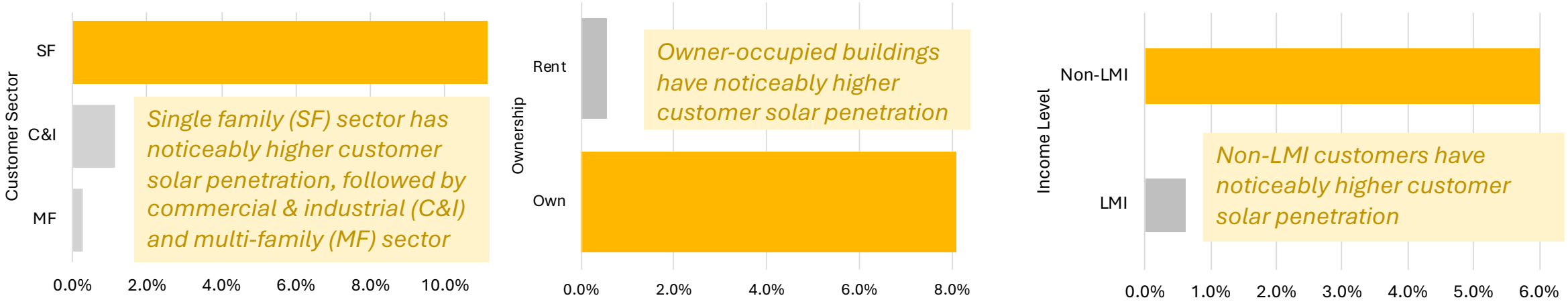
Share of 2016-2022 Solar Adopters by County Area Median Income (AMI)



Source: Lawrence Berkeley National Laboratory (LBNL)

Glendale's current solar and storage penetration pattern skews towards single-family, owner-occupied, and non-LMI households

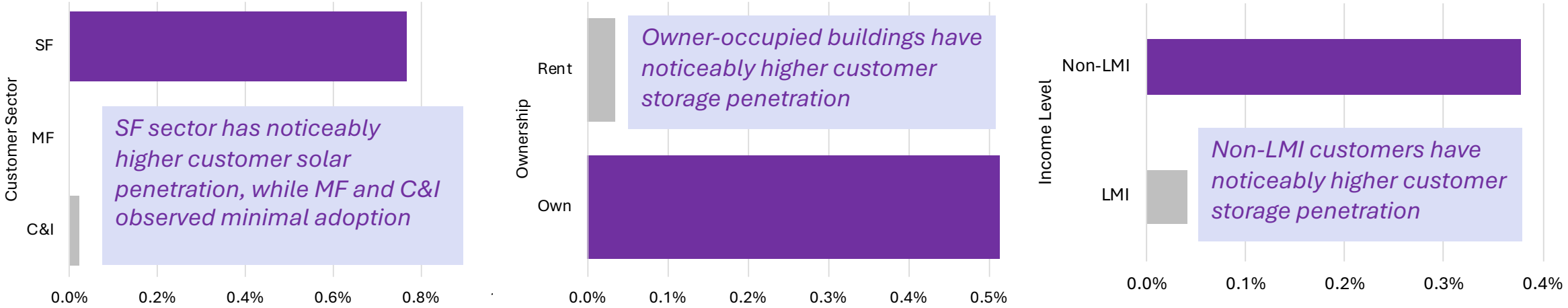
- Glendale has 2,900 customer-sited solar systems totaling 28 MW, most of which are owner-occupied, single-family, non-LMI households. Solar penetration is currently at 3.25% and solar system installations in Glendale have been increasing every year, despite the end of the solar incentive program in 2022.



Adoption Level (% of Total GWP Electric Customers)

Glendale's current solar and storage penetration pattern skews towards single-family, owner-occupied, and non-LMI households

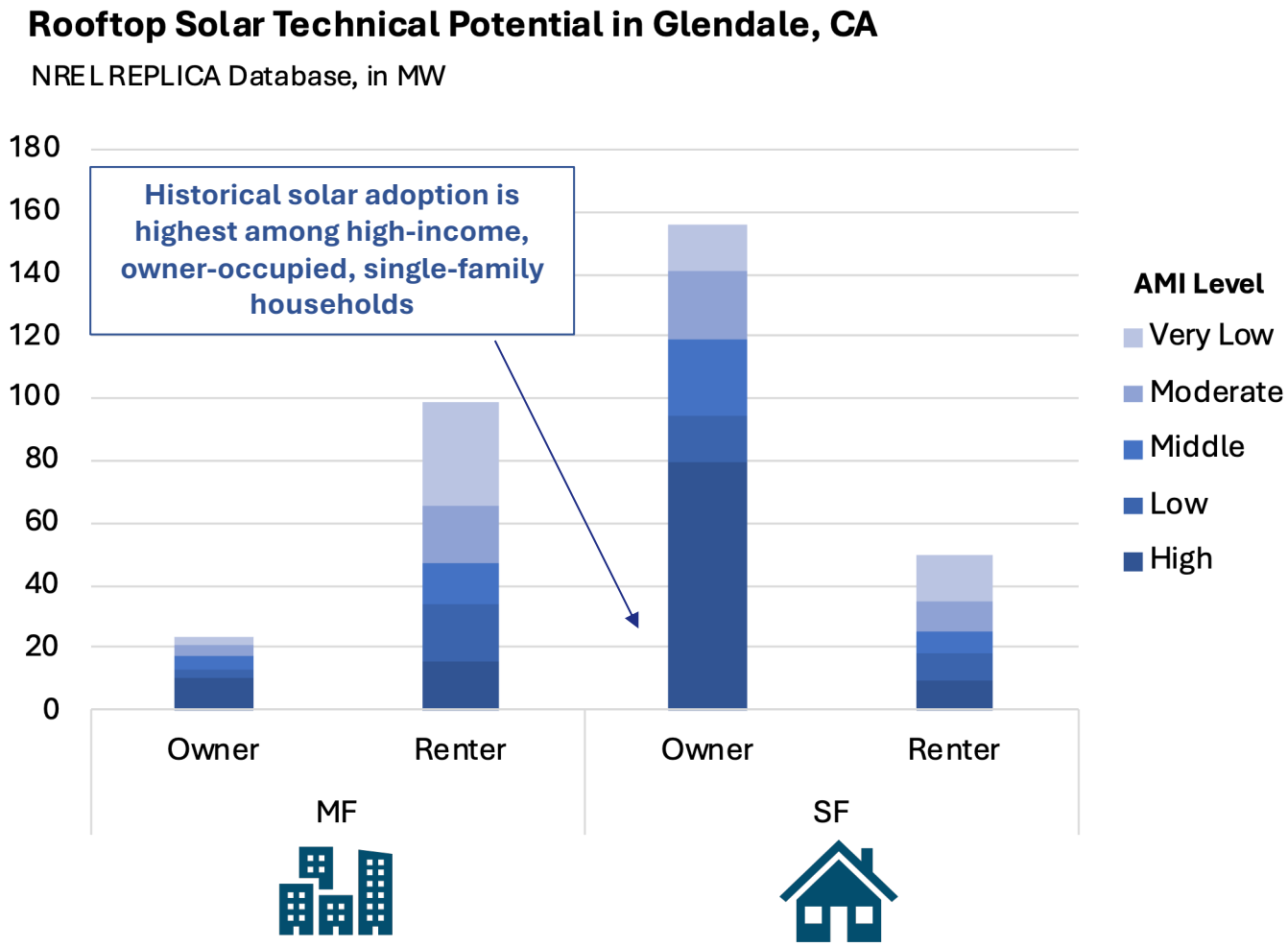
- Glendale has less than 200 customer-sited storage systems, totaling 3 MWh. Most of these systems are owner-occupied, single-family, non-LMI households, with just one large system from commercial customers and none from multi-family residences, reflecting adoption barriers for renter and LMI customers.



Residential Rooftop Solar Technical Potential in Glendale

From NREL REPLICA (see appendix for more details)

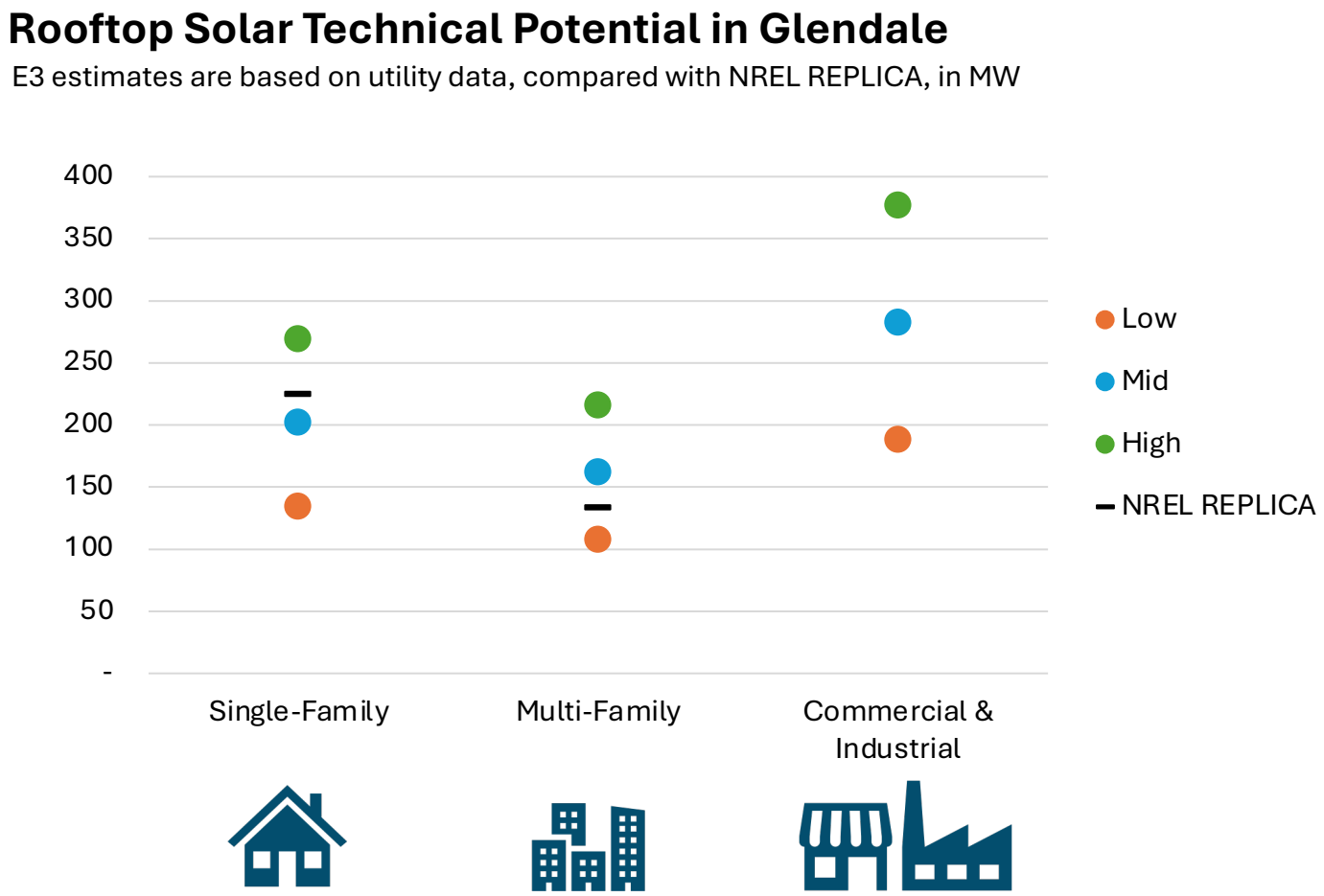
+ **REPLICA estimates that the City of Glendale has approx. 330 MW rooftop solar potential from residential sector, including single-family and multi-family customers**
  - Owner-occupied, single-family (SF) households have the highest potential, followed by multi-family (MF) rental properties
  - Difficult to penetrate rental properties because of inherent challenges associated with ownership and split incentives
  - Resolving these challenges would help unlock over 70% of potential in Glendale
+ **Existing Caveats**
  - REPLICA relies on data from 2015, with just 70k households in Glendale. To compare against E3 estimates, E3 scaled REPLICA totals to match current GWP residential customers (approximately 77k total residential customers).
  - Of the 70k households modeled in REPLICA, 40k are SF and 30k are MF. This breakdown does not perfectly align with the real-world distribution in Glendale as of FY23 (24k SF vs. 53k MF)
  - REPLICA does not constrain system size based on the customer's annual load, so E3 ran an unconstrained case for an apples-to-apples comparison



Rooftop Solar Technical Potential in Glendale

E3 Estimates vs. NREL REPLICA

- **Based on data provided by GWP and other public sources, E3 estimates of rooftop solar technical potential in Glendale are:**
  - Single-Family: 135-269 MW
  - Multi-family: 108-216 MW
  - Commercial & Industrial: 188-377 MW
- **Wide range of sensitivities capture:**
  - Percentage of total roof space available for siting solar (50%, 75%, 100%)
  - Minimum size and site suitability limits
- **At this step, system size limits based on the annual load requirement (as specified by the current NEM policy) are not considered**
  - This will be addressed in subsequent analyses to finalize the technical potential in compliance with the rules
- **Does not include solar potential from private parking lots (carports and canopies), hillside, or landfills**



** REPLICA data adjusted to account for growth in building stock since publication*

Rooftop solar technical potential for planning purposes should further consider system size limits beyond suitability and developable roof areas

Rooftop solar technical potential refers to the maximum generation capacity that can be sited on developable rooftops in a region assuming economics and grid integration are not a constraint. Variations in the definition of technical potential may impact results substantially.

Project Sunroof

466 MW-DC solar installation potential from all sectors, with 80% buildings suitable for solar

- Potential estimate includes existing systems
- Technical potential is estimated using a machine learning algorithm based on Google's overhead imagery and weather data
- Solar-suitable buildings are identified based on irradiance, orientation, and shading
- System size (2 - 1000 kW) is a function of developable roof area, which takes obstacles into account

- Does not consider parking lots or fields as eligible sites
- Does not limit system size based on applicable program limits (e.g., NEM)

NREL REPLICA

330 MW-DC solar installation potential from residential sector

- Potential estimate includes existing systems.
- Technical potential is estimated using a statistical model that leverages LiDAR data to determine rooftop suitability
- Solar-suitable buildings are identified based on irradiance, orientation, and shading.
- System size (> 1.5 kW) is a function of developable roof area, which takes obstacles into account

- Does not consider parking lots or fields as eligible sites
- Does not limit system size based on applicable program limits (e.g., NEM)

E3

313 MW-DC solar installation potential from all sectors

- Potential estimate includes existing systems
- Technical potential is estimated using anonymous GWP customer and building data and LA County Assessor parcel data
- Developable roof area derived from building footprint with derating factor to account for setback requirements, obstacles, etc.
- Glendale solar suitability adjustment of 79.25% (Project Sunroof) to account for structural stability, electrical code compliance, etc.
- Any building with enough developable roof area to site a 1 kW system (based on historical installations) is considered solar-suitable

- Does not consider parking lots or fields as eligible sites
- **Runs sensitivities for different rooftop area availability and program limits**
- **Constrains system size based on applicable program limits (e.g., NEM)**

https://sunroof.withgoogle.com/data-explorer/place/ChIJqYPwyDLAwoARpibJ_p6hP-U/
https://www.nrel.gov/docs/fy18osti/70901.pdf

Site suitability, developable roof areas, system size limits, and other constraints shape rooftop solar technical potential

Technical potential was estimated using anonymous GWP customer and building data and LA County Assessor parcel data. The study calculated roof area for all suitable buildings, then applied developable roof area, system size, site suitability, minimum project size, and other constraints to develop a range of reasonable estimates of rooftop solar technical potential in the City of Glendale.

	Developable Roof Area (% of Total Roof Area Available)	System Size Limit (% of Annual Load)
Low	50%	110%
Mid	75%	110%
High	100%	110%

×

Site Suitability (% of Total Building): 79.25%

Minimum Size (kW for Each Rooftop Solar Installation): 1 kW

=

Final E3 Estimates
Low
Mid
High

Technical Potential Methodology - Rooftop Solar & Customer Battery Storage (E3 Mid-Case)

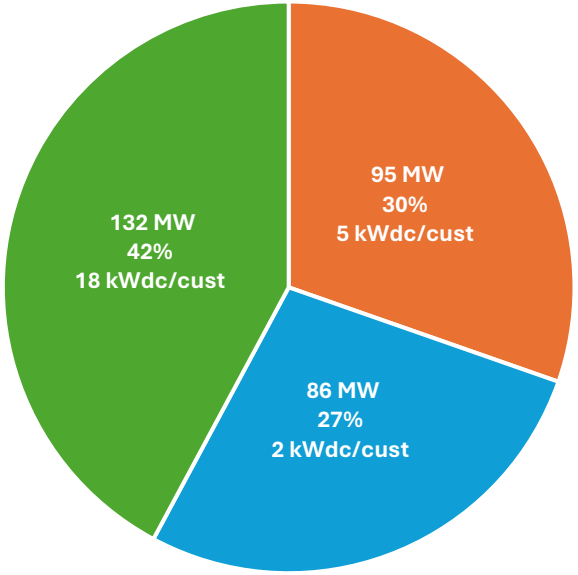
+ **Obtained anonymous GWP customer and building data**
+ **Filtered invalid customer accounts (see next page for details)**
  - Excluded government-owned properties and parking lots, accounts without a structure, etc.
  - Solar suitability adjustment (see right) accounted for structures deemed incapable of supporting rooftop solar
+ **Merged with parcel data from LA County Assessor**
  - Defaulted to building square footage from tax parcel data due to inconsistencies in customer data
  - Obtained number of stories from property use code, if available, otherwise estimated based on sector and number of units
+ **Calculated roof area for suitable buildings**
  - Estimated building square footage where missing based on average energy use intensity of accounts with the same meter bill code
  - Calculated building footprint from square footage and number of stories, then translated to roof area (assuming 0% roof slope)
+ **Adjusted roof area based on uniform developable roof area factor of 75% (% of total roof areas available, from LA100 study)**
  - Percentage will vary roof-to-roof based on geometry, but designed to capture 3-foot setback factor required by CA fire code
  - Obstructions and shading are not explicitly modeled due to the lack of satellite or LiDAR data
+ **Limit rooftop solar technical potential based on:**
  - Developable roof area, assuming default power density of 160 W/m^2 (approximately 14.86 W/sq. ft., in alignment with NREL REPLICA)
  - Percentage of customer's annual load (default to 110% based on GWP's current NEM program eligibility), assuming DC capacity factor of 20%
+ **Enforced minimum size threshold of 1 kW for rooftop solar installations**
  - Based on literature review and analysis of current system sizes in Glendale (where 99.9% of installations are >1 kW historically)
+ **Determined customer battery storage technical potential based on maximum DER ratings allowed by GWP**
  - Assumed only customers with non-zero solar technical potential are considered eligible to install a battery storage system
  - Minimum storage technical potential is 30 kWh; if solar technical potential exceeds 10 kW, storage technical potential is set to max of 30 kWh or 110% historical average daily usage
+ **Additional solar suitability adjustment of 79.25% (based on Project Sunroof data)**
  - Designed to account for factors such as structural stability of roof and electrical code compliance, which cannot be captured solely by customer data

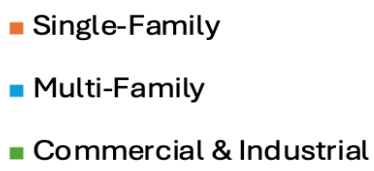
Technical Potential Methodology - Rooftop Solar & Customer Battery Storage (E3 Mid-Case) (Continued)

+ **Summary of customer accounts dropped from the technical potential analysis:**
  - Info-only meters: 2,554
  - Public account holders (e.g., Glendale City): 547
  - City-owned parking lots: 43
  - No facility (e.g., vacant lots): 808
  - Other (e.g., cable and telephone boxes, irrigation systems, outdoor advertising, etc.): 85
+ **Duplicated identifiers (i.e., combined account ID, customer ID, and service point ID)**
  - Used most recent descriptors (e.g., meter bill code) and summed the annual energy usage across accounts
+ **Merged with LA County Assessor tax parcel data**
  - Public data source that contains detailed property use types and building characteristics, such as number of stories and square footage
  - Merge occurred at the property level (not unit level) with a success rate of ~73%
+ **Treatment of missing data**
  - Categorical variables assigned based on most frequent value associated with similar accounts (e.g., sector)
  - Missing building square footage data (~ 8%) back-calculated using the average energy use intensity of accounts with the same meter bill code

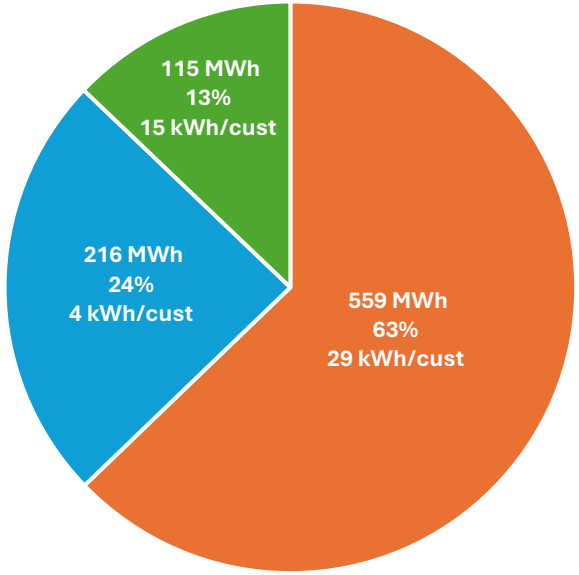
Rooftop Solar and Customer Battery Storage Technical Potential in Glendale (E3 Mid-Case)

Rooftop Solar Potential in Glendale
For Mid-Case





Battery Storage Potential in Glendale
For Mid-Case



+ **75% of total roof space (based on building footprint) is considered developable for rooftop solar**
  - Accounts for setback factor required by LA County, as well as potential obstructions; based on research conducted for NREL's LA100 study
+ **Solar potential based on 110% of customer's annual load**
  - Assuming 20% capacity factor (DC), based on default system parameters from NREL's PVWatts tool for Glendale
  - Module power density of 160 W/m^2 (approximately 14.86 W/sq. ft.), in line with NREL REPLICA estimate for flat roofs
+ **Number of buildings suitable for solar adjusted to 79.25%**
  - Based on Project Sunroof data for Glendale; accounts for factors such as structural stability of roof and electrical code compliance
+ **Storage potential aligns with maximum DER ratings allowed by GWP for solar and storage systems**
  - Assume only customers with non-zero solar technical potential are considered eligible to install storage
  - Minimum storage potential is 30 kWh; if solar potential exceeds 10 kW, maximum storage potential of 110% of the historical average daily usage

Note: These figures represent the theoretical maximum of solar and storage capacity under applicable policies and other constraints. In the adoption analysis, systems were sized based on customer needs.

Solar and Storage Technical Potential Capacity by Customer Sector

	Total # of Units	# of Solar-Suitable Units	Total PV Capacity (MW)	Total Battery Storage Capacity (MWh)	Total Battery Dispatch Capacity (MW)
Single-Family	23,843	19,046	95	559	279
Multi-Family	61,201	49,130	86	216	108
Commercial & Industrial	9,474	7,491	132	115	57

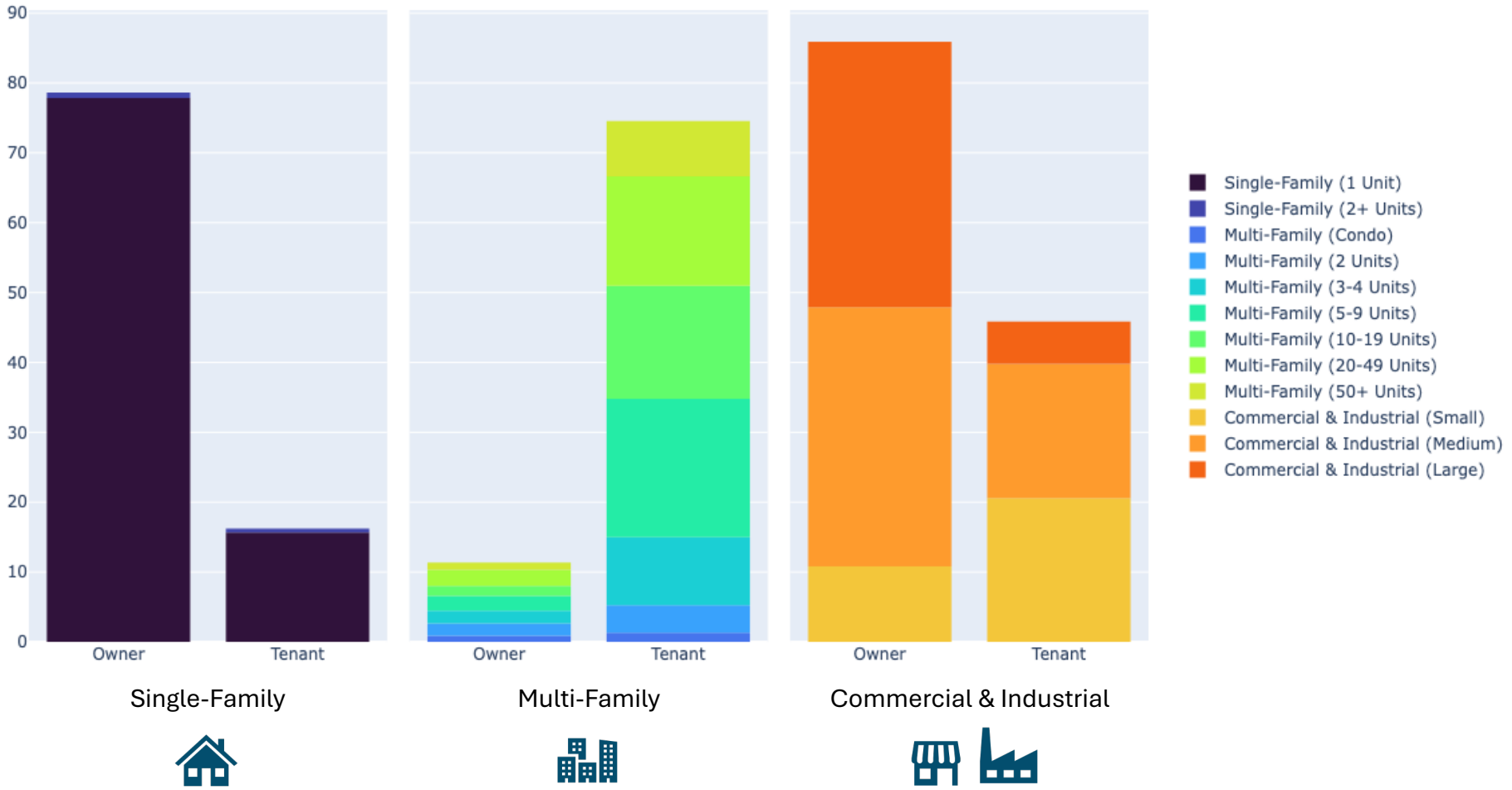
	Total # of Units	# of Solar-Suitable Units	Total PV Capacity (MW)	Total Battery Storage Capacity (MWh)	Total Battery Dispatch Capacity (MW)
Owner	31,904	25,355	176	550	275
Tenant	62,588	50,299	137	339	169
Manager	26	14	0.05	0.39	0.20

** Statistics for solar-suitable buildings under E3 "mid-case." Omits sites that could not be categorized.*

E3 estimates identify 313 MW GWP solar potential from all market segments (E3 Mid-Case)

Solar Potential by Sector, Ownership Status, and Building Type

For Mid-Case, in MW



Single-Family

Multi-Family

Commercial & Industrial

Key Observations

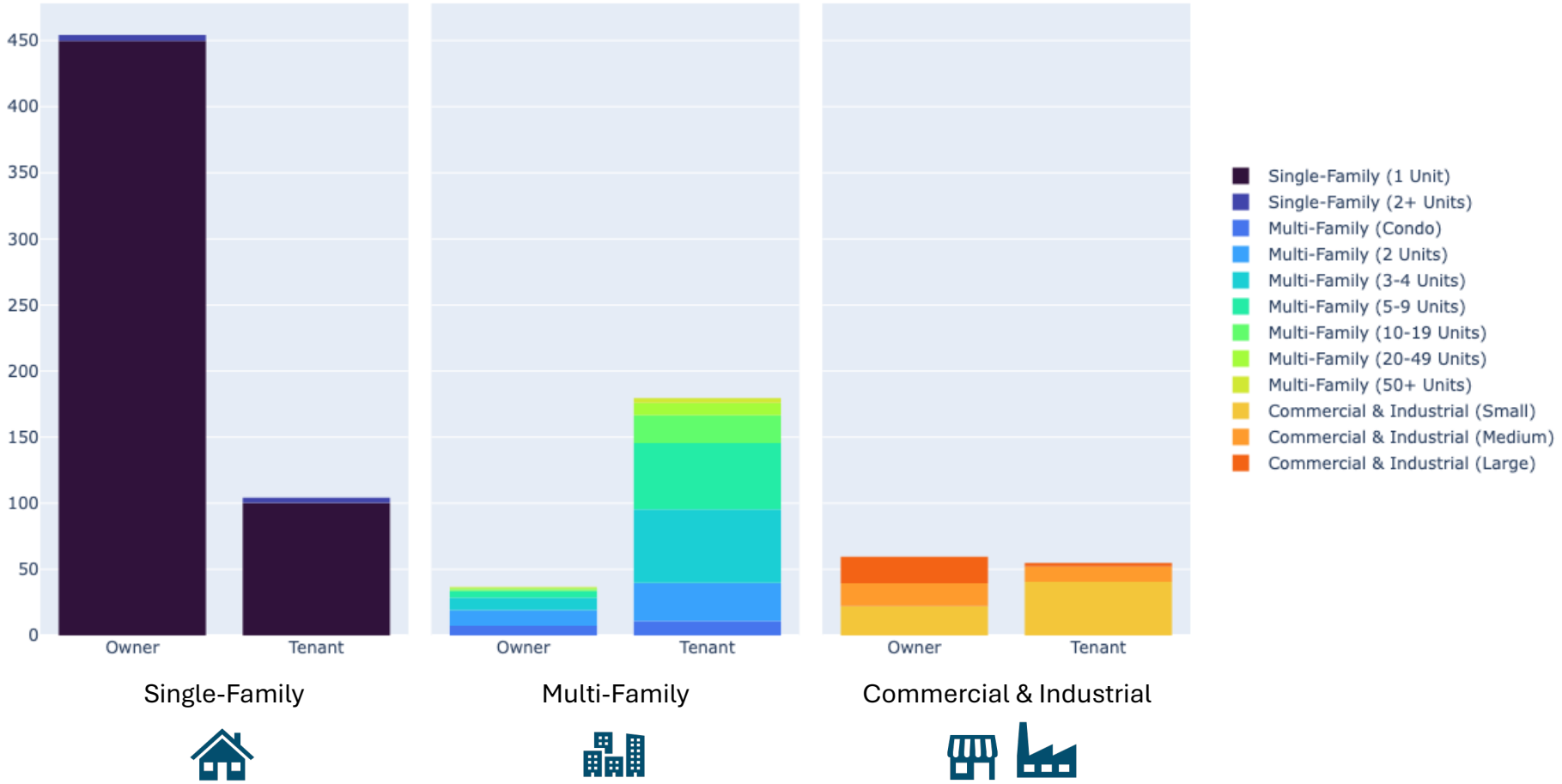
- **Single-Family:** **Owner-occupied single-family residences show the greatest potential for adoption.**
- **Multi-Family:** **Multi-family rental properties follow closely behind but face challenges due to ownership dynamics and split incentives between owners and tenants. Addressing these issues could unlock significant potential.**
- **Commercial & Industrial:** **While comprising fewer customers, these sectors have larger average installation sizes, making them significant contributors to achieving the 100 MW DER capacity target.**

* Omits sites that could not be categorized

E3 estimates identify 900 MWh GWP storage potential from all market segments (E3 Mid-Case)

Storage Potential by Sector, Ownership Status, and Building Type

For Mid-Case, in MWh



Single-Family | Multi-Family | Commercial & Industrial

Key Observations

- **Single-Family:** **Owner-occupied single-family residences show the greatest potential for adoption. Customers with less than 10 kW solar systems can install up to 30 kWh battery storage systems.**
- **Multi-Family:** **Multi-family rental properties follow closely behind but face challenges due to ownership dynamics and split incentives between owners and tenants. Addressing these issues could unlock significant potential.**
- **Commercial & Industrial:** **For large solar systems (>10 kW), maximum storage potential is up to 110% of the historical average daily usage, which constrains the potential from the C&I sectors.**

* Omits sites that could not be categorized

Technical Potential Characteristics of GWP Customers – Rooftop Solar and Customer Battery Storage (E3 Mid-Case)

By Sector, Building Type, Vintage, or Ownership

Sector	Total # of Units	# of Solar-Suitable Units	Avg Building Area (sq ft/unit)	Avg Roof Area (sq ft/unit)	Avg Developable Roof Area (sq ft/unit)	Avg Annual Energy Usage (kWh/unit)	Avg PV Capacity (kW/unit)	Avg Battery Storage Capacity (kWh/unit)	Avg Battery Dispatch Capacity (kW/unit)	Total PV Capacity (MW)	Total Battery Storage Capacity (MWh)	Total Battery Dispatch Capacity (MW)
Sector												
Single-Family	23843	19046	1904.42	958.42	718.81	8133.93	4.98	29.33	14.67	94.90	558.68	279.34
Multi-Family	61201	49130	947.93	296.77	222.58	3614.01	1.75	4.40	2.20	85.94	216.36	108.18
Commercial & Industrial	9474	7491	5409.71	3408.82	2556.61	51322.74	17.59	15.29	7.64	131.77	114.51	57.25
Building Type												
Single-Family (1 Unit)	22953	18344	1939.85	970.23	727.67	8329.34	5.10	30.00	15.00	93.58	550.32	275.16
Single-Family (2+ Units)	890	703	979.28	650.13	487.60	3031.49	1.88	11.90	5.95	1.32	8.36	4.18
Multi-Family (Condo)	798	601	1540.80	536.06	402.05	13263.72	3.70	30.00	15.00	2.22	18.03	9.01
Multi-Family (2 Units)	3604	2738	969.83	658.04	493.53	3594.42	2.08	15.00	7.50	5.70	41.08	20.54
Multi-Family (3-4 Units)	9828	7660	1119.06	465.37	349.03	3731.34	1.51	8.50	4.25	11.54	65.11	32.56
Multi-Family (5-9 Units)	15241	12283	886.70	288.45	216.34	2961.98	1.79	4.48	2.24	21.95	55.08	27.54
Multi-Family (10-19 Units)	12294	9947	865.12	234.31	175.73	2925.65	1.77	2.24	1.12	17.57	22.32	11.16
Multi-Family (20-49 Units)	11735	9589	903.93	205.66	154.24	3565.03	1.88	1.10	0.55	18.00	10.59	5.29
Multi-Family (50+ Units)	7701	6313	990.79	165.73	124.30	4989.24	1.42	0.66	0.33	8.96	4.15	2.08
Commercial & Industrial (Small)	5055	3894	4059.25	3113.76	2335.32	15483.01	8.06	16.11	8.06	31.39	62.75	31.37
Commercial & Industrial (Medium)	2157	1743	8542.90	5189.23	3891.92	82621.44	32.32	16.74	8.37	56.32	29.17	14.58
Commercial & Industrial (Large)	2262	1854	5300.76	2355.03	1766.27	97166.08	23.76	12.19	6.09	44.06	22.60	11.30
Building Vintage												
Pre-War	24287	19142	1379.00	698.83	524.12	6086.42	3.34	17.56	8.78	63.93	336.04	168.02
Post-War	44325	35528	1535.68	767.23	575.42	8639.28	3.91	11.62	5.81	138.84	412.74	206.37
Post-1980	23933	19501	1906.86	666.83	500.12	9999.20	3.68	5.78	2.89	71.79	112.74	56.37
Unknown	1973	1497	3491.51	3160.87	2370.65	65804.50	25.42	18.72	9.36	38.05	28.03	14.01
Ownership												
Owner	31904	25355	2360.06	1220.52	915.39	16906.84	6.94	21.71	10.86	175.91	550.47	275.24
Tenant	62588	50299	1262.61	545.01	408.75	5729.45	2.72	6.73	3.37	136.65	338.68	169.34
Manager	26	14	1583.07	807.55	605.66	6260.21	3.60	28.24	14.12	0.05	0.39	0.20

** Statistics for solar-suitable buildings under E3 "mid-case." Omits sites that could not be categorized.*

Technical Potential Characteristics of GWP Customers – Rooftop Solar and Customer Battery Storage (E3 Mid-Case)

By Sector, Building Type, and Ownership (excludes Vintage)

Sector	Building Type	Ownership	Total # of Units	# of Solar-Suitable Units	Avg Building Area (sq ft/unit)	Avg Roof Area (sq ft/unit)	Avg Developable Roof Area (sq ft/unit)	Avg Annual Energy Usage (kWh/unit)	Avg PV Capacity (kW/unit)	Avg Battery Storage Capacity (kWh/unit)	Avg Battery Dispatch Capacity (kW/unit)	Total PV Capacity (MW)	Total Battery Storage Capacity (MWh)	Total Battery Dispatch Capacity (MW)
Single-Family	Single-Family (1 Unit)	Owner	18771	14991	2009.32	1004.81	753.61	8464.93	5.19	30.00	15.00	77.85	449.73	224.87
Single-Family	Single-Family (1 Unit)	Tenant	4167	3343	1628.35	815.16	611.37	7722.59	4.69	30.00	15.00	15.69	100.29	50.15
Single-Family	Single-Family (2+ Units)	Owner	439	343	1007.27	737.33	552.99	3776.75	2.33	13.13	6.57	0.80	4.50	2.25
Single-Family	Single-Family (2+ Units)	Tenant	451	360	952.64	567.10	425.33	2321.87	1.45	10.73	5.36	0.52	3.86	1.93
Multi-Family	Multi-Family (Condo)	Owner	308	239	1550.68	527.03	395.27	10553.46	3.65	30.00	15.00	0.87	7.16	3.58
Multi-Family	Multi-Family (Condo)	Tenant	487	361	1538.51	543.55	407.66	15101.62	3.73	30.00	15.00	1.35	10.82	5.41
Multi-Family	Multi-Family (2 Units)	Owner	1120	813	1004.91	650.84	488.13	3614.67	2.17	15.00	7.50	1.76	12.20	6.10
Multi-Family	Multi-Family (2 Units)	Tenant	2482	1923	955.11	661.29	495.97	3587.51	2.05	15.01	7.50	3.93	28.86	14.43
Multi-Family	Multi-Family (3-4 Units)	Owner	1467	1089	907.15	366.60	274.95	3685.85	1.68	8.58	4.29	1.83	9.34	4.67
Multi-Family	Multi-Family (3-4 Units)	Tenant	8357	6571	1154.17	481.73	361.30	3738.88	1.48	8.49	4.24	9.70	55.78	27.89
Multi-Family	Multi-Family (5-9 Units)	Owner	1313	1053	1039.96	443.09	332.31	3268.54	2.01	4.65	2.32	2.12	4.89	2.45
Multi-Family	Multi-Family (5-9 Units)	Tenant	13928	11229	872.33	273.95	205.46	2933.23	1.77	4.47	2.23	19.83	50.18	25.09
Multi-Family	Multi-Family (10-19 Units)	Owner	754	618	1042.35	303.14	227.35	3764.31	2.29	2.15	1.07	1.41	1.33	0.66
Multi-Family	Multi-Family (10-19 Units)	Tenant	11540	9329	853.37	229.75	172.31	2870.08	1.73	2.25	1.13	16.16	20.99	10.50
Multi-Family	Multi-Family (20-49 Units)	Owner	1411	1126	1019.18	215.43	161.57	4641.72	2.05	1.12	0.56	2.31	1.26	0.63
Multi-Family	Multi-Family (20-49 Units)	Tenant	10324	8463	888.61	204.36	153.27	3421.84	1.85	1.10	0.55	15.69	9.33	4.66
Multi-Family	Multi-Family (50+ Units)	Owner	803	658	1001.66	165.94	124.46	6136.25	1.60	0.78	0.39	1.05	0.51	0.26
Multi-Family	Multi-Family (50+ Units)	Tenant	6898	5655	989.53	165.70	124.28	4855.72	1.40	0.64	0.32	7.91	3.64	1.82
Commercial & Industrial	Commercial & Industrial (Small)	Owner	1894	1462	3811.55	2773.46	2080.10	14439.19	7.38	15.09	7.55	10.79	22.06	11.03
Commercial & Industrial	Commercial & Industrial (Small)	Tenant	3160	2431	4209.21	3319.06	2489.30	16115.11	8.47	16.72	8.36	20.59	40.66	20.33
Commercial & Industrial	Commercial & Industrial (Medium)	Owner	1499	1221	7505.92	4727.45	3545.59	78205.99	30.38	14.34	7.17	37.11	17.52	8.76
Commercial & Industrial	Commercial & Industrial (Medium)	Tenant	657	521	10972.29	6271.08	4703.31	92965.83	36.85	22.34	11.17	19.21	11.65	5.82
Commercial & Industrial	Commercial & Industrial (Large)	Owner	2125	1742	5115.43	2147.98	1610.98	91469.28	21.81	11.46	5.73	38.00	19.97	9.99
Commercial & Industrial	Commercial & Industrial (Large)	Tenant	137	112	8175.38	5566.66	4175.00	185528.86	53.95	23.37	11.68	6.06	2.62	1.31

- *Statistics for solar-suitable buildings under E3 "mid-case."*
- *Omits sites that could not be categorized. No "Manager" ownership status.*

Section 5

Dispatchable Capacity and Demand Reduction Capacity

Energy+Environmental Economics

E3 reviewed GWP's IRP focusing on load & DER forecasts to ensure accurate system representation and inform study design

Reviewed IRP Inputs

- To properly support GWP's DER strategy, E3 must comprehensively understand GWP's system
- The E3 team conducted a thorough review of GWP's Integrated Resource Plan (IRP), load and DER adoption forecast
- The review included a detailed analysis of GWP's assumptions, methodologies, and data inputs used in the development of the IRP

Evaluated Adoption Levers

- The IRP review focused on evaluating GWP's resource mix, key upcoming decisions, and levers that may accommodate the adoption of DERs
- It also included an evaluation of the approach to determining the reliability of GWP's proposed resource plan
- E3 also had a focused review of GWP's assumptions and methodologies for assessing the potential for DERs and load growth

Informed Study Design

- The E3 team leveraged its findings to inform other components of this study, including but not limited to the DER reliability analysis, targeted DER adoption strategies, and the cost benefit analysis

Review IRP Inputs → Evaluate Adoption Levers → Inform Study Design

GWP faces many challenges in transitioning to a cleaner grid, and local clean energy resources could provide significant support

System Context and Challenges

Glendale's Clean Energy Vision

- 60% RPS by 2030 (CA regulatory requirement)
- 100% Clean Energy by 2035 (Glendale goal)

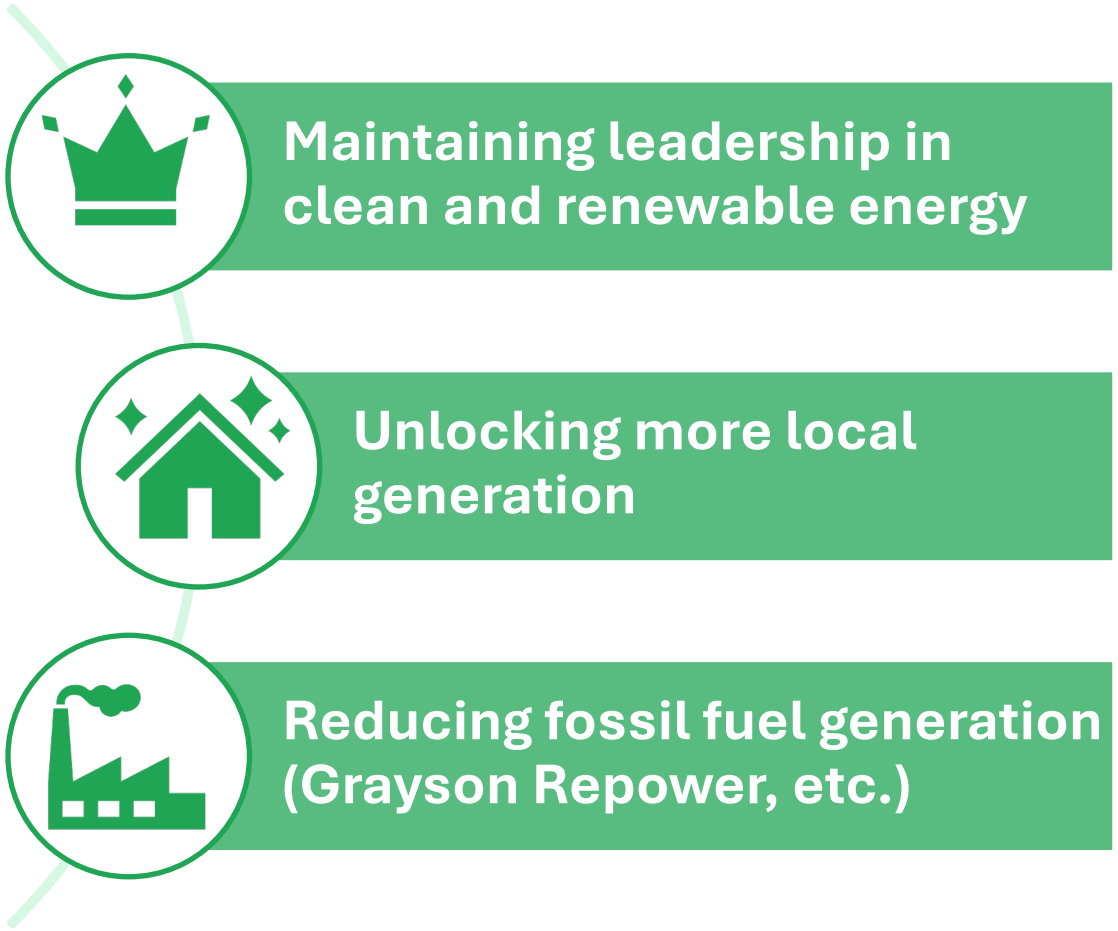
Transmission & Land Constraints

- Procuring new renewables outside of the City
- Procuring new renewables within the City

Integrated Resource Plan (IRP) Planning Challenges

- Integrating renewables, coal retirement, and hydrogen combustion turbine (CT) conversion
- Maintaining system reliability

Role of Local Clean Energy Resources



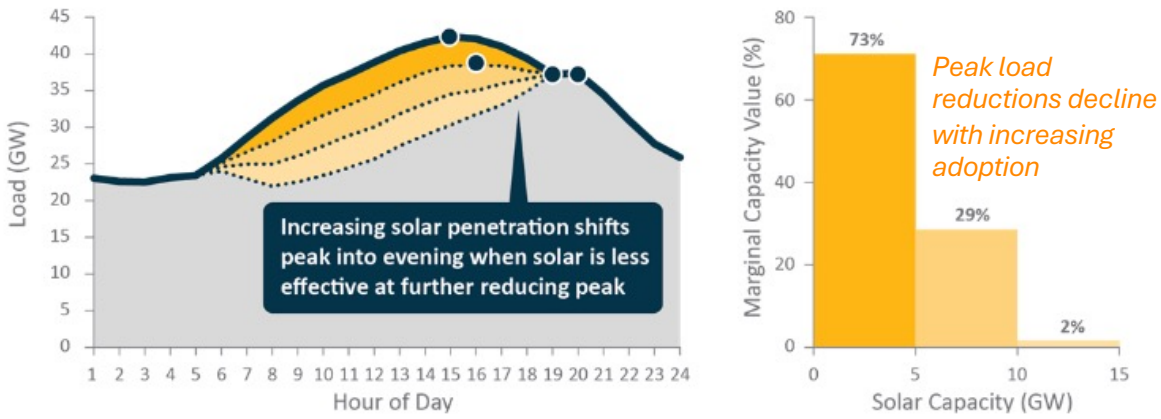
Resource adequacy (RA) is increasing in complexity and importance as the grid shifts to low-carbon resources

- **The transition towards renewables and storage introduces new complexity in resource adequacy planning**
- **The concept of planning exclusively for "peak" demand is becoming obsolete**
- **Instead, long stretches with low solar and wind output, corresponding with high loads, are the times of most challenging resource adequacy needs**
- **As more of one resource is integrated, the net peak hours shift to other times, reducing its capacity value or ELCC**

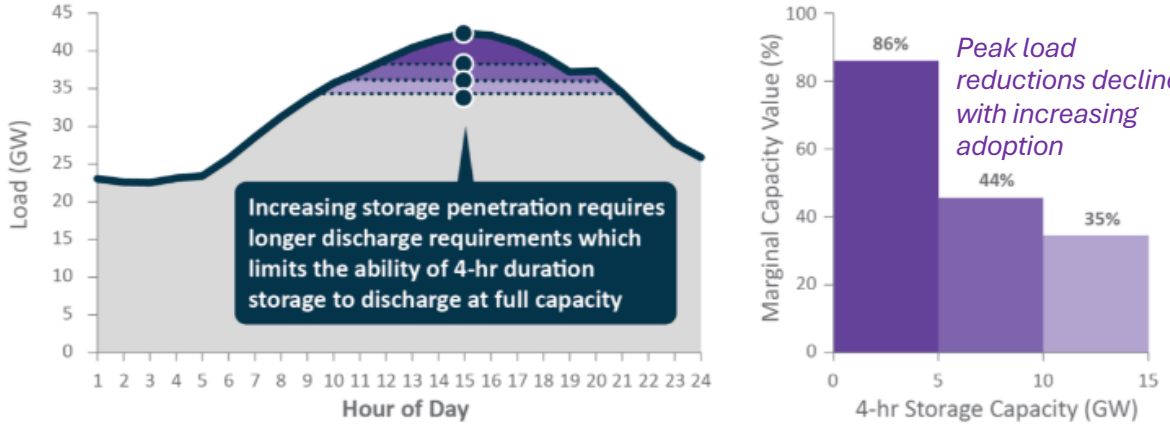
Effective Load Carrying Capacity (ELCC)

- *ELCC measures a resource's contribution to reliability based on the incremental quantity of load that can be satisfied by adding the resource to the grid*
- *ELCC expresses the capacity contribution of intermittent and energy-limited resources in terms of equivalent "perfect" capacity (capacity that is always available)*
- *For example, if the ELCC of solar is 50%, then an electricity system with 100 MW of solar (i.e., 50 MW of ELCC) would achieve the same reliability as an electricity system with 50 MW of a perfect resource*

Diminishing Value of Solar ELCC



Diminishing Value of 4h Storage ELCC



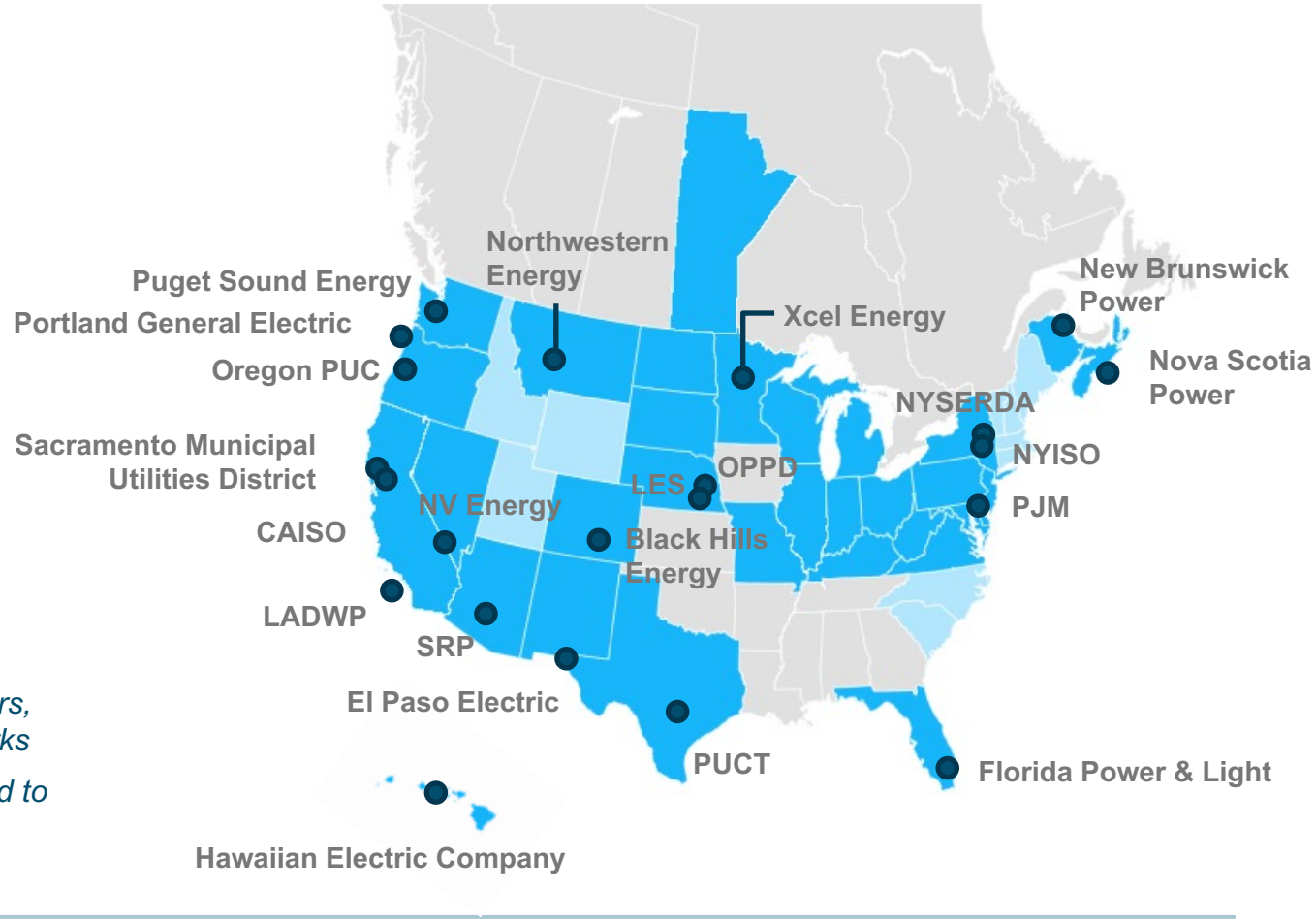
Schlag et. al., "Capacity and Reliability Planning in the Era of Decarbonization: Practical Application of Effective Load Carrying Capability in Resource Adequacy," Energy and Environmental Economics, Inc., August 2020. Available at: https://www.ethree.com/elcc-resource-adequacy/

E3 leveraged its experience performing RA analyses and used Effective Load Carrying Capacity (ELCC) results from other CA work

+ **E3 has resource adequacy experience across California:**
  - CPUC IRP – California-wide ELCC work
  - CAISO – CAISO DR ELCC work
  - LADWP – neighbor for GWP
  - SMUD – another smaller-sized CA utility

+ **For this study, E3 developed GWP-catered approximations of ELCC without having to conduct extensive Loss-of-load Probability (LOLP) modeling**

E3 has worked directly with utilities across North America to study resource adequacy needs



States where E3 has provided direct support to utilities, market operators, and/or state agencies to perform RA modeling or develop RA frameworks

Areas where E3 has worked with other clients to examine issues related to resource adequacy

E3 calculated the estimated dispatchable capacity and demand reduction that can be achieved through the adoption plan

DER Nameplate Capacity × **DER ELCCs** = **DER Effective Capacity**

- Customer adoption forecasts for distributed solar and storage were modeled across scenarios S1-S5.
- For electric vehicles (EVs), demand response (DR), and energy efficiency (EE), a single adoption scenario was modeled based on GWP's IRP.
- Further details are available in *Section 7: Adoption and Impact Analysis*.

- ELCC measures a resource's contribution to grid reliability by quantifying the additional load the system can support. This concept applies to dispatchable and peak-load-reducing DERs as well.
- E3 developed tailored ELCC approximations for GWP.
- Further details are provided in the following slides.

- For example, if solar has an ELCC of 50%, then a system with 100 MW of solar capacity would provide the same reliability as a system with 50 MW of an ideal, always-available resource. In this case, the effective capacity of solar is 50 MW.
- Further details are provided in the following slides.

E3 designed this approach for approximating GWP DER ELCCs based on data availability

1

2024 DER Shed or Provided Power Potential × **Loss-of-Load Hours (LOLH)** × **Utility-Scale Battery Storage Marginal ELCC Curve** = **GWP DER ELCCs***

Approximated from 2022 CPUC IRP DR study

From 2022 CPUC ACC Capacity Allocation Hours (2024-2030)

From 2023 CPUC IRP RESOLVE Utility-Scale 4-hr Battery Storage Marginal ELCC Curve (2024-2030)

Electric Vehicles

2

2024 DER End-Use Profiles (Normalized) × **Loss-of-Load Hours (LOLH)** = **GWP DER ELCCs***

Profiles simulated by this study, or approximated from previous E3 work

From 2022 CPUC ACC Capacity Allocation Hours (2024-2030)

Solar and Energy Storage

3

Approximations based on E3's work in California and across the U.S. = **GWP DER ELCCs***

Demand Response

** Post-processed as a range (±5%) based on the calculated value to account for uncertainties that were not fully addressed*

Key Results: Approximations of GWP DER ELCCs in 2027

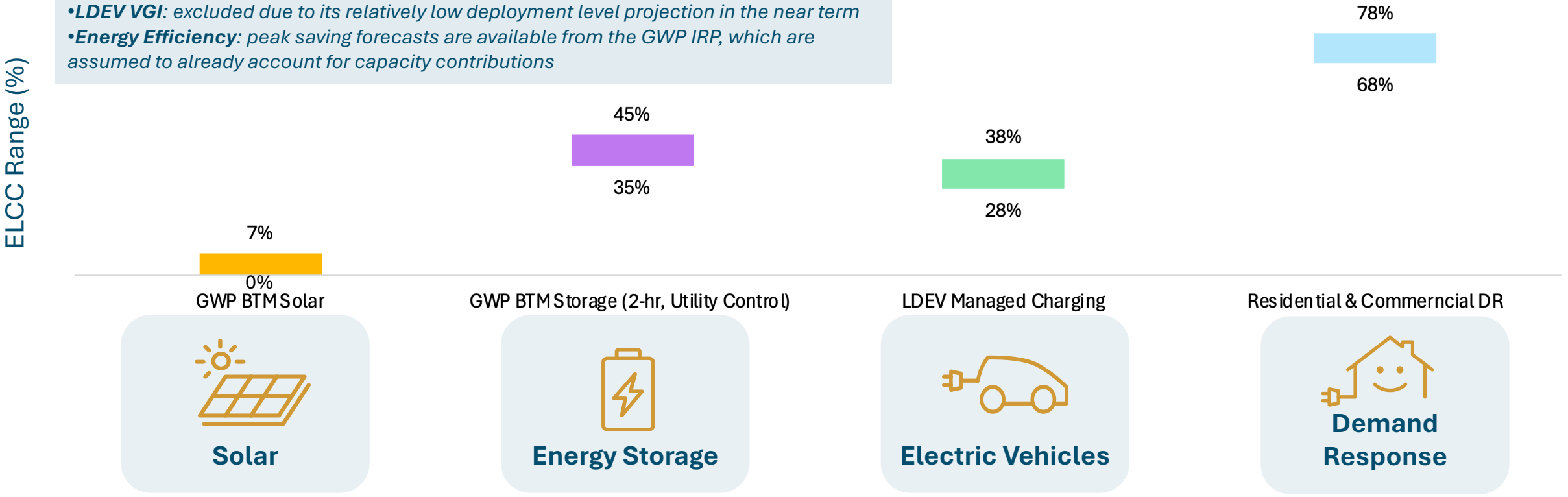
GWP BTM solar profiles from PVWatts (used across the whole study)

GWP BTM storage profiles simulated by this study (used across the whole study)

CA LDEV Shed Potential data from E3 2022 CPUC IRP DR study

From E3 CAISO DR ELCC study assuming 15 events per year and 1-hr max duration (approximating GWP Power Saving Program)

Exceptions:
- ***LDEV VGI**: excluded due to its relatively low deployment level projection in the near term*
- ***Energy Efficiency**: peak saving forecasts are available from the GWP IRP, which are assumed to already account for capacity contributions*



- ***LDEV:** Light-Duty Electric Vehicle*
- ***VGI:** Vehicle Grid Integration*

Can GWP reach 100 MW dispatchable and peak load reduction capacity by 2027?

Achieving 100 MW Additional DER by 2027:

- + Customer-owned solar and storage would provide reliable peak load reductions of 10 MW or less by 2027
- + Including other DERs such as demand response, managed electric vehicle charging, and energy efficiency could theoretically provide peak load reductions of 20-44 MW by 2027
- + **Effective Capacity:** requires approximately 200-300 MW customer solar, 40-60 MW customer battery storage, and other DERs by 2027
- + **Nameplate Capacity:** theoretically feasible with significant utility investment, suggest considering a MW nameplate capacity goal and a later target year

DER Contributions by 2027

DER	Nameplate Capacity (MW)	Approx. ELCC (%)	Effective Capacity (MW)
Customer Solar	39-70	0-7	0-5
Customer Storage	3-10	35-45	1-5
LDEV Managed Charging	50-55	28-38	14-21
Energy Efficiency	0-5	100*	0-5
Residential and C&I DR	8-12	68-78	5-9
Total MW	**100-152**		**20-44**

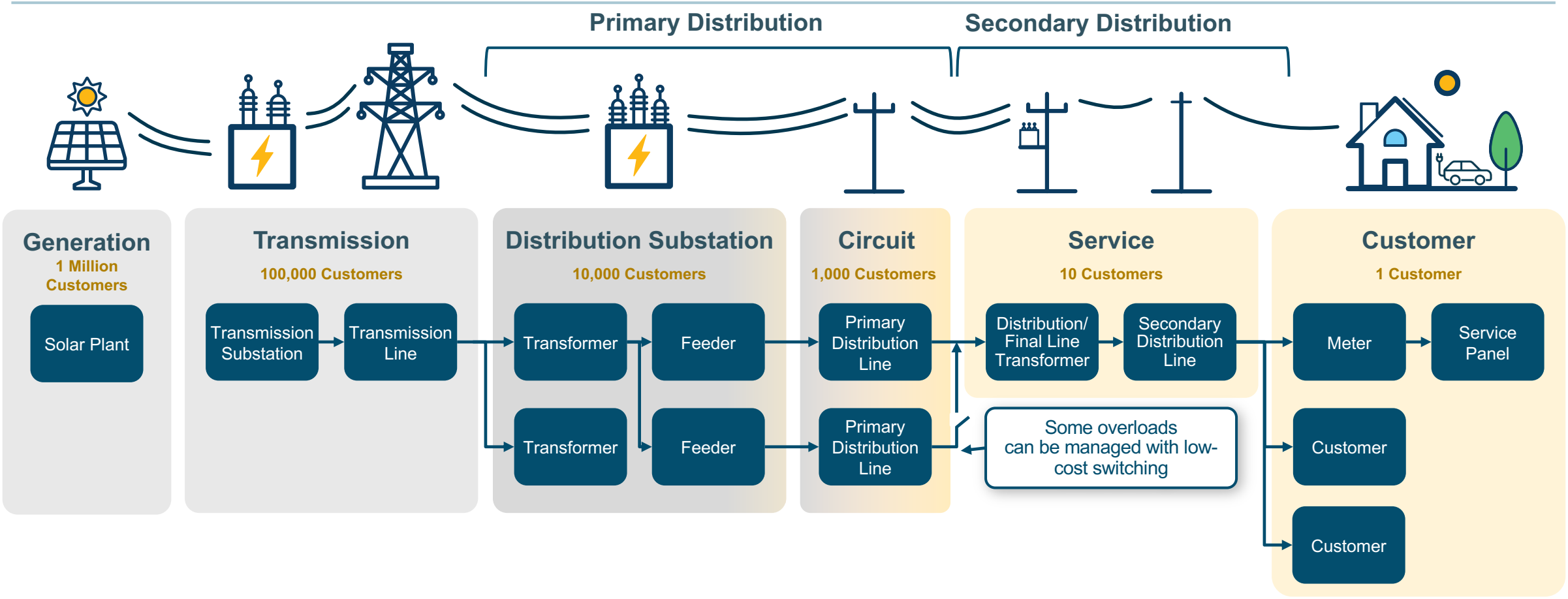
- Achieving 100 MW additional effective capacity, considering DER's ability to reduce GWP system peak demand, will require 200-300 MW DER nameplate capacity coming online by 2027.
- A more realistic target is achieving 100 MW additional DER nameplate capacity with a later target year.

** EE capacity here represents 'peak saving' forecast from GWP IRP, E3 assumes peak saving already accounts for capacity contributions (i.e. after ELCC adjustment)*

Section 6
Customized Avoided Costs for GWP

Energy+Environmental Economics

DERs have the potential to avoid several system costs



Increasing complexity of the electrical system requires a new approach to translate supply-side investments to avoided costs

+ Origin: 1978 Public Utilities Regulatory Policy Act (PURPA)

- Utilities must pay co-generators/qualifying facilities (QF) their 'avoided costs'
  - Avoided cost is the incremental cost of electric energy or capacity which, but for the purchase from the QF, a utility would generate itself or purchase from another source
  - Avoided costs analysis enables the quick evaluation of the costs or benefits of a particular action while avoiding more time-consuming, complex full planning analysis
- FERC outlines principles but gives each state the authority to determine its own approaches

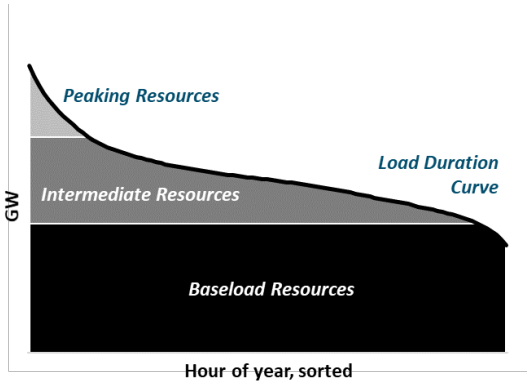
+ Separate from PURPA, many states turned to this concept to value Energy Efficiency and Demand Side Management

- The evolving electricity system makes this valuation more complex than it once was

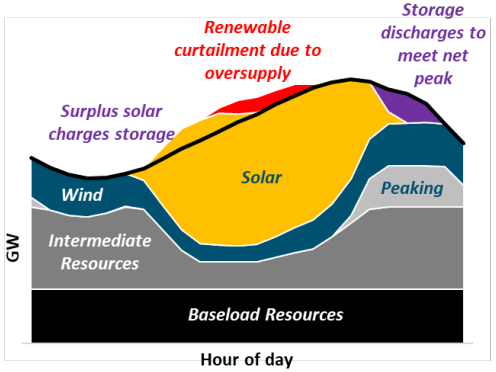
Avoided cost must evolve to reflect the value of DER for a low-carbon grid – a new planning paradigm

	Then	Now
Planning Targets	Reliability	Reliability and clean energy
Marginal Fixed Costs	Combined Cycle Gas Turbine Combustion Turbine	Wind, solar, and storage
Marginal Variable Costs & Emissions	Mostly fuel in all hours - high	Limited fuel needed for ramping and reliability - low or zero in most hours
Hourly Variability	Modest	Significant
Policy Goals	Encourage conservation	Encourage electrification

Supply Side



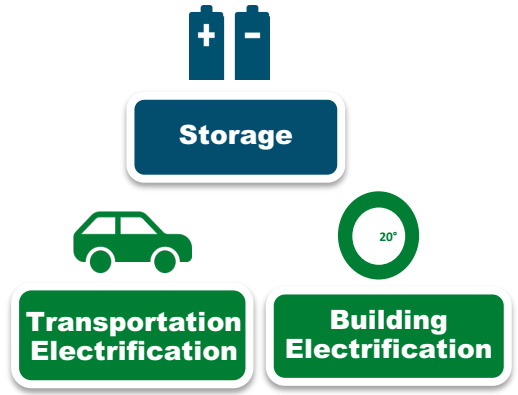
Peaking and baseload resources to meet reliability targets



Portfolio of resources selected to meet reliability, clean energy, and GHG targets

Demand Side

Load reducing, fixed shape resources



Load increasing, flexible shape resources

Principles of Avoided Cost Framework

Marginal

Marginal costs represent the costs that the utility avoids by installing a marginal unit of DER relative to the existing/planned portfolio. These costs serve as implicit and explicit price signals to achieve energy, reliability, and climate goals.

Long-Term

Long-term costs represent the long-run avoided costs of a DER over its lifetime, aligning with planning expectations for meeting long-term goals.

Technology Agnostic

These costs provide a single, flexible technology agnostic set of avoided costs that can be applied to all types of DERs.

- Load Reducing
- Load Shifting
- Load Increasing

Translating avoidable system costs to avoided cost components

Energy	Marginal cost to serve one MWh of load in each hour of the year
Generation Capacity	Marginal cost to add one kW of qualifying resource capacity to the system
Greenhouse Gas/Renewable	Marginal cost to reduce one ton of greenhouse gas (GHG) emissions and/or procure one Renewable Energy Credit (REC)
Transmission Capacity	Marginal cost to reduce one kW of transmission capacity needed to meet load growth
Distribution Capacity	Marginal cost to reduce one kW of distribution capacity needed to meet local load growth – true value is highly location-specific
Others	Monetized costs associated with losses, methane leakage, ancillary services, and others

Principles of calculating GWP avoided costs

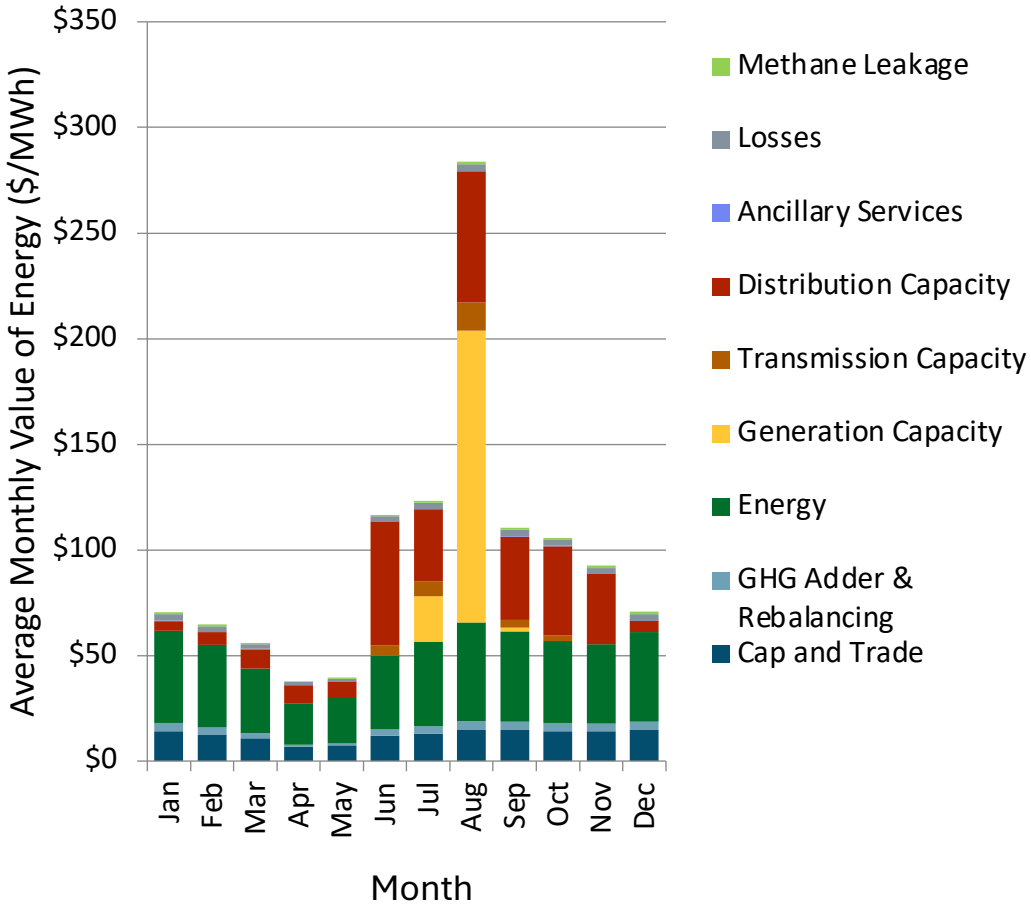
+ **Principle: ensure values were customized, defensible, and aligned with GWP's unique system plans and characteristics while avoiding a complete overhaul of avoided costs to save time and resources**

+ **Usage: avoided costs are used to quantify DER's benefits to GWP and as part of the Net Energy Billing (NEB) tariff**

+ **Approach: E3 calculated GWP avoided costs based on the CPUC 2022 Avoided Cost Calculator (2022 ACC) because…**
  - **Precedence**: GWP has previously used the CPUC ACC to evaluate energy efficiency programs, establishing a precedent.
  - **Versatility**: The hourly stream format of the CPUC ACC is adaptable for evaluating various DERs.
  - **Challenges with Alternatives**: Estimating proxy utility-scale resources for each DER can be difficult, especially for flexible resources and EVs.

2022 CPUC Avoided Cost Calculator

SCE CZ9 Monthly Average Avoided Costs in 2030



Common usage of the CPUC Avoided Cost Calculator (ACC) – the basis of GWP's avoided costs

+ **The CPUC Avoided Cost Calculator (ACC) is a simplified representation of the utility-integrated resource plan to answer:**
  - *Are Distributed Energy Resources (DER) more cost-effective than supply-side alternatives?*

+ **Energy Efficiency and Demand Response Evaluation**
  - Comparing the total cost of new efficiency measures to the marginal cost savings of the utility
+ **Self Generation Incentive Program (SGIP) Energy Storage Evaluation**
  - What ratepayer benefits and GHG reductions are being realized by behind-the-meter (BTM) energy storage?
+ **Building and Transportation Electrification**
  - Economic and GHG benefits of utility electrification programs
+ **Value of Solar**
  - Cost-shift to non-participating customers due to compensating BTM solar at the retail rate

NEM 3.0

+ **Rate Setting**
  - The ACC sets export compensation for prosumers

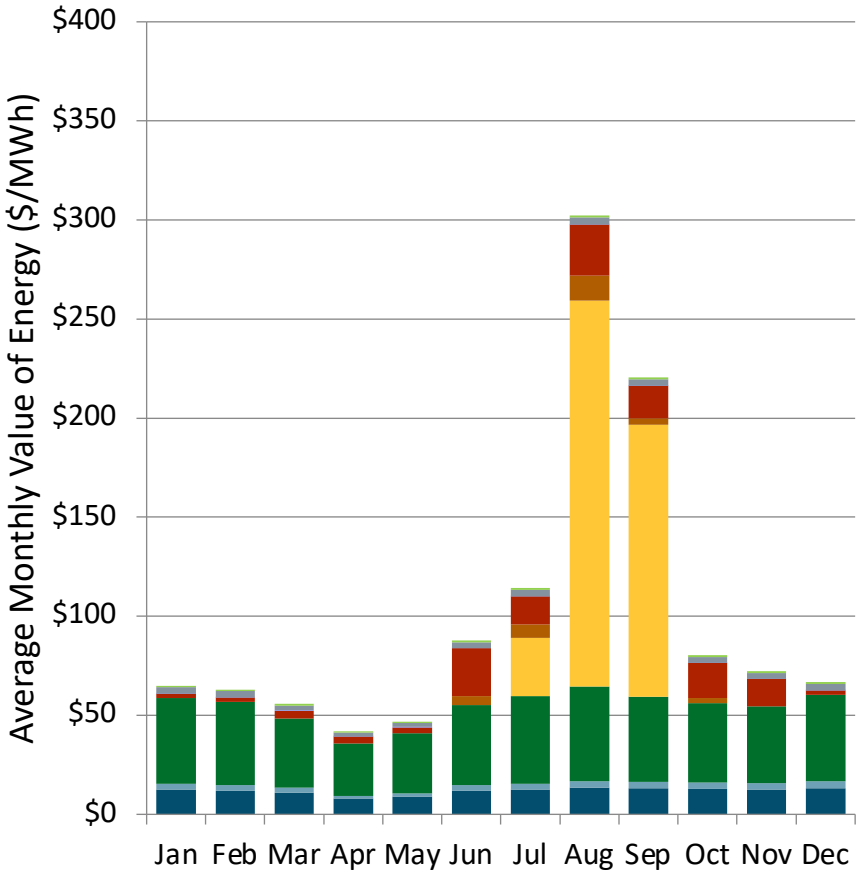
E3 updated four components tailored to GWP's systems

Components	2022 ACC Methodology	Updates for GWP
Generation Capacity	Assumed 4-hr storage is the marginal capacity resource and calculated the opportunity cost of deferring the investment by one year	Assumed various capacity resources by year according to the GWP IRP
Renewable/GHG	Escalated from the 2035 "shadow price" on the carbon constraint in RESOLVE (the IRP's capacity expansion model)	Removed the GHG adder component and added avoided RECs because GWP plans its system according to a Renewable Portfolio Standard and Clean Energy Standard while the CPUC IRP system is mainly driven by GHG reduction goals
Transmission Capacity	Provided by Southern California Edison	Assumed zero for GWP because GWP does not anticipate any change in its transmission upgrade regardless of DER adoption
Losses	From the CPUC IRP	Updated for GWP (7% transmission losses and 7% distribution losses)

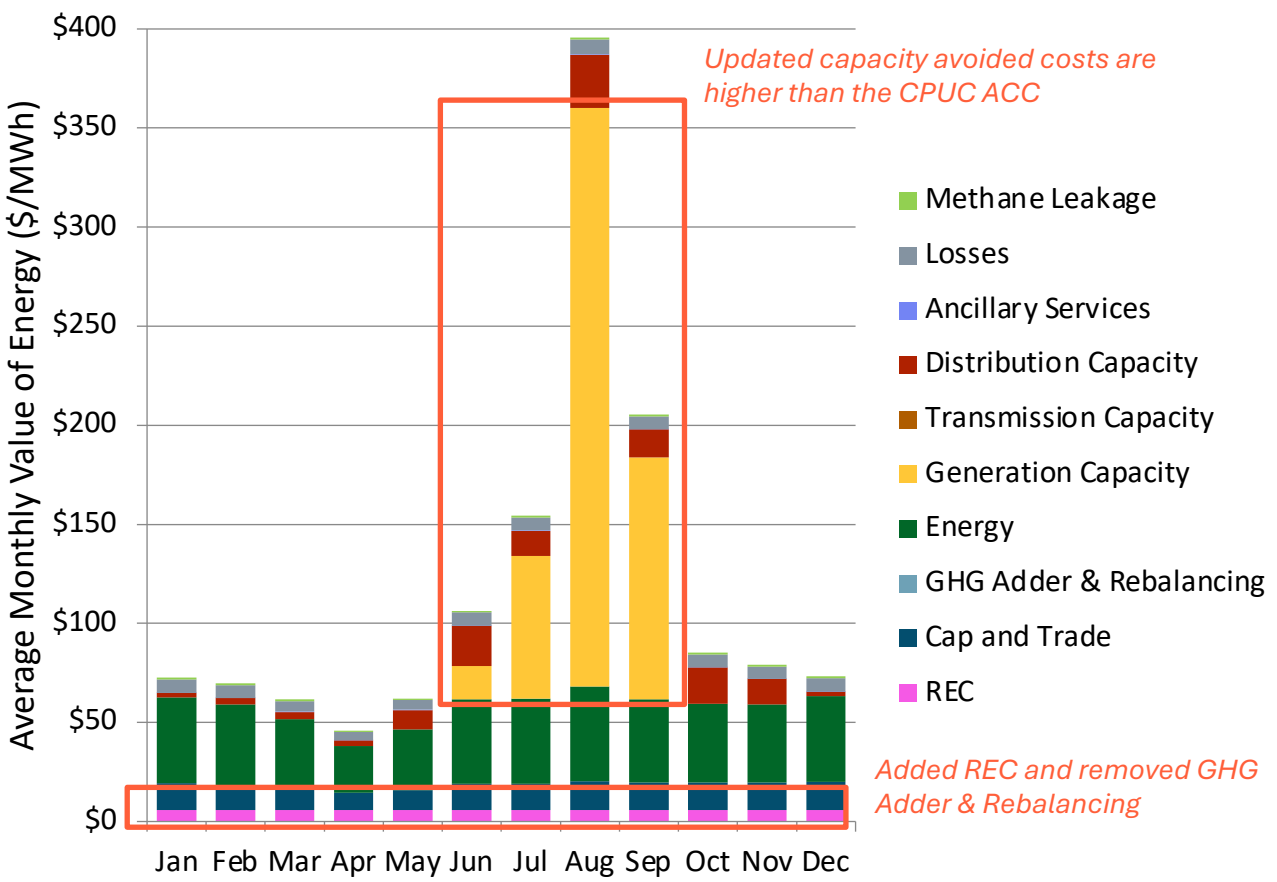
Energy, Distribution Capacity, Methane Leakage, and Ancillary Services were not updated due to a lack of detailed data. For example, GWP's IRP does not have hourly energy prices, which made it challenging to update energy avoided costs.

Result: total avoided costs for GWP are similar to the CPUC ACC

CPUC 2022 ACC
SCE CZ9 2027



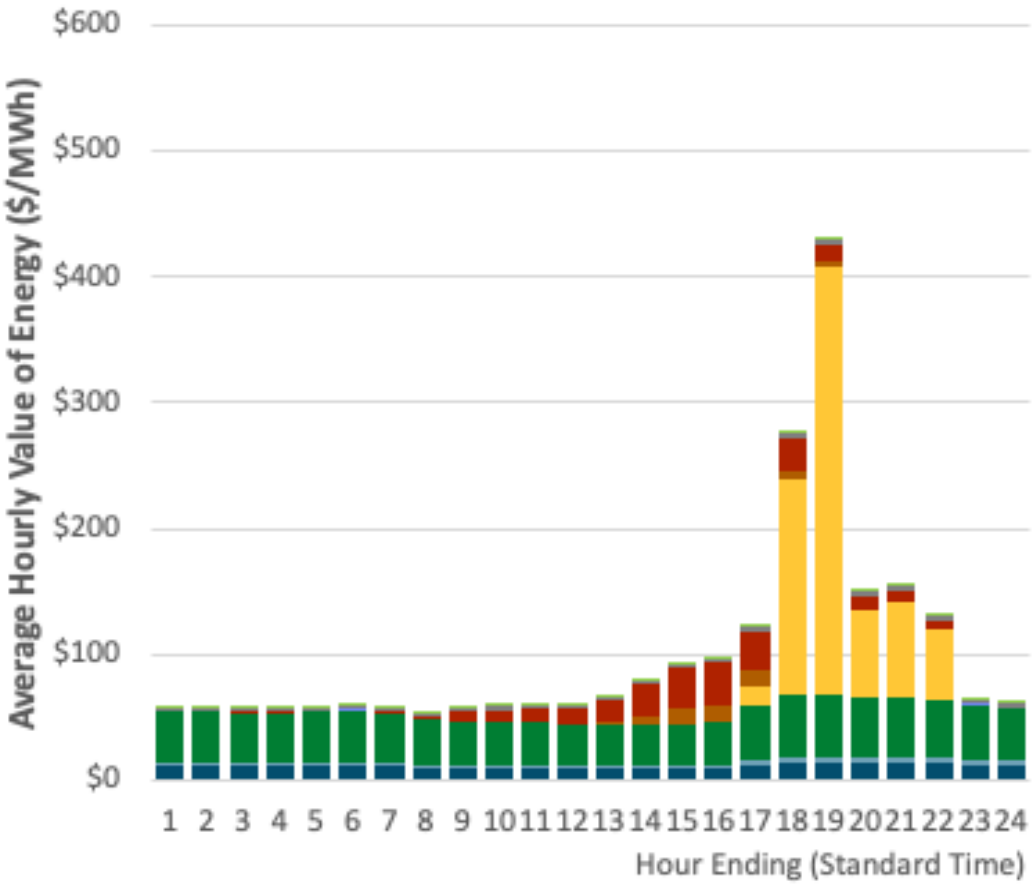
GWP Customized Avoided Costs
2027



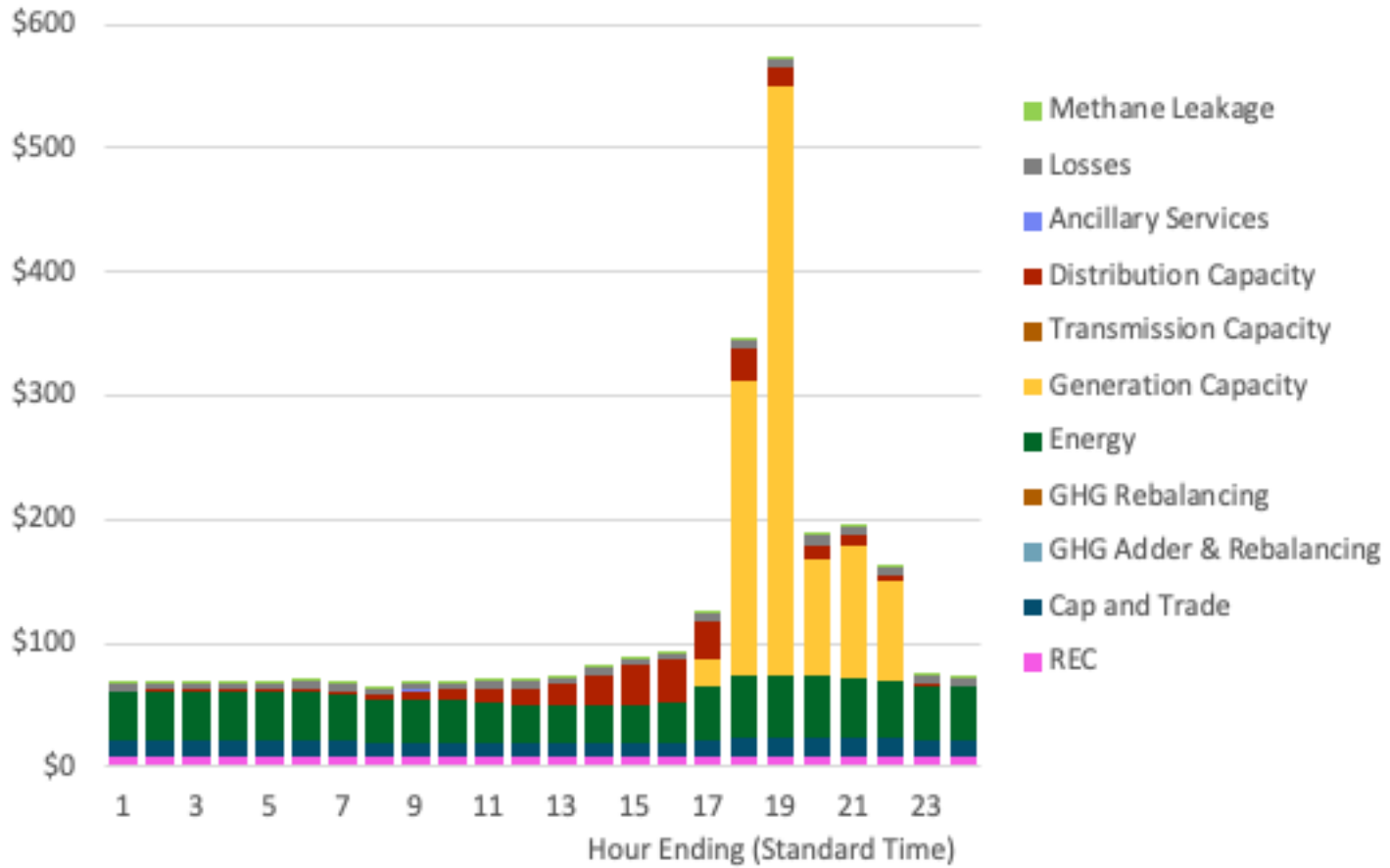
** The CPUC ACC is in 2020 calendar year while GWP avoided costs are in 2018 calendar year*

Result: total avoided costs for GWP are similar to the CPUC ACC

CPUC 2022 ACC
SCE CZ9 2027



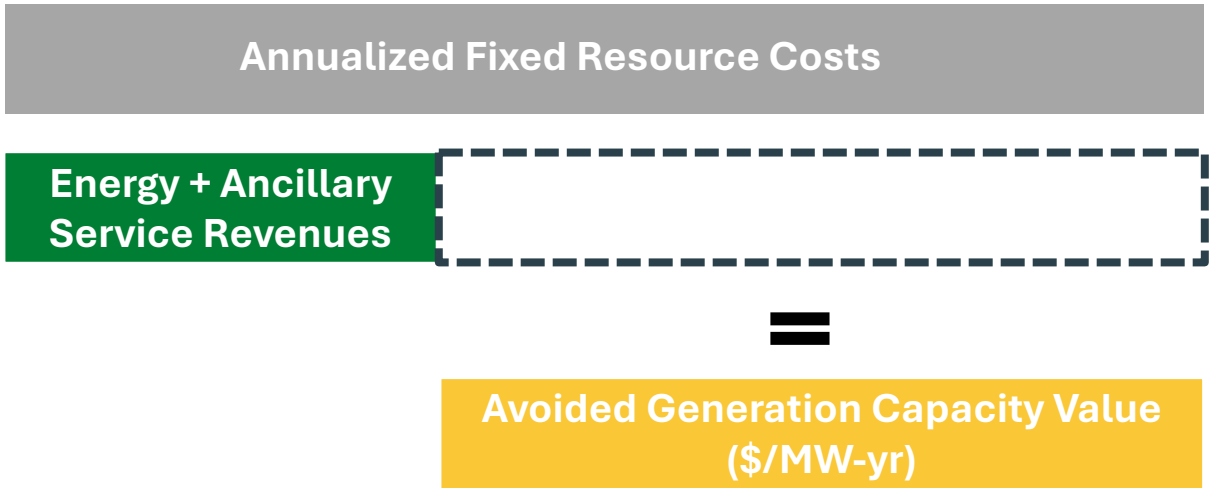
GWP Customized Avoided Costs
2027



Calculation of Generation Capacity Avoided Costs

- **The avoided cost of capacity reflects the net fixed cost of a new resource that would fulfill the capacity needs**
- **Avoided capacity costs were calculated as a "residual" of a given capacity resource, meant to reflect the fixed cost of a new resource that is not offset by margins from the energy market**
  - Also described as the "missing money"
- **E3 used Real Economic Carrying Charge (RECC) to derive generation capacity avoided costs for 4-hr storage, consistent with the 2022 ACC, with updated resource costs from GWP's IRP***
- **E3 calculated the Net Cost of New Entry of the re-powering gas plant and new hydrogen power plant, using GWP's IRP costs**

Calculation of Avoided Capacity Cost
$/kW-yr

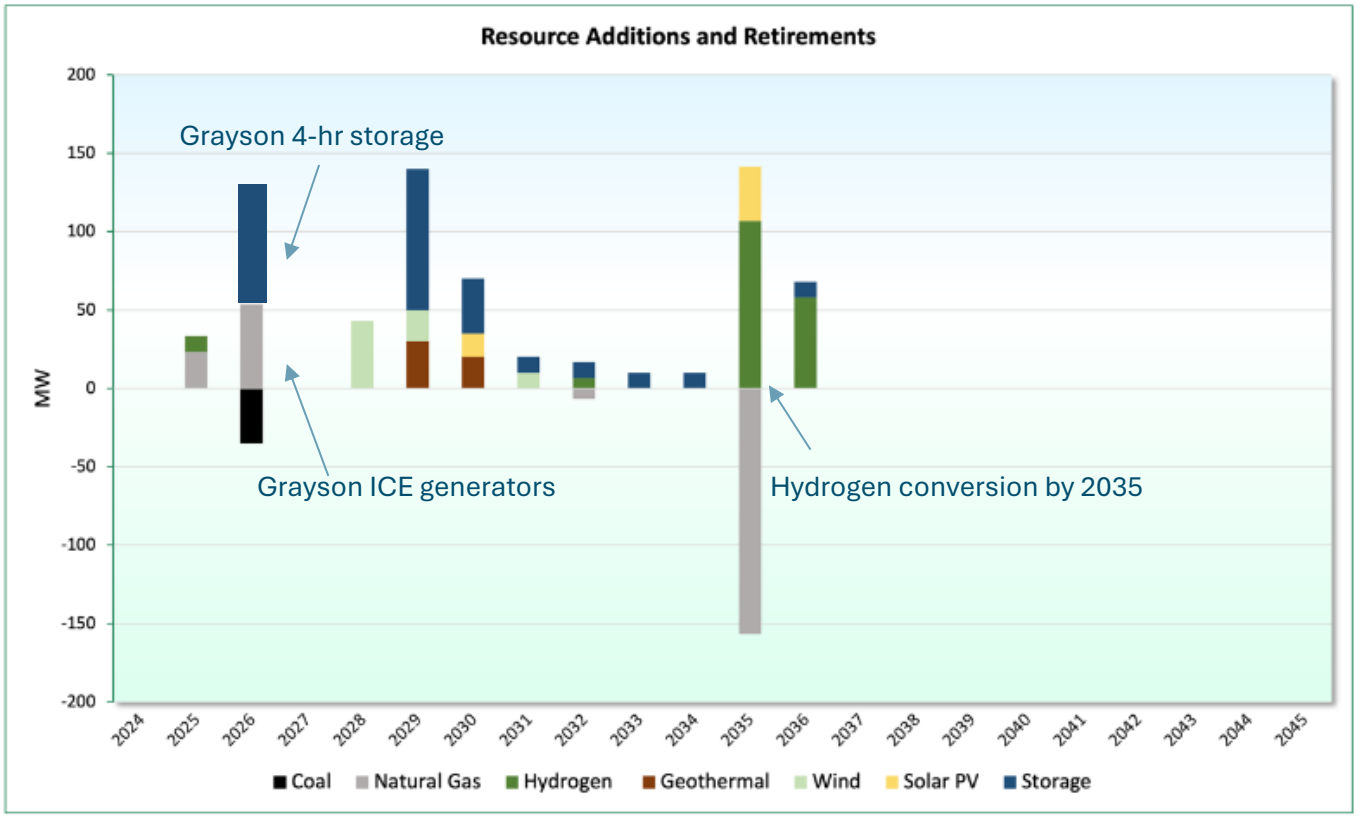


*For more details of the RECC method, see 2022 ACC documentation (pg. 38)

Ancillary service: a group of grid services for balancing electricity supply and demand in real-time and ensuring the smooth operation of the grid

E3 calculated capacity avoided costs assuming different capacity resources in different years

- **Capacity avoided costs were calculated assuming different marginal capacity resources in different years given the planned capacity resources in GWP's IRP.**
  - 2024-2025: re-powering of gas plant
  - 2026-2034: 4-hr storage
  - 2035 onward: hydrogen CT
- **Avoided capacity costs in 2024-2026 should technically be zero because GWP is currently building Grayson Repowering and battery storage, which cannot be avoided by DERs.**



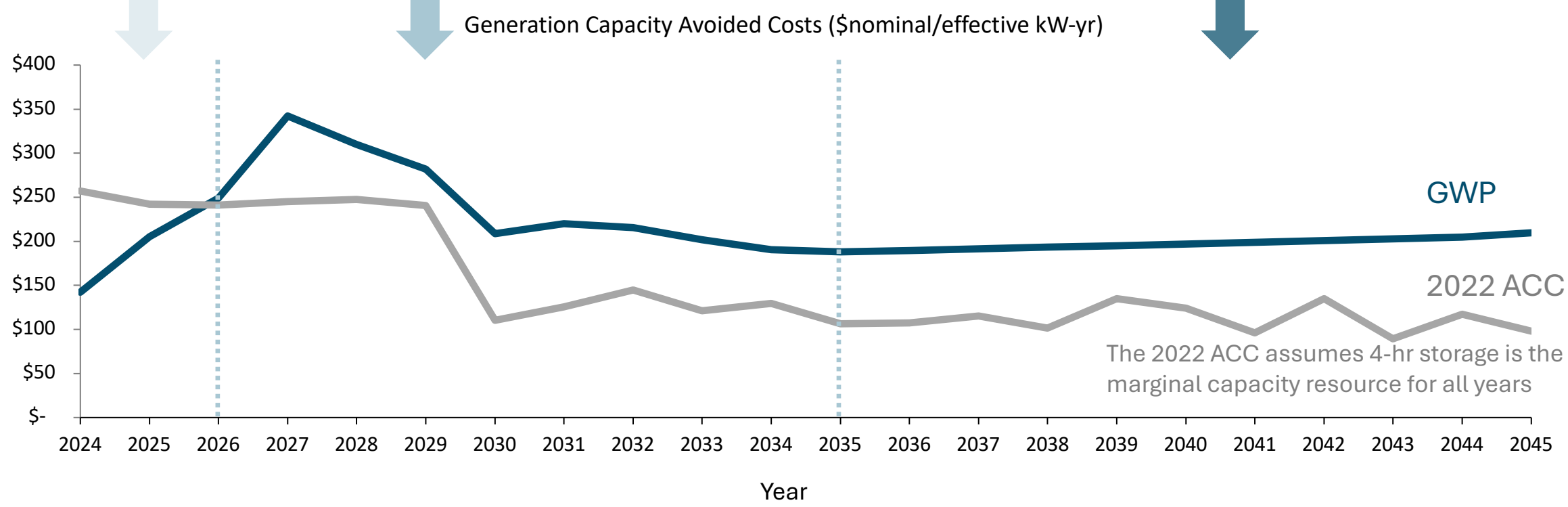
Source: GWP 2024 IRP

GWP's avoided capacity costs are higher than the 2022 CPUC ACC due to higher storage costs and hydrogen CT

GWP capacity avoided costs are low in the near-term because of low cost in gas plant repowering

GWP capacity avoided costs are higher than the 2022 ACC due to higher storage cost assumed in GWP's IRP

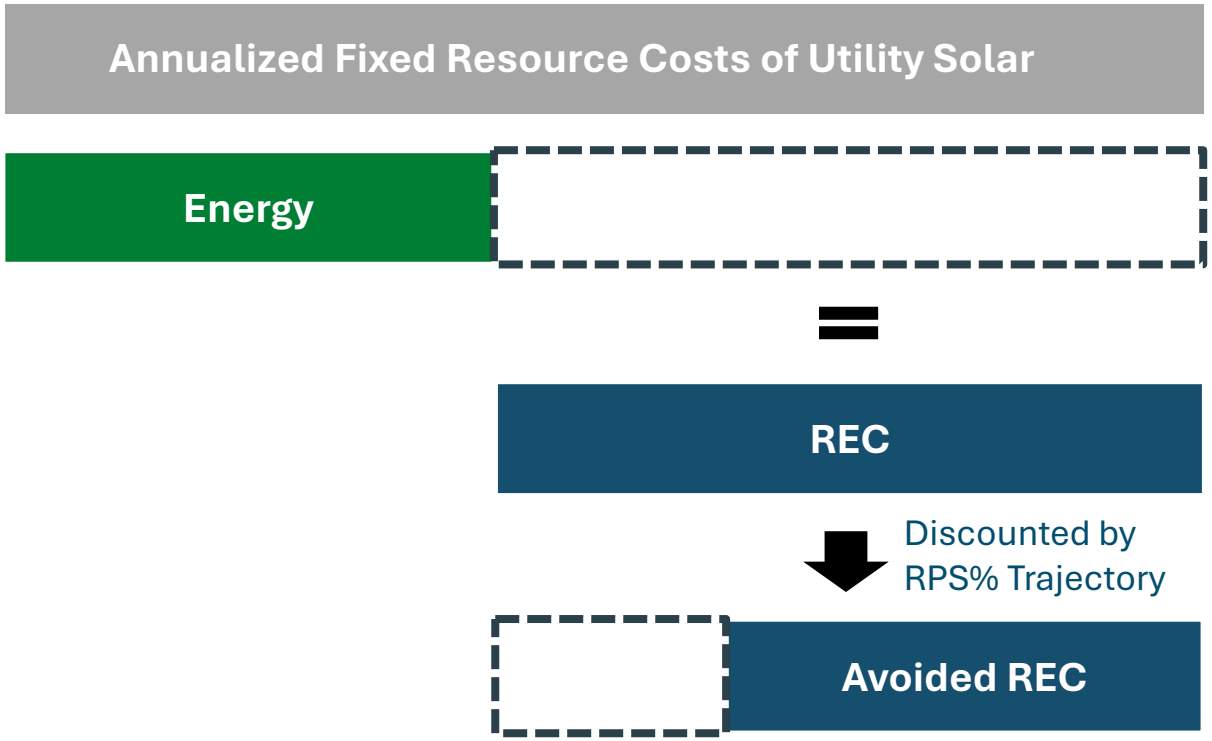
GWP capacity avoided costs stay high after 2035 because a hydrogen CT is assumed to be the marginal capacity resource



Calculation of Avoided Renewable Energy Credits (REC)

- E3 calculated avoided REC as the additional revenue needed beyond the energy market to cover levelized costs for new solar resources.
- Levelized costs for new solar are consistent with the GWP IRP and reflect higher solar PPA prices in the near term.
- Avoided REC are discounted by the RPS percentage. Given that GWP plans to serve 100% clean energy by 2035, the RPS is assumed to be 100% after 2035.
- The avoided REC is ~5$/MWh in the near term due to RPS discounting and increases over time as solar earns fewer energy revenues due to curtailment.

Calculation of Avoided REC
$/kW-yr



Section 7
Adoption and Impact Analysis

Energy+Environmental Economics

Section 7.1
Scenario Design Framework

Energy+Environmental Economics

Adoption and Impact Analysis

E3 employed the IDSM tool to assess the predicted adoption of distributed solar and storage according to several different scenarios with varying utility incentives and rate designs

- The scenarios were evaluated not only on whether they reached the 10% target but also on their ability to distribute the benefits of DERs equitably among more than a dozen different customer segments
- Bill savings, avoided costs, emissions, and other operation metrics were calculated in the model

The balance between affordability and adoption impact is a careful consideration when selecting program portfolios to ensure equitable growth

- IDSM modeling results enabled the E3 team to reveal the feasibility of achieving the 10% adoption target through a strategic combination of robust community outreach, utility incentives, and a rate design that encourages adoption while also mitigating ratepayer impacts

How we interpret the City Council's resolution is important

In August 2022, the Glendale City Council passed a resolution expressing their intent to adopt policies and practices aimed at achieving the goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027, and to develop additional demand management measures with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

At least 10% of GWP customers adopt solar and energy storage systems by 2027

Key Clarification Question: Which systems qualify for the 10% adoption target?

Possible Interpretations

- **Eligible systems include customer-sited solar, solar + storage, and/or standalone storage systems**
- **Achieve the resolution by December 31st, 2027**
- **Eligible GWP electric customer adoption includes:**

Expanded Eligibility Criteria

1. Rooftop solar owned, financed, or leased by single-family and commercial & industrial customers (one system for one electric customer)
2. Rooftop solar owned, financed, or leased by multi-family property owners/managers and commercial & industrial customers under virtual solar programs and shared among tenants and unit owners (one system for multiple electric customers)
3. Subscribers of off-site solar solutions like community solar, solar share, and green rate options (one project for numerous electric customers)

Develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW

Key Clarification Question: 100 MW nameplate or effective capacity?

Possible Interpretations

- **Achieve the resolution by December 31st, 2027**
- **Eligible demand management measures include solar, storage, electric vehicles, energy efficiency, and/or demand response (both load shedding and load shifting)**
- **Focused on additional measures and exclude existing capacity**
- **Peak dispatchable capacity: battery storage and EVs with bidirectional charging/discharging capability (V2G)**
- **Peak load-reducing capacity: solar, EV managed charging (V1G), energy efficiency, and demand response which either shave load during peak periods or shift load to off-peak periods**
- **Capacity measured by nameplate capacity or effective capacity (kW)**

- *In general, Effective Capacity = Nameplate Capacity * ELCC*
- *Effective Load Carrying Capability (ELCC) measures a resource's contribution to reliability based on the incremental quantity of load that can be satisfied by adding the resource to the grid*

Qualitative screening analysis prioritizes program and policy options crucial for achieving City Council targets over others

+ Program proposals ranked by overall qualitative performance
+ Reasonable DER compensation levels that mitigate cost shifts are preferred

Priority Level

Program Ideas	Involved Technologies	Overall Priority	Low Administrative Cost	Correctly Values DER Compensation	Program Matureness	Promote Adoption (Solar/Storage Penetration)	Promote Adoption (DER Capacity)	Ease of Implementation
Outreach, Education, & Support	All	High	High	None	High	High	High	High
Net Metering	Solar, Storage	High	High	Low	High	High	High	Mid
Base Rebate	Solar, Storage	High	Mid	Low	High	High	High	High
Net Billing	Solar, Storage	High	High	High	Mid	Mid	Mid	Mid
Community Solar	Solar, Storage	High	Mid	High	Mid	High	Mid	Mid
Streamline Permitting Process	Solar, Storage	High	Mid	None	Mid	High	High	Mid
Feed-in Tariff	Solar	High	Mid	High	High	Low	High	Mid
VNEM	Solar, Storage	High	Mid	Low	Mid	High	Mid	Mid
Performance-based Incentive	Storage	Mid	Low	High	Mid	Mid	Mid	Mid
Load Shedding DR	All	Mid	Mid	High	High	Low	Low	Mid
TOU	All	Mid	Low	None	High	Mid	High	Low
Buy-all, Sell-all	Solar, Storage	Low	High	High	Low	Low	Low	Mid
VPP	All	Low	Low	High	Low	Low	Mid	Low
Load Shifting DR	All flexible loads	Low	Low	High	Low	Low	Mid	Low
VGI	EVs	Low	Low	High	Low	None	Low	Low

Section 7.2
Scenario Design Framework

Energy+Environmental Economics

The adoption scenarios represent theoretical upper bounds of how much adoption we can expect

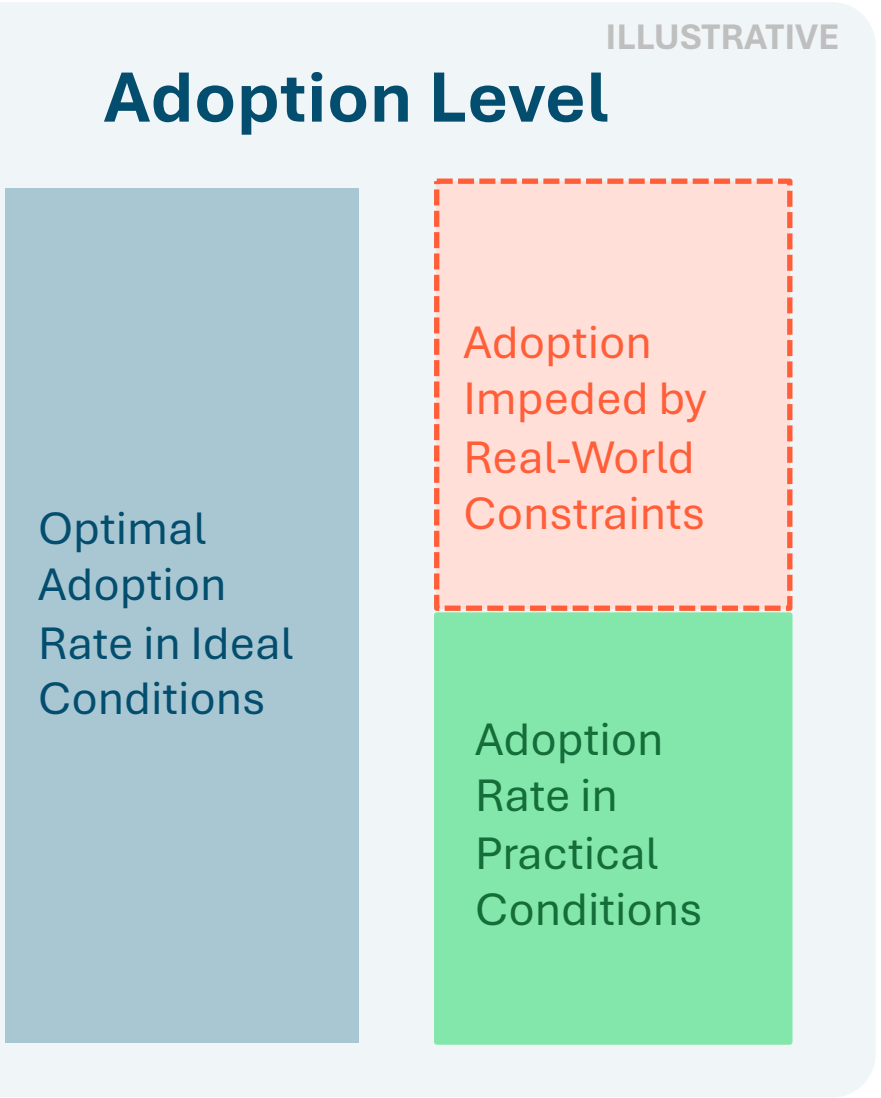
E3 developed best-case scenarios for evaluating the theoretical feasibility of achieving adoption targets.

- While E3 aimed to account for consumer decision-making across different customer groups and the split incentive issue for renters, these methods fall short of fully capturing the broad range of financial and non-economic barriers that households face in adopting DERs. The scenarios represent an upper bound of what is possible if these barriers were mitigated.
- The study assumes perfect implementation from GWP providing additional utility support and improved access for renter and LMI customers. Other real-world barriers and constraints that naturally exist regarding admin costs, admin resources, pace of program delivery, community participation rate, etc., are not considered.
- The Cost and Benefit Analysis section of this report provides a more comprehensive view of costs and benefits, examining direct and indirect economic benefits and costs as well as environmental, societal, and other non-economic benefits and costs.

When interpreting these results in a real-world context, several considerations must be made.

- The adoption level will be further limited by how much progress GWP can make on providing solutions for renters and LMI customers and for improving community outreach, support, and permitting processes.
- Correspondingly, E3 expects utility program costs to be higher because additional incentives must be imposed to fill in the gap of adoption shortfall.

ILLUSTRATIVE



E3 evaluated four program scenarios to identify target feasibility and show trade-offs in adoption, equity, and costs

Scenario 1: Continue NEM

Scenario 2: Targeted LMI/DACs & MF Adoption

Scenario 3: Balanced

Scenario 4: Widespread Adoption

Program & Incentive Design

- **NEM Compensation**
- **Additional Incentives**

Address Additional Barriers

- **Access for Renter and LMI Customers**
- **Provide More Utility Support**

Various adoption scenarios capture multifaceted programs targeting various property types and communities

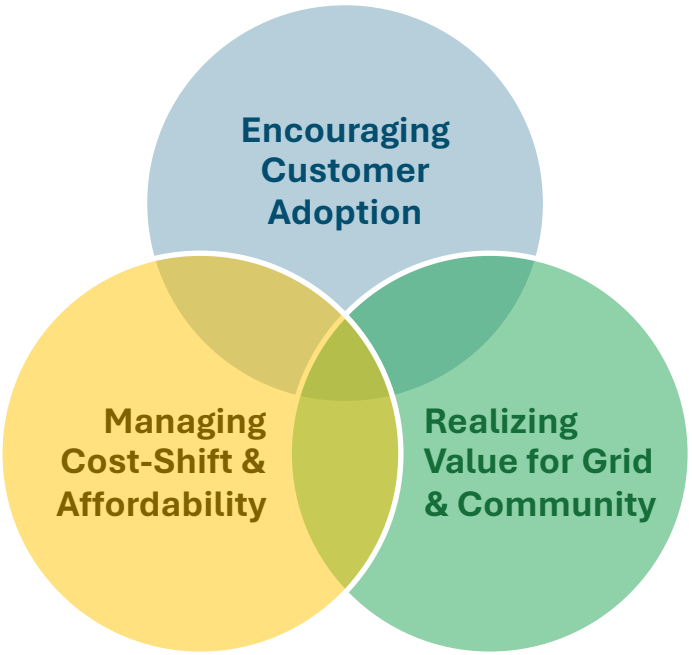
Each scenario features a portfolio of programs, including some combination of customer solar and storage billing compensation mechanisms, additional utility incentives, other utility support, etc.

Scenarios are guided by values from stakeholders, policy, and GWP, and for each scenario the proposed program portfolio was scored on how well it captured each value from multiple perspectives.

S0 and S5 represent bookend scenarios derived from standalone, simplified back-of-envelope calculations, intended to provide a broad estimate of magnitude.

No.	Scenarios	Narrative & Philosophy
0	Business as Usual	Reflects current GWP policies at business-as-usual conditions without any additional incentive programs or other utility support.
1	Continue Current NEM	Reflects current NEM policies without new incentive programs, but with improved outreach, support, and improved permitting processes.
2	Targeted MF LMI Adoption	Aims to reach as much adoption as possible while maintaining high standards for equitable implementation. Focuses on minimal cost shifting and promotes MF LMI/DAC adoption via direct install programs.
3	Balanced	Aims to reach a balance between S2 and S4, with a focus on increasing customer adoption while reducing cost shifting potential, supplemented with MF LMI/DAC upfront incentives as needed.
4	Widespread Adoption	Aims to reach adoption goal with an emphasis on customer-sited solar and storage. Focuses on maximizing adoption with supplemental upfront incentives as needed.
5	Direct Install	Serves as a high-cost bookend under which GWP direct installs up to 10% of customer with solar. Emphasis on MF properties (lower cost per customer) and adoption in LMI/DACs.

Balancing Multiple Objectives



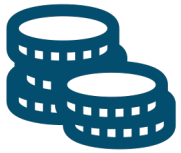
The scenarios outline different pathways towards Glendale's DER adoption target

		NEM Compensation	Additional Incentives*	Renter and LMI Customer Barriers	Other Utility Support
Reference	**S0** Business as Usual	Net energy metering at retail rates	Federal and state	Persist	At the Current Level
Evaluate Adoption Strategies	**S1** Continue Current NEM	Net energy metering at retail rates	Federal and state	Persist	Optimistic outlook on enhanced community outreach and support, along with improved permitting processes starting early 2025
	S2 Targeted LMI MF Adoption	Net energy billing at avoided costs	Federal and state, utility direct install for LMI/DAC MF customers	Optimistic outlook for providing renter and LMI customer solutions starting early 2025	
	S3 Balanced	Net energy billing above avoided costs but below retail rates	Federal and state, 7-yr payback utility incentive for LMI/DAC MF buildings		
	S4 Widespread Adoption	Net energy metering at retail rates	Federal and state, 5-yr payback utility incentive for all MF customers		
Hypothetical Feasibility	**S5** Direct Install	Net energy metering at retail rates	Federal and state, and direct install for MF renter LMI/DAC customers	Persist	At the Current Level

Additional incentives is a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP. Assuming receipt of GWP incentives requires customers dispatch battery storage against utility signals to maximize community benefits.

Assumptions on Additional Incentives and Solutions for Renter and LMI Customers

Additional incentives modeled are a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP



- Assuming receipt of GWP incentives requires customers to dispatch battery storage against utility signals to maximize community benefits

Assume renter and LMI access can be provided with virtual solar or other financing solutions starting early 2025

- In practice, real-world solutions to explore later may include on-bill financing options, green leases, and off-site solar solutions like community solar, solar share, green rate, and virtual net metering, all of which are pivotal for cost reduction and broadening access to multi-family, low-income, or tenant households

Clarifying Assumptions in Modeling the Resolution of Split Incentives

+ **To distinguish consumer decision-making among different household types, E3 assigned varying discount rates (investment hurdle rates) based on income levels and customer sectors, accounting for the frictions to DER adoption.**
  - Higher discount rates (16%) were assigned to Multifamily, C&I, and LMI customers, while other customers received a 7% rate (normal discount rate assumption in this study), determined based on historical solar and storage adoption in the City of Glendale.
  - These rates were applied solely to distinguish consumer adoption behavior in the adoption model and were not used in the downstream cost-benefit analysis.
+ **Specifically, renters and multifamily households may encounter a "split incentive" issue, where tenants who benefit from bill savings do not control the rooftop, and building owners who make upgrades don't directly benefit from utility savings. There is no existing work to mathematically characterize split incentives; therefore, to model the effect of split incentives on adoption, two scenarios were considered:**
  - **Split Incentives Fully Resolved:** Renters are assumed to behave similarly to owners, leading to the application of the same discount rate for both groups.
  - **Split Incentives Persist:** Renters are assumed to have a significantly higher discount rate (100%), effectively preventing the adoption of solar and storage systems in rental units.
+ **For this study, E3 focused on quantifying the impact of resolving split incentives on DER adoption, rather than evaluating the effectiveness of specific solutions. In practice, solutions for addressing split incentives between owners and tenants typically involve programs designed to realign financial incentives for energy measures (details in the *Potential Program and Policy Options* section).**

E3's approach draws on methodologies established in NREL studies[1, 2], which were further tailored to fit the specific needs of the analysis.

Building Type	Ownership Status	Income Class	Discount Rate *(Split Incentives Fully Resolved)*	Discount Rate *(Split Incentives Persist)*
Single-Family	Owner	LMI	16%	16%
Single-Family	Owner	Non-LMI	7%	7%
Single-Family	Tenant	LMI	16%	100%
Single-Family	Tenant	Non-LMI	7%	7%[3]
Multi-Family Low-Rise	Owner	LMI	16%	16%
Multi-Family Low-Rise	Owner	Non-LMI	16%	16%
Multi-Family Low-Rise	Tenant	LMI	16%	100%
Multi-Family Low-Rise	Tenant	Non-LMI	16%	100%
Multi-Family High-Rise	Owner	LMI	16%	16%
Multi-Family High-Rise	Owner	Non-LMI	16%	16%
Multi-Family High-Rise	Tenant	LMI	16%	100%
Multi-Family High-Rise	Tenant	Non-LMI	16%	100%
C&I Small	Owner	N/A	16%	16%
C&I Small	Tenant	N/A	16%	100%
C&I Medium	Owner	N/A	16%	16%
C&I Medium	Tenant	N/A	16%	100%
C&I Large	Owner	N/A	16%	16%
C&I Large	Tenant	N/A	16%	100%

1. *"Chapter 8: Equitable Rooftop Solar Access and Benefits." In LA100 Equity Strategies, National Renewable Energy Laboratory. NREL/TP-7A40-85955. https://www.nrel.gov/docs/fy24osti/85955.pdf.*
2. *Affordable and Accessible Solar for All: Barriers, Solutions, and On-Site Adoption Potential. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-80532. https://www.nrel.gov/docs/fy21osti/80532.pdf.*
3. *The adjusted discount rate for split incentives applies to all renters except non-LMI single-family tenants, due to their historically high adoption rates.*

Section 7.3
Key Model Results

Energy+Environmental Economics

Key Results: Bill Savings and Utility Incentive Levels by Scenario

Variations in customer segments may lead to a range of outcomes

		NEM Compensation	2025 Level ($/kWh)	Additional Incentives*	2025 Level ($/W)
Reference	**S0** Business as Usual	Net energy metering at retail rates	0.13-0.28 0.00	Federal and state	0.00 0.00
Evaluate Adoption Strategies	**S1** Continue Current NEM	Net energy metering at retail rates	0.13-0.28 0.00	Federal and state	0.00 0.00
	S2 Targeted LMI MF Adoption	Net energy billing at avoided costs	0.09-0.19 0.08-0.28	Federal and state, utility direct install for LMI/DAC MF customers	2.6 1.65
	S3 Balanced	Net energy billing above avoided costs but below retail rates	0.11-0.22 0.06-0.25	Federal and state, 7-yr payback utility incentive for LMI/DAC MF buildings	1.3-1.5 1.4-1.5
	S4 Widespread Adoption	Net energy metering at retail rates	0.13-0.28 0.00	Federal and state, 5-yr payback utility incentive for all MF customers	1.0-1.2 1.7-1.8
Hypothetical Feasibility	**S5** Direct Install	Net energy metering at retail rates	N/A N/A	Federal and state, utility direct install for all MF renter LMI/DAC customers	N/A N/A

**Additional incentives is a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP. Assuming receipt of GWP incentives requires customers dispatch battery storage against utility signals to maximize community benefits.*

Key Results: Adoption Level, Equity, and Key Observations by Scenario

These adoption scenarios represent the best-case adoption forecast

		NEM Compensation	Additional Incentives*	Renter and LMI Customer Barriers (Split Incentives)	Other Utility Support	2027 Customer Adoption	2027 Equity & Access	Key Observations
Reference	**S0** Business as Usual	Net energy metering at retail rates	Federal and state	Persist	At the Current Level	5.2 % 39 MW 0.8 % 3 MW	MF Renter LMI 5% 12% 11% 0% 11% 11%	To achieve the goal, utility interventions are necessary to accelerate and further promote adoption.
Evaluate adoption strategies	**S1** Continue Current NEM	Net energy metering at retail rates	Federal and state	Persist	Optimistic outlook on enhanced community outreach and support, along with improved permitting processes starting early 2025	9.6 % 60 MW 1.5 % 5 MW	MF Renter LMI 10% 10% 16% 13% 22% 18%	Enhancing utility support alone can boost solar adoption to reach 10% adoption by 2030 without further utility interventions, but has limited impact on promoting battery storage adoption.
	S2 Targeted LMI MF Adoption	Net energy billing at avoided costs	Federal and state, utility direct install for LMI/DAC MF customers	Optimistic outlook for providing renter and LMI customer solutions starting early 2025		11.6 % 58 MW 2.7 % 7 MW	MF Renter LMI 44% 46% 42% 56% 58% 54%	Utility incentives and virtual solar solutions are needed in reaching the adoption target along with improving utility support. Positive but still limited impact on storage adoption.
	S3 Balanced	Net energy billing above avoided costs but below retail rates	Federal and state, 7-yr payback utility incentive for LMI/DAC MF buildings			11.8 % 59 MW 2.1 % 6 MW	MF Renter LMI 41% 43% 37% 55% 59% 54%	Improving NEM equity with reasonable upfront incentives for MF LMI/DAC customers could also work, if implemented along with improving utility support. Positive but still limited impact on storage adoption.
	S4 Widespread Adoption	Net energy metering at retail rates	Federal and state, 5-yr payback incentive for all multifamily customers			15.8 % 70 MW 2.0 % 6 MW	MF Renter LMI 51% 52% 40% 72% 67% 47%	Maintaining current NEM with strong (lower but broader) upfront incentives for all MF customers could also work, if implemented along with improving utility support. Positive but still limited impact on storage adoption.
Hypothetical Feasibility	**S5** Direct Install	Net energy metering at retail rates	Federal and state, and direct install for all MF renter LMI/DAC customers	Persist	At the Current Level	10.0 % 48 MW 10.0 % 10 MW	MF Renter LMI 51% 54% 53% 92% 93% 93%	Targeted direct install alone could work as an adoption goal compliance measure, but with significant utility investment (huge cost premium compared with lower-cost utility-scale alternatives) .

**Additional incentives is a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP. Assuming receipt of GWP incentives requires customers dispatch battery storage against utility signals to maximize community benefits.*

Key Results: Additional Key Observations by Scenario

Variations in customer segments may lead to a range of outcomes

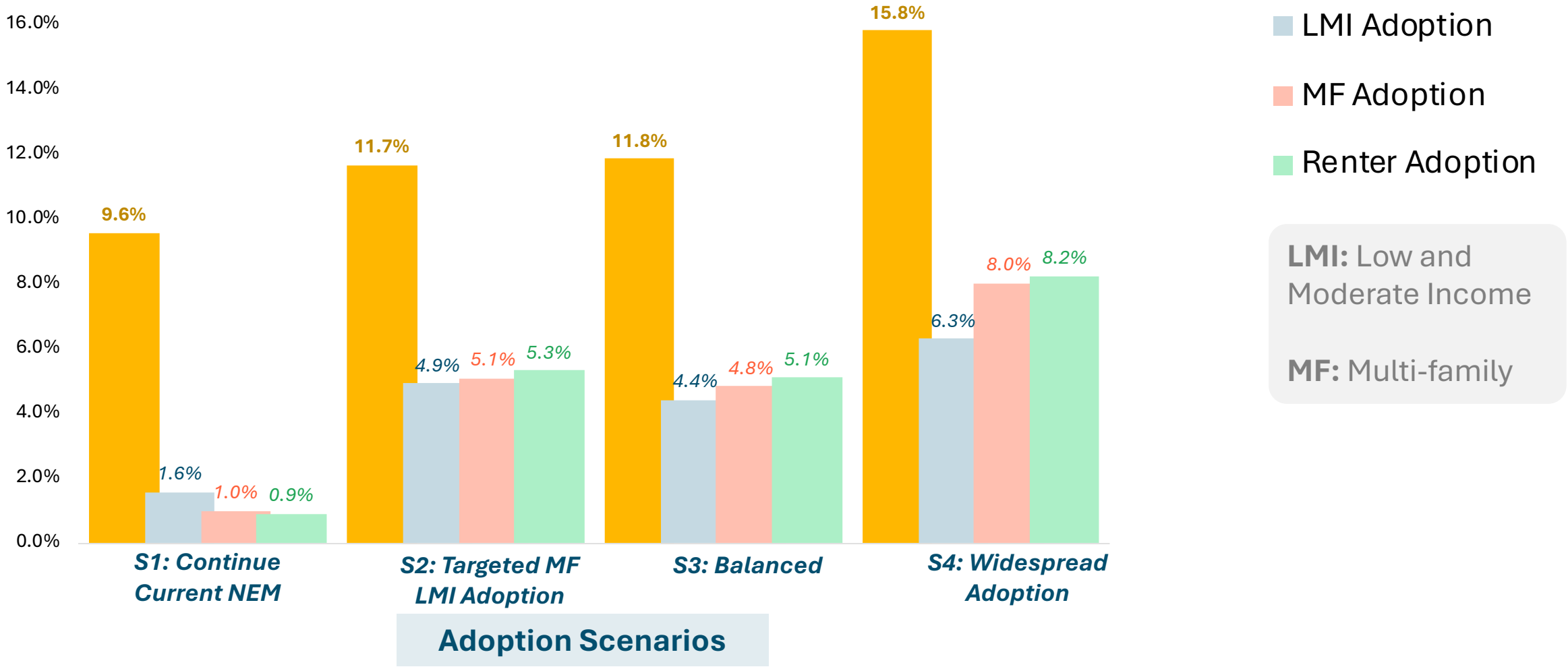
		Solar	Storage
Reference	**S0** Business as Usual	At the current annual adoption rate, solar adoption is projected to reach 5.2% under business-as-usual conditions and achieve 7.4% by 2030. To achieve the goal, utility interventions are necessary to accelerate and further promote adoption.	At the current annual adoption rate, solar adoption is projected to reach 0.8% under business-as-usual conditions and achieve 2.0% by 2030. To achieve the goal, utility interventions are necessary to accelerate and further promote adoption.
Evaluate Adoption Strategies	**S1** Continue Current NEM	Enhancing customer outreach and support and simplifying the permitting process can boost adoption. Without further utility interventions, adoption may fall short of the 2027 target, but it would be enough to reach 10% adoption by 2030.	Enhancing customer outreach and support and simplifying the permitting process alone has limited impact on promoting adoption, mainly due to the poor economic performance of adding battery storage systems to customer solar.
	S2 Targeted LMI MF Adoption	Utility interventions to provide additional utility support and incentives and increase access for renter and LMI customers are needed to reach the adoption target. Unlocking adoption potential from the MF sector creates opportunities to maximize the equity of the current net metering mechanism, with co-benefits of increasing the cost-effectiveness of storage additions to customer solar systems.	Additional utility incentives through direct install programs, coupled with the enhanced value proposition under NEB, promote greater adoption of customer storage (mostly SF households). Storage adoption remains insufficient to meet the adoption target by 2027, and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.
	S3 Balanced	Improving NEM equity with reasonable upfront incentives for MF LMI/DAC customers could also help reach the target, if implemented along with improving customer outreach, support, and the permitting process.	Additional utility incentives through upfront incentives promote greater adoption of customer storage (mix of SF/MF households). While the attachment rate of storage to solar systems falls within the average range, it remains insufficient to meet the adoption target by 2027, and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.
	S4 Widespread Adoption	Maintaining current NEM policies with strong (lower but broader) upfront incentives for all MF customers could also help reach the target, if implemented along with improving customer outreach, support, and the permitting process.	Additional utility incentives through upfront incentives promote greater adoption of customer storage (mostly MF households). While the attachment rate of storage to solar systems falls within the average range, it remains insufficient to meet the adoption target by 2027, and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.
Hypothetical Feasibility	**S5** Direct Install	N/A	N/A

**Additional incentives is a general representation of all types of incentives including potential upfront incentives and performance-based incentives offered by GWP. Assuming receipt of GWP incentives requires customers dispatch battery storage against utility signals to maximize community benefits.*

2027 Customer Adoption by Scenario – Solar

Including solar-only and solar + storage systems, cumulative adoption by 2027

Solar Adoption (% of Total GWP Electric Customers)



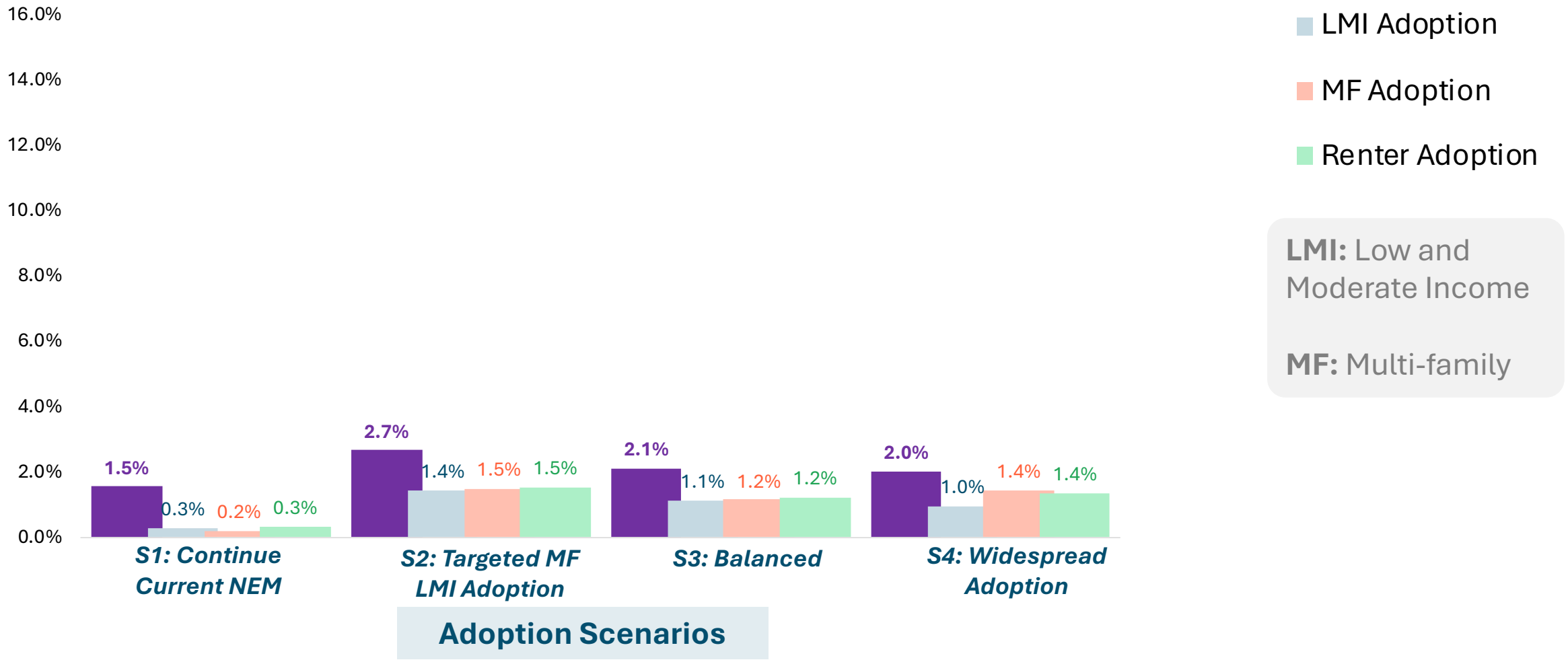
LMI: Low and Moderate Income

MF: Multi-family

2027 Customer Adoption by Scenario – Battery Storage

Including solar + storage systems, cumulative adoption by 2027

Battery Storage Adoption (% of Total GWP Electric Customers)



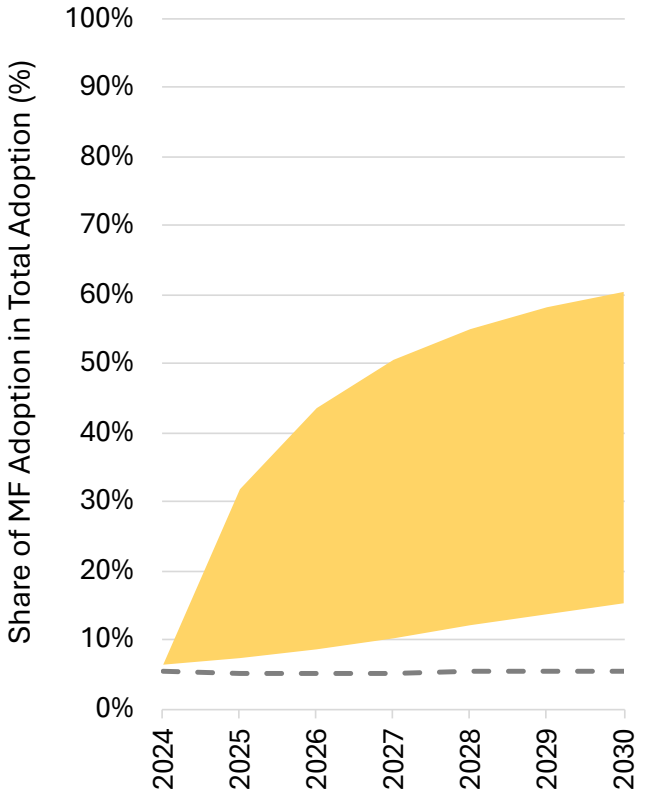
LMI: Low and Moderate Income

MF: Multi-family

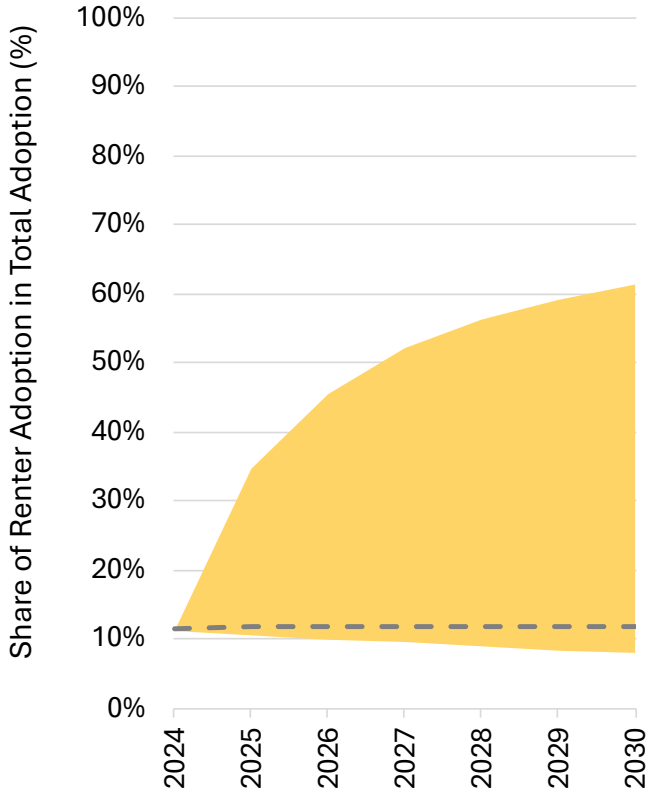
Most of the examined adoption-accelerating program portfolios increase solar access

- The share of customer solar adoption attributed to multifamily, renter, or LMI customers increases in most adoption scenarios due to enhanced utility support, enhanced options for renter and LMI customers, improved net metering compensation, and targeted additional incentives

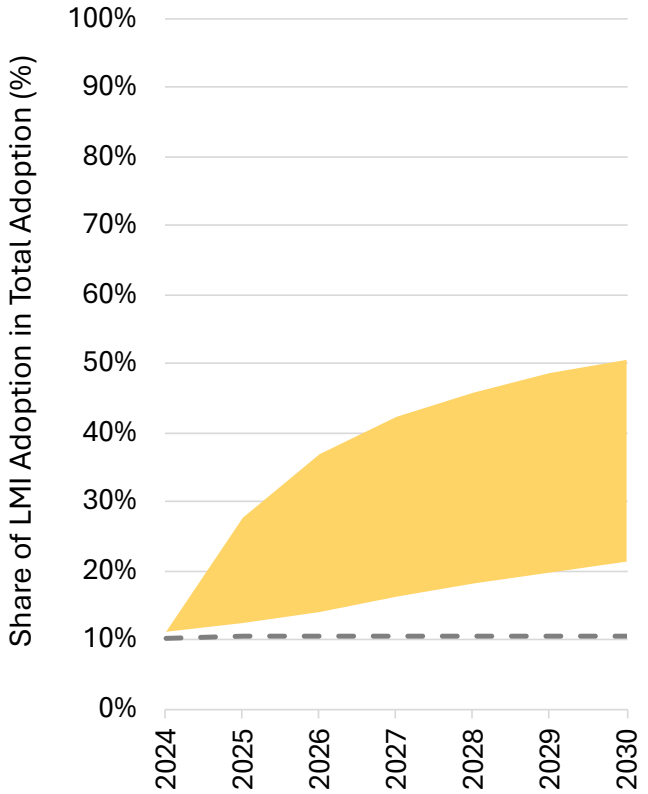
Multifamily %



Renter %



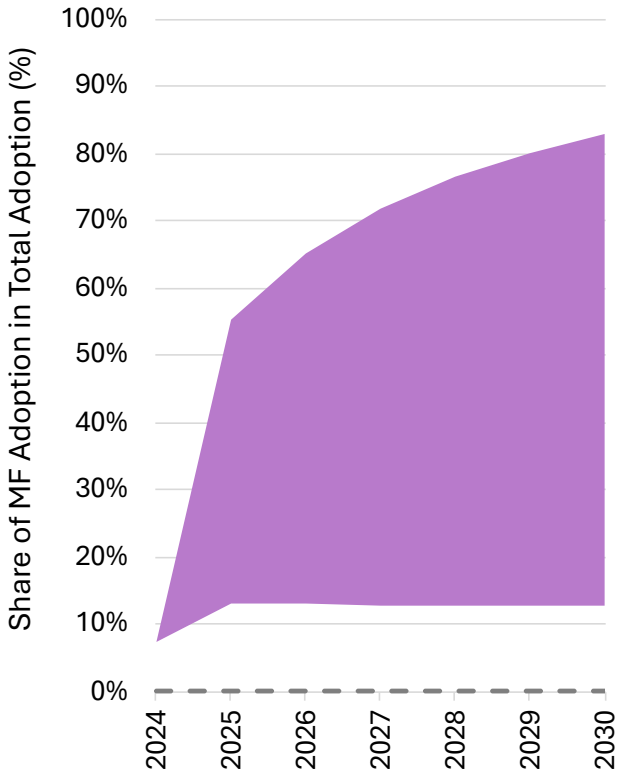
LMI %



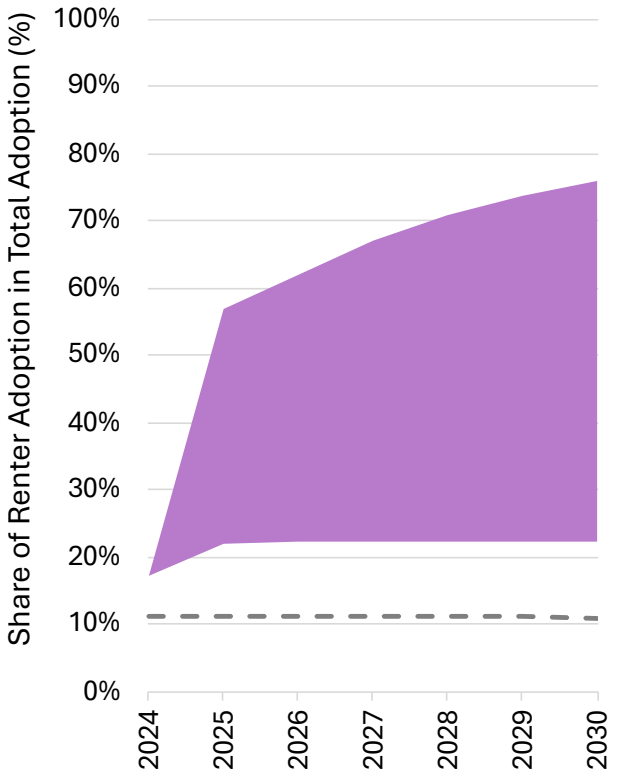
All examined adoption-accelerating program portfolios increase battery storage access

- The share of customer battery storage adoption attributed to multifamily, renter, or LMI customers increases in all adoption scenarios due to enhanced utility support, enhanced options for renter and LMI customers, improved net metering compensation, and targeted additional incentives
- Although access improves, storage adoption does not meet the target due to high upfront costs and minor bill savings

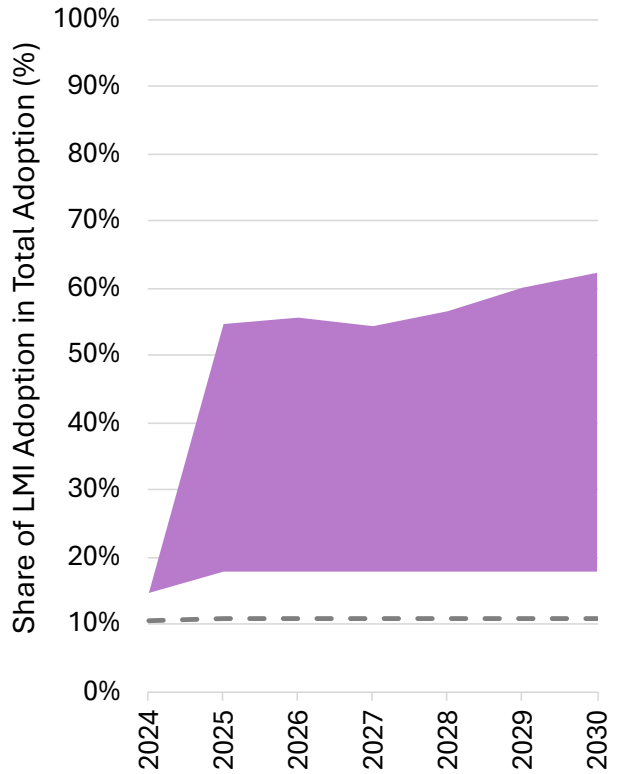
Multifamily %



Renter %



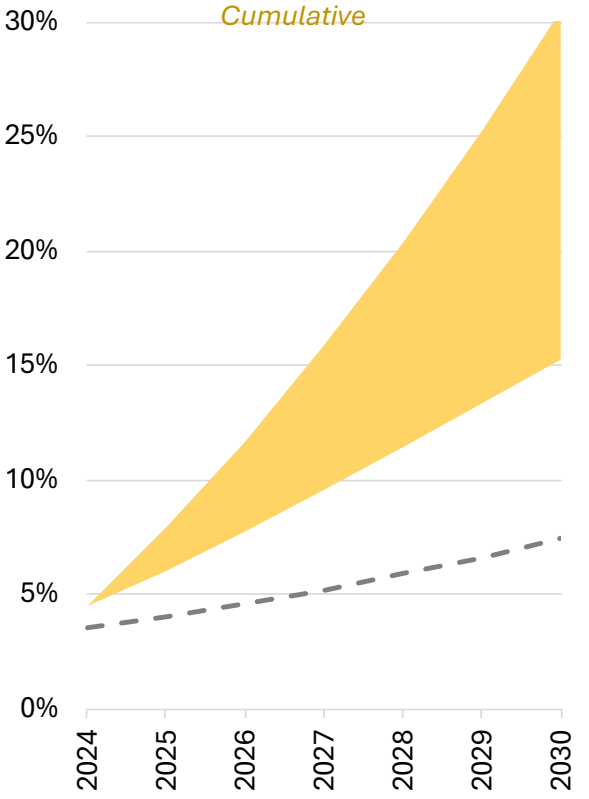
LMI %



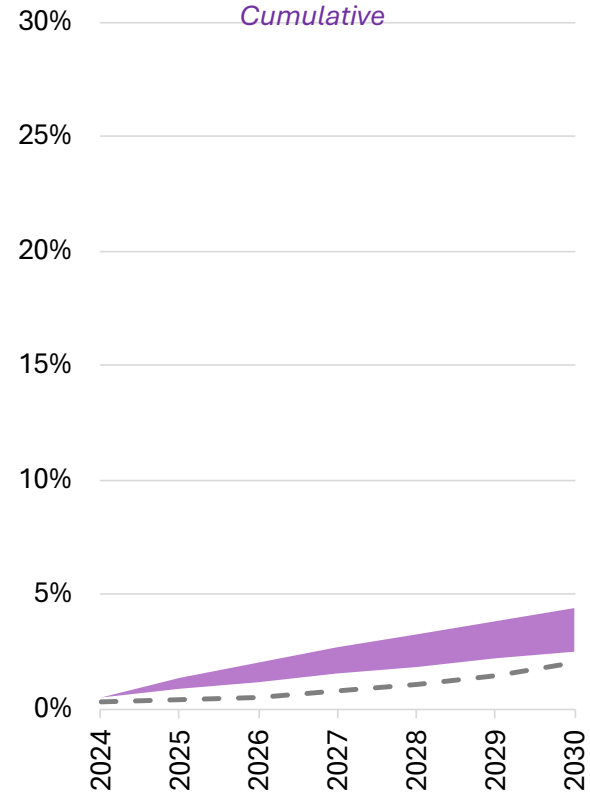
Adoption scenarios project *theoretical upper bounds* for adoption, resulting in net ratepayer costs and rate impacts

- The adoption scenarios project upper bounds for solar adoption by 2027. The adoption level results will be further limited by implementation barriers, customer adoption behavior, and other financial and non-economic barriers that customers face.
- All proposed strategies impose more costs on GWP ratepayers and lead to further increases in retail rates.
- There are alternatives to current NEM that can still promote local solar and storage but also reduce costs to GWP ratepayers.

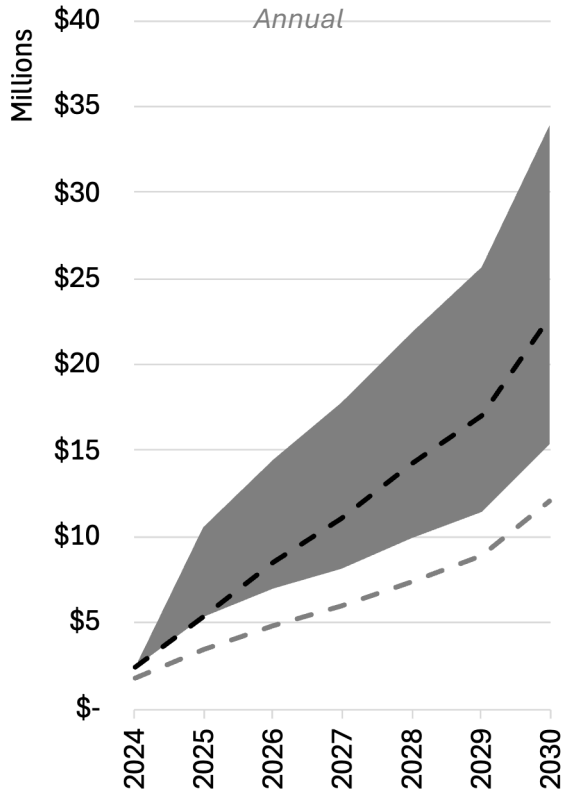
Solar Adoption (%)



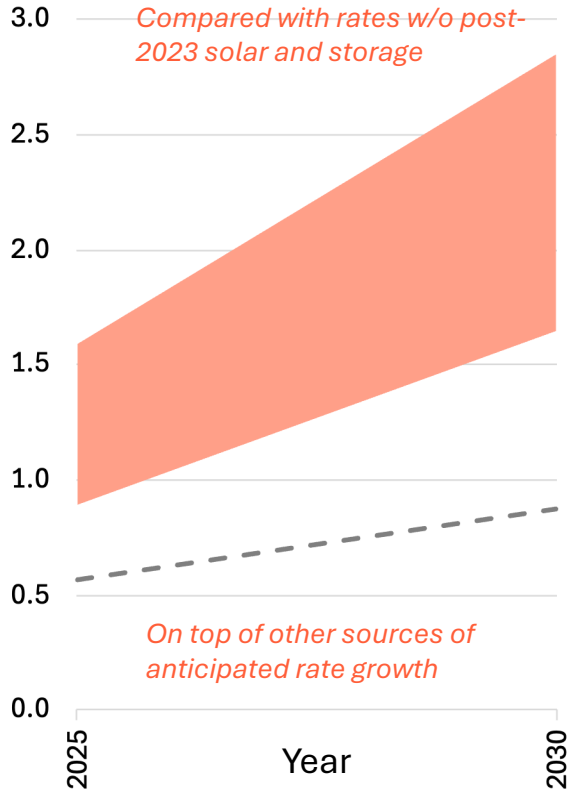
Storage Adoption (%)



Net Ratepayer Costs ($)



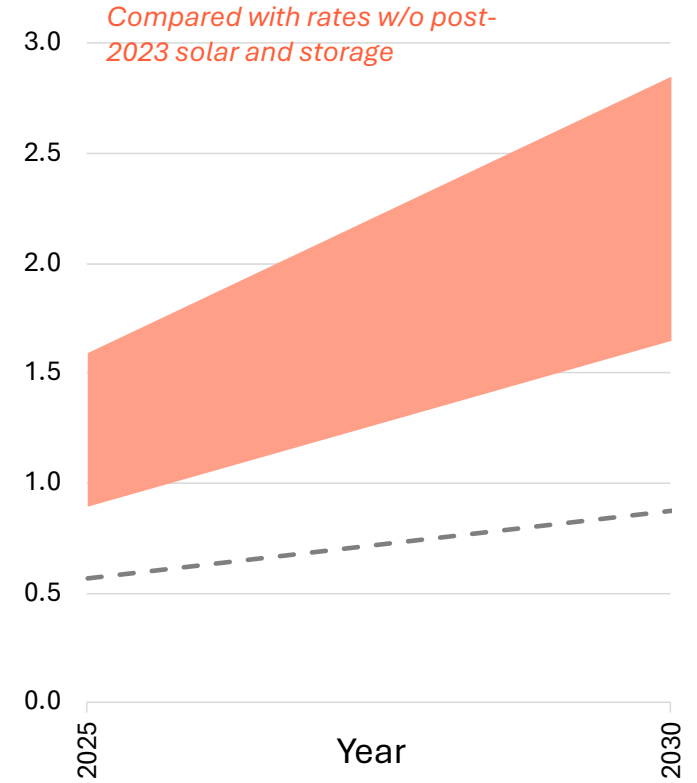
Rate Impacts (¢/kWh)



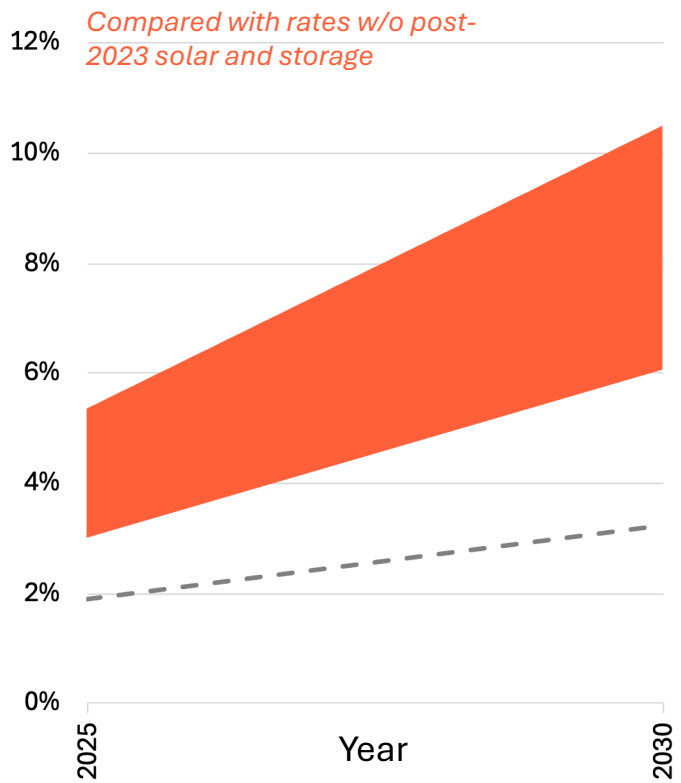
All examined program portfolios require significant utility investments, increasing rates and bills for all GWP customers

- Across all adoption scenarios, retail rates are anticipated to increase between 6% and 11% by 2030 due to solar and storage programs on top of other anticipated sources of rate growth
- This means that the average LMI customer will pay between $4 and $6 more per month on electricity, or $48 to $72 per year

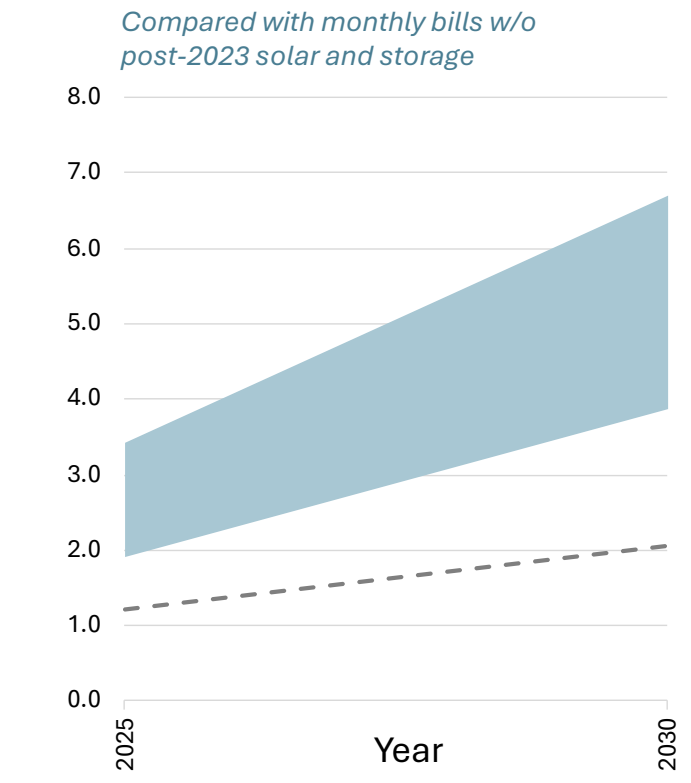
Rate Impacts (¢/kWh)



Rate Impact (%)



Avg. LMI Bill Impact ($/month)



Section 7.4

Modeling Approach, Inputs, and Assumptions

Energy+Environmental Economics

E3 quantified the dispatchable capacity and demand reduction potential of DERs for valuation and rate design considerations

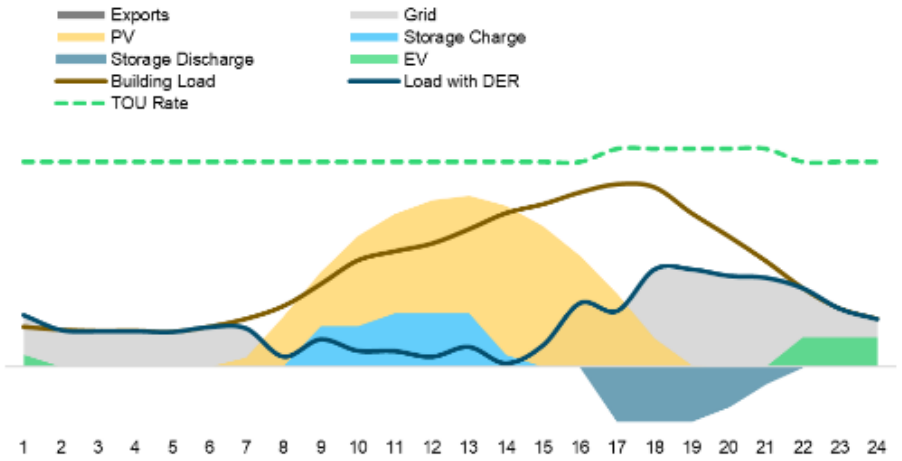
- E3 developed prototypical customer shapes using NREL ResStock and ComStock and leveraged work with the CPUC and LBNL on modeling flexible loads
- E3 performed DER optimal dispatch simulation through its RESTORE model and identified appropriate rate signals to guide dispatch providing grid value

RESTORE

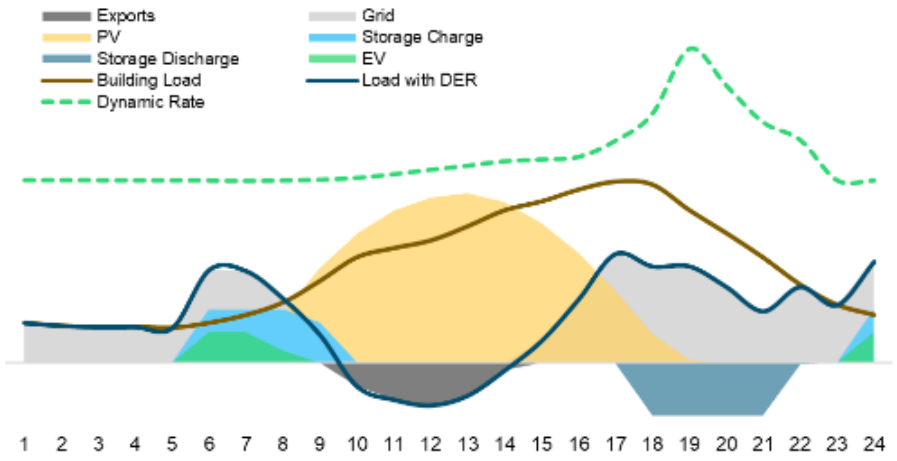
A broad range of technologies

Market prices, utility rates → Optimal dispatch → Market revenues or customer savings

Customer Load with Dispatchable DER Responding to TOU Rate



Customer Load with Dispatchable DER Responding to Dynamic Multi-Part Rate



E3 utilized its in-house DER toolkit (RESTORE) to estimate DER adoption forecasts

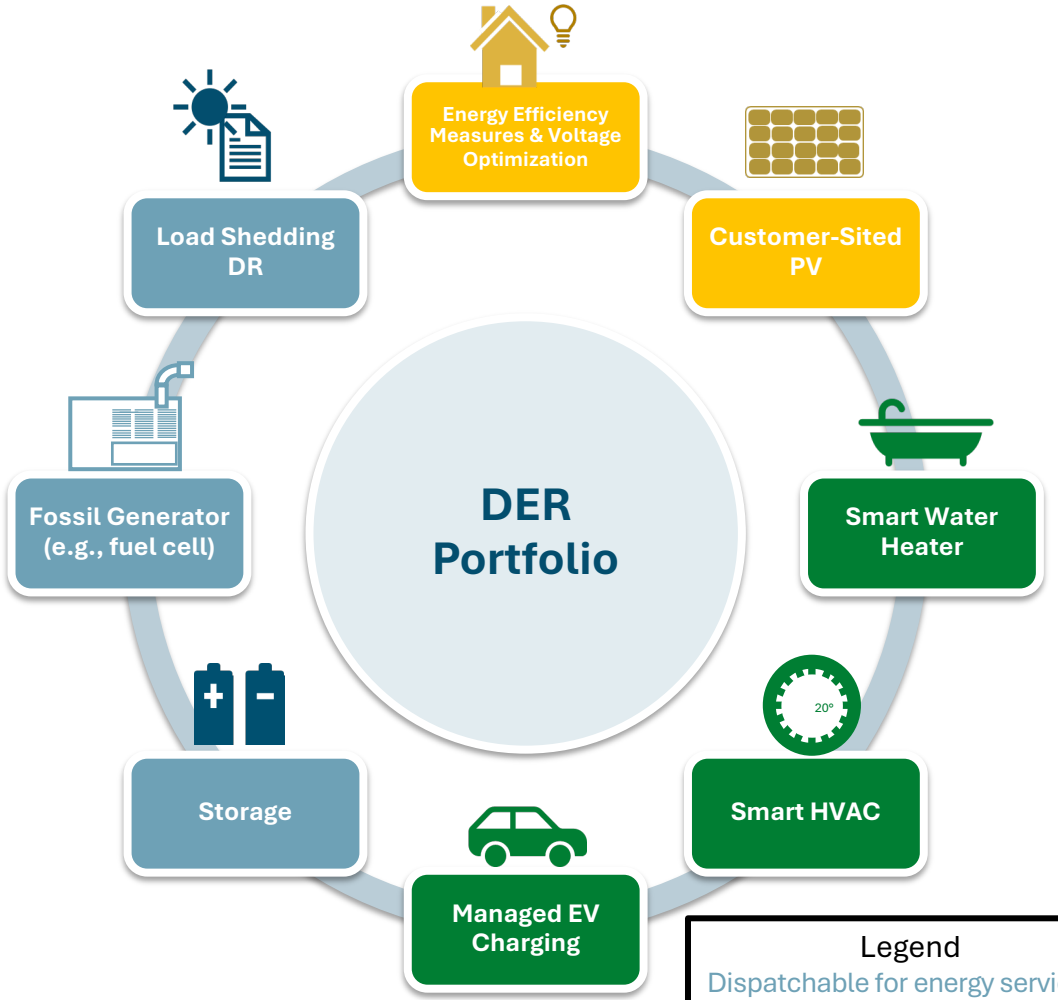
The Integrated Demand Side Management (IDSM) feature of E3's RESTORE model can be used to predict adoption of a range of DER technologies. For this study, E3 used it to predict solar and storage adoption for GWP customers.

RESTORE

A broad range of DER

Resource planning data, utility rates → Optimal dispatch → Adoption forecast

Output designed for utility and regulatory commission consideration including Standard Practice Manual



A public version of RESTORE without the IDSM feature can be found here:
CEC Docket Log 19-MISC-04, https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-MISC-04

RESTORE estimates DER adoption based on dispatch and cost-effectiveness

+ Adoption

- Impacts of rate scenarios and sensitivities on cumulative adoption

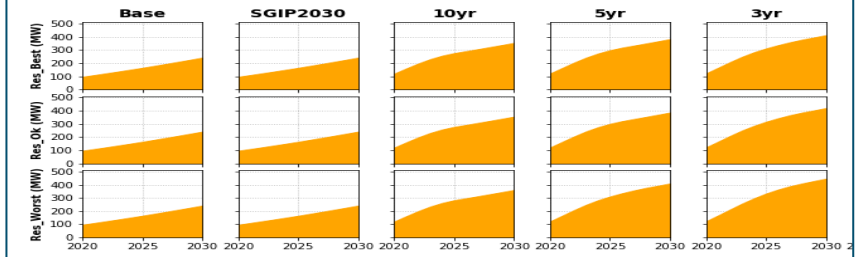
+ Costs & Benefits

- Detailed costs and benefits shedding light on how economics affect consumer adoption

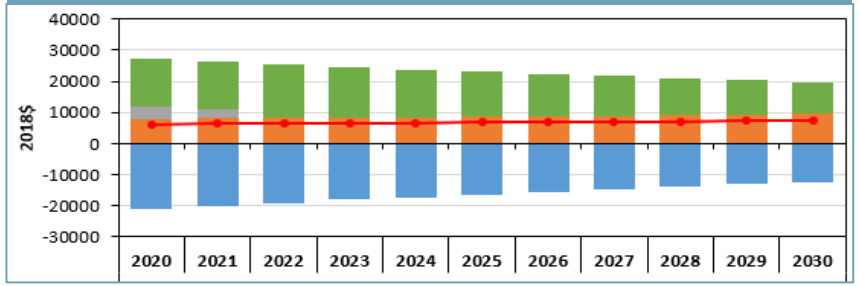
+ DER Dispatch / Customer Load Impact

- How DER affects BTM customer net load under different scenarios

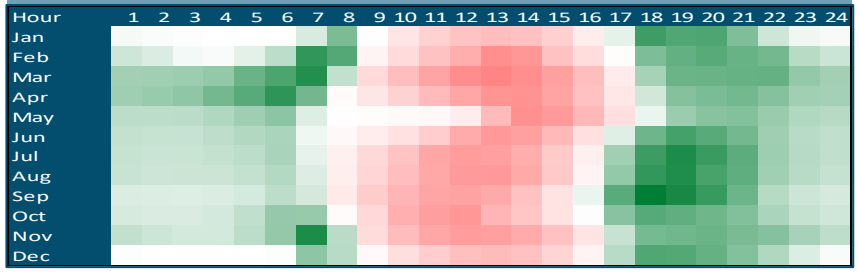
Adoption



Costs & Benefits

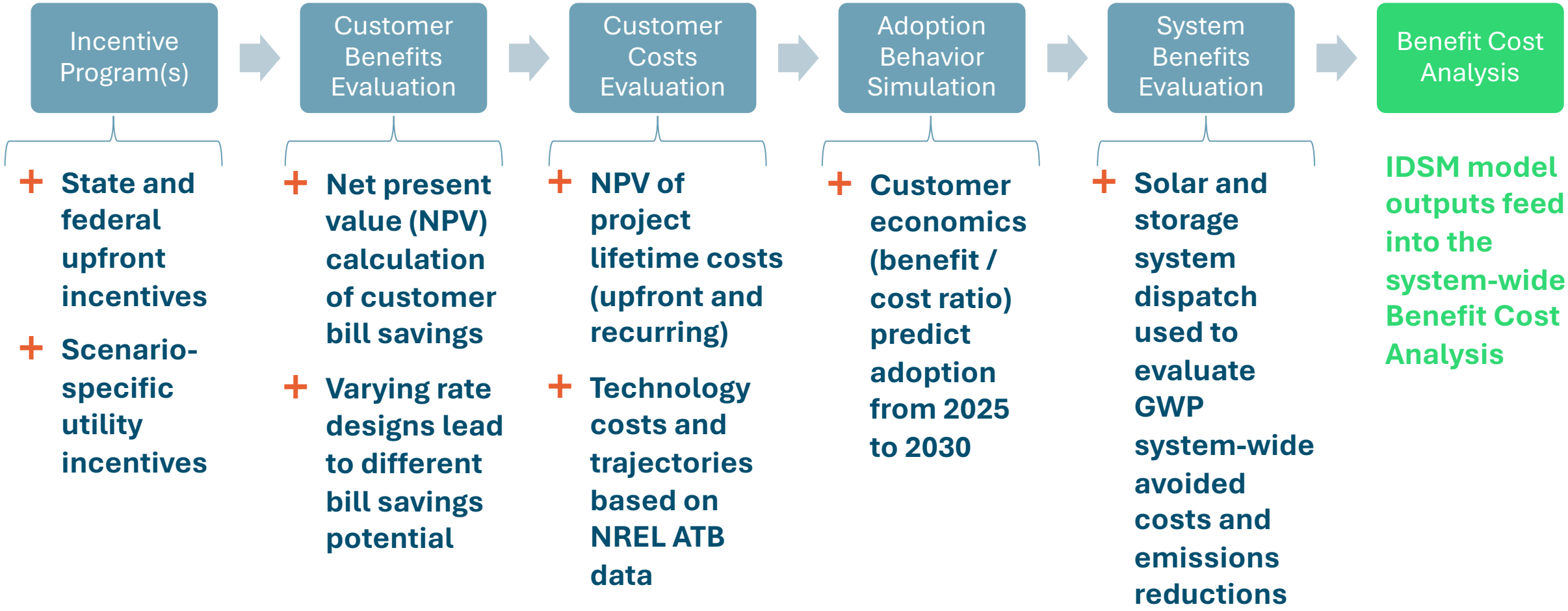


Customer Load Impact



GWP-Customized Workflow of the IDSM Feature of RESTORE

RESTORE Integrated Demand-Side Management (IDSM) Tool Flowchart



RESTORE deploys bass diffusion adoption modeling considering DER cost-effectiveness

Incentive Program(s) → Customer Benefits Evaluation → Customer Costs Evaluation → **Adoption Behavior Simulation** → System Benefits Evaluation → Benefit Cost Analysis

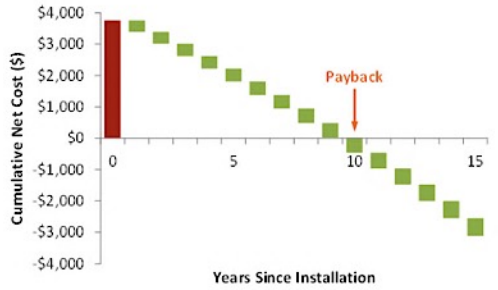
The Distributed Generation Market Demand (dGen™) model simulates customer adoption of distributed energy resources for residential, commercial, and industrial entities in the United States or other countries through 2050.

dGen

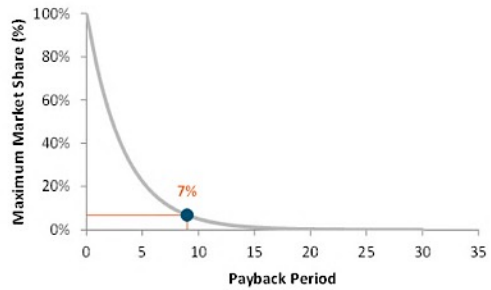
- **The pace of adoption is controlled by year-to-year changes in economics**
- **Adoption will be accelerated if economics substantially improve**

+ **IDSM utilizes classic bass diffusion model**
+ **An empirical market share model to determine the long-run market equilibrium of customer adoption**
  - The relationship between economic attractiveness and maximum market share based on payback period or benefit-cost ratio
+ **A bass diffusion model explains the time dynamics and adoption path to this equilibrium**

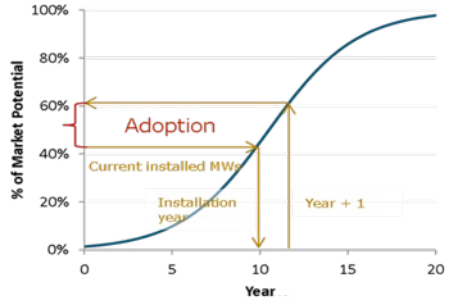
1. Determine payback period



2. Determine max market share



3. Fit logistic curve



4. Apply to technical potential

	Technical potential	MW
x	Market penetration at *t*	%
=	**Installed capacity at *t***	**MW**

More than a dozen customer segments were captured in E3's analysis

+ **Identified 18 customer segments to represent diversity by customer sector, ownership, and income**
  - Enabled segmentation of MF, renter, and LMI/DAC customers for equity analysis
+ **Segmented into three customer sectors**
  - SF, MF, and C&I
+ **Classified into six building types**
  - SF: Single-Family
  - MF: Multi-Family Low-Rise vs. High-Rise
  - C&I: Small, Medium, Large
+ **Distinguished by two ownership statuses**
  - Owner vs. Tenant
+ **Categorized by two income classes**
  - LMI and non-LMI (general market)

Customer Segmentation in RESTORE Modeling

Customer No.	Customer Sector	Building Type	Ownership Status	Income Class
1	SF	Single-Family	Owner	LMI
2	SF	Single-Family	Owner	Non-LMI
3	SF	Single-Family	Tenant	LMI
4	SF	Single-Family	Tenant	Non-LMI
5	MF	Multi-Family Low-Rise	Owner	LMI
6	MF	Multi-Family Low-Rise	Owner	Non-LMI
7	MF	Multi-Family Low-Rise	Tenant	LMI
8	MF	Multi-Family Low-Rise	Tenant	Non-LMI
9	MF	Multi-Family High-Rise	Owner	LMI
10	MF	Multi-Family High-Rise	Owner	Non-LMI
11	MF	Multi-Family High-Rise	Tenant	LMI
12	MF	Multi-Family High-Rise	Tenant	Non-LMI
13	C&I	Small	Owner	N/A
14	C&I	Small	Tenant	N/A
15	C&I	Medium	Owner	N/A
16	C&I	Medium	Tenant	N/A
17	C&I	Large	Owner	N/A
18	C&I	Large	Tenant	N/A

Key model assumptions are important to note for accurate interpretation of adoption forecasts

Several prerequisites are fundamental for a successful adoption plan. For the purposes of this study, E3 made the following assumptions to assume the existence of these premises. For instance, the model assumes that customers have complete information about the program, its costs and benefits, and will make economic decisions accordingly, along with other key assumptions.

Premises of a Successful Adoption Plan

- **Strong Outreach, Education, Support:** assumed the level of outreach is not a constraint, and comprehensive outreach and educational campaigns are present which enhance awareness and empower residents to make informed decisions with understanding of the underlying economics.
- **Improved Permitting Process:** assumed permitting process is not a constraint, and a faster, easier, and scalable permitting, interconnection, and approval process to facilitate smoother installations is present.
- **Intelligible Program Design:** assumed information access and intelligibility of program design is not a constraint for adoption.
- **Addressing Split Incentives:** modeled the split incentive assuming renters have a significantly higher discount rate than owners in cases where split incentives persist. A deep dive into what programs could mitigate split incentives is presented later.

Other Model Assumptions

- **Modeling LMI Customers:** LMI customers were assumed to have higher hurdle rates for DER economics, necessitating higher investment decision thresholds.
- **Adoption Sequencing:** customers were assumed to consider adopting solar first, followed by potential adoption of storage. Only customers with existing solar installations would consider adding storage.
- **Interconnection Charges:** charges related to interconnection are already accounted for in solar installation costs.
- **Building Stock:** solar and storage mandate estimates were estimated via downstream analysis. Customer counts were assumed to remain static, with no changes in the building stock. New construction was considered separately (see next slide).
- **Building Electrification:** the model assumed stable customer load profiles. Sensitivity of building electrification can be done as sensitivities in later stages.

Section 7.5

Detailed Model Results: Solar & Battery Storage

Energy+Environmental Economics

Building code-compliant solar and storage adoption from new construction contributes to achieving the adoption target

+ **Glendale has a local "reach code" that adopts the local amendments to the 2022 California Energy Code (Title 24, Part 6, and Part 11) that provide local, cost-effective standards for new residential, non-residential, and hotel and motel buildings that exceed the minimum standards of the 2022 California Energy Code and 2022 California Green Building Standards Code. Requirements vary based on locations and building types, with waivers and exceptions available as needed.**

Solar

- **SF:** All newly constructed single-family buildings must have new solar PV systems/modules (Title 24).
- **MF, C&I:** Install a PV system that offsets 100% of building electricity, or at least covers 50% of gross roof space area (Reach Code).

For the purposes of this study, E3 assumed SF, MF, and C&I new construction comes with PV systems at average PV capacity accounting for roof and size limits.

Battery Storage

- **SF:** No requirement.
- **MF High-rise, C&I:** All buildings required to have solar PV must also have battery storage (Title 24).

For the purposes of this study, E3 assumed MF and C&I's new construction includes a 2-hour battery storage size to cover customer annual peak demand.

+ **For the purposes of this study, future growth in residential new construction was estimated utilizing building permit survey data from 1990 to 2022.**

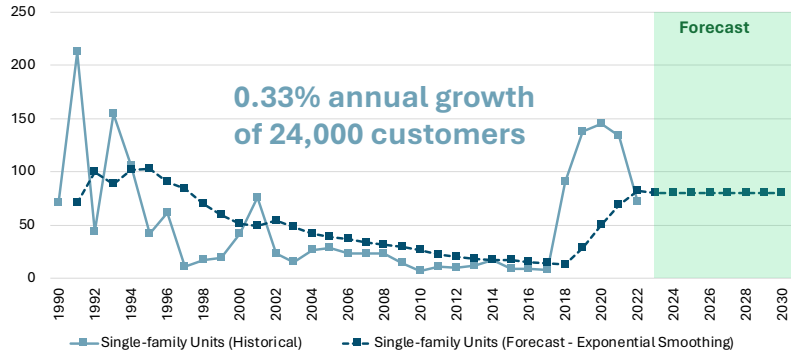
- Single-family: 80 units/yr (0.33% annual growth)
- Multi-family: 290 units/yr (0.54% annual growth)
- Commercial & Industrial: 63 units/yr (0.48% annual growth)**

•The 2023 values were estimated by applying exponential smoothing to historical data from 1990 to 2022, employing a short-term time series forecasting method. Future annual growth was assumed to mirror the 2023 forecast as a conservative estimate.

*** Commercial and Industrial new construction was estimated by mirroring the overall new construction growth rate from the residential sector, multiplied by 13,184 units reported in the GWP 2023 Annual Report.*

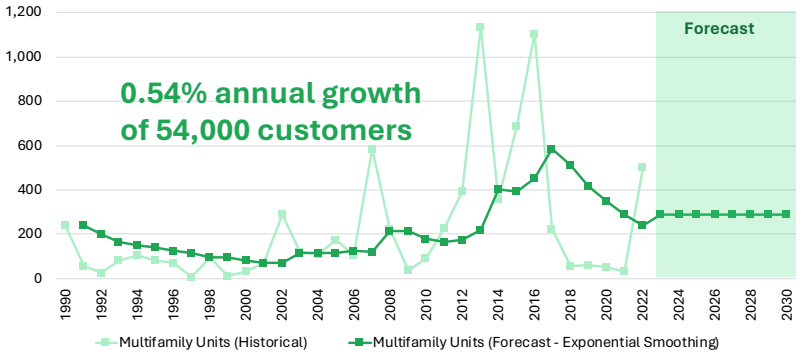
Single-family: 80 units/yr*

Glendale New Privately Owned Housing Unit Authorizations
U.S. Census Bureau Building Permits Survey, # of Units, Single-family



Multi-family: 290 units/yr*

Glendale New Privately Owned Housing Unit Authorizations
U.S. Census Bureau Building Permits Survey, # of Units, Multi-family

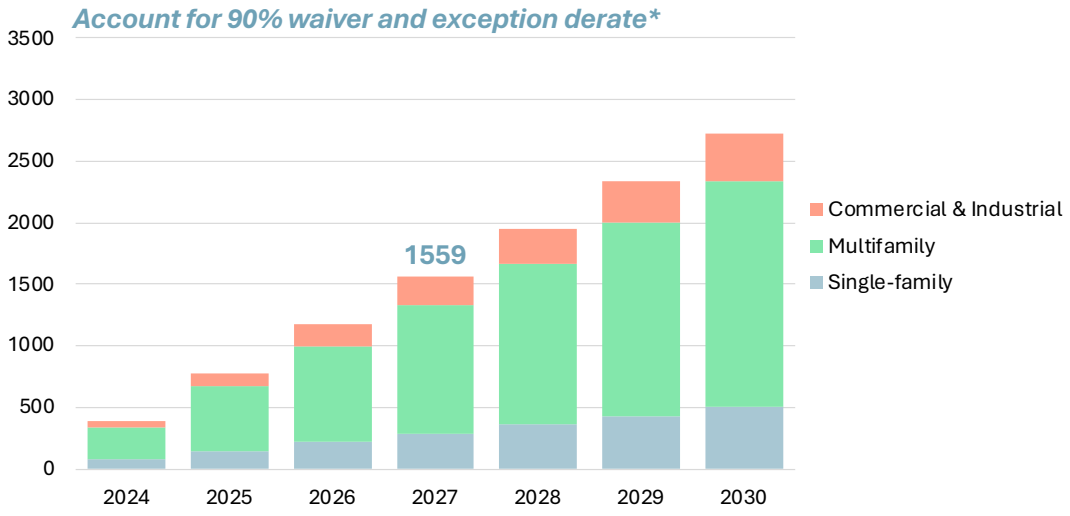


Building code-compliant solar and storage adoption from new construction will be important

+ **By the end of 2027, building code-compliant customer solar adoption could have the potential to reach 1,700+ units since the start of 2024.**
  - Approximately 20% of the 10% customer penetration target
  - For the purposes of this study, E3 assumed SF, MF, and C&I new construction comes with PV systems at average PV capacity accounting for roof and size limits

Cumulative Mandated Adoption from New Construction

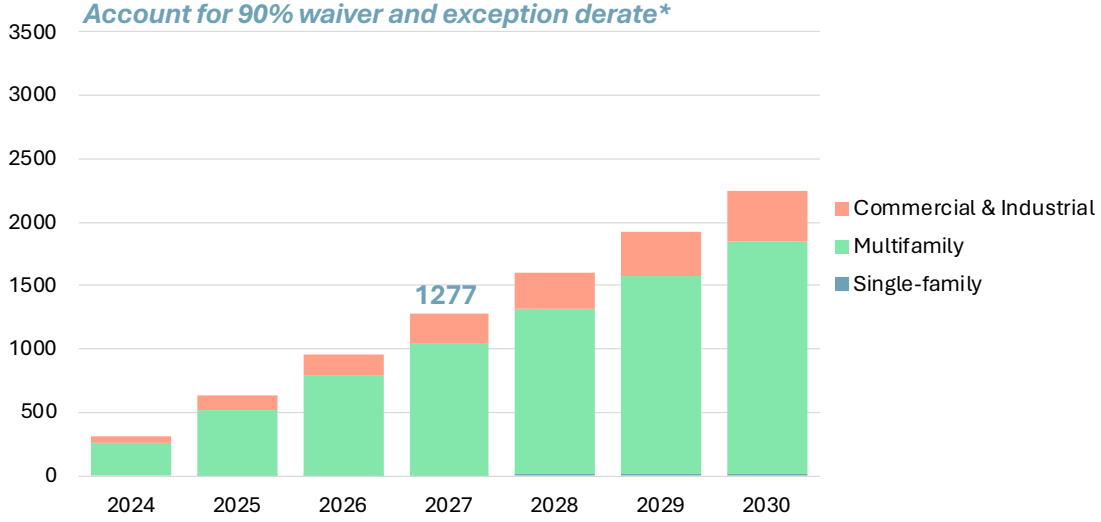
Customer-sited Solar, # of New Construction Units



+ **By the end of 2027, building code-compliant customer storage adoption could have the potential to reach 1,400+ units since the start of 2024.**
  - Approximately 15% of the 10% customer penetration target
  - For the purposes of this study, E3 assumed MF and C&I's new construction includes a 2-hour battery storage size to cover customers' annual peak demand

Cumulative Mandated Adoption from New Construction

Customer-sited Storage, # of New Construction Units



**Requirements for solar installations may vary based on location and building type. Waivers and exceptions are available as needed. In this study, a 90% derating factor was applied to represent exceptions and waivers. This factor accounts for uncertainties in specific building designs. It is crucial to note that this assumption requires further study to validate its accuracy.*

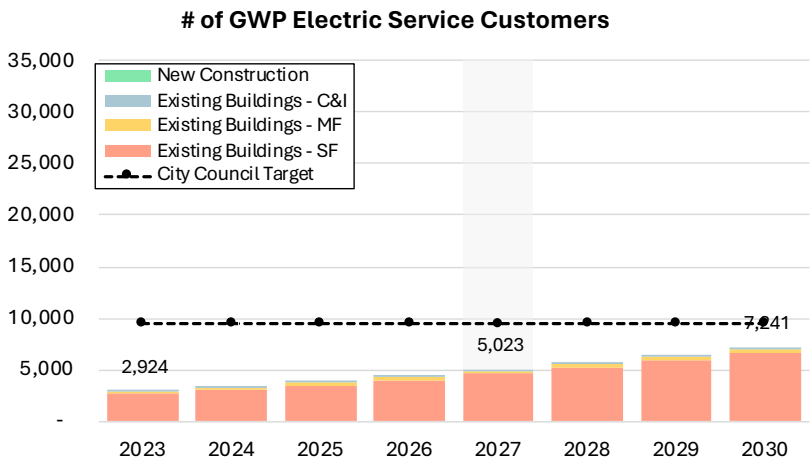
Customer Solar and Storage Adoption Modeling Results

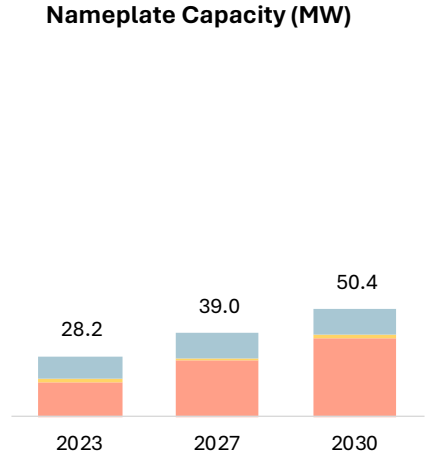
Scenario 0 – Business-as-Usual (Solar)

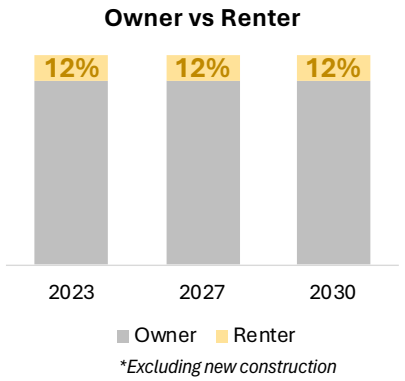
This scenario reflects current GWP policies without new incentive programs and without improved outreach, support, and improved permitting process. The adoption forecast was developed using historical adoption data by customer segment, calibrated through a Bass Diffusion curve.

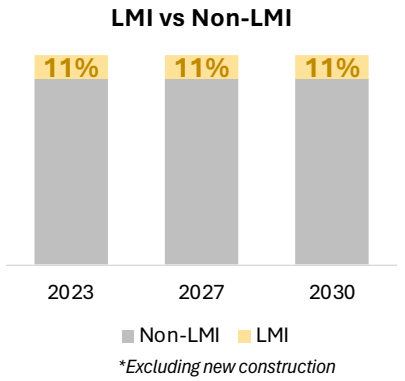
+ **This scenario is based on:**
  - Stacking of available federal, state funding and applicable tax credits
  - NEM at retail rate without virtual net metering or off-site solar programs
  - No additional utility incentives and follow current feed-in-tariff program rules
  - No additional enhanced community outreach and support, along with improved permitting processes starting early 2025
  - Split incentive issue for tenants persists throughout the analysis period
+ **Expected adoption level:**
  - **2027 customer penetration:** 5.2%
  - **2030 customer penetration:** 7.4%
  - **Nameplate capacity:** 39 MW by 2027, and 50 MW by 2030
+ **Key takeaways:**
  - **At the current rate of annual adoption, solar adoption is projected to reach 5.2% under business-as-usual conditions and achieve 7.4% by 2030. To achieve the goal, utility interventions are necessary to accelerate and further promote adoption.**
  - Adoption is dominated by owner-occupied, single-family, non-LMI households

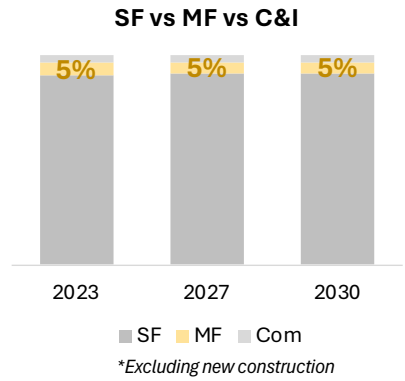
GWP Customer Solar Penetration - Business-as-Usual (BAU) Scenario











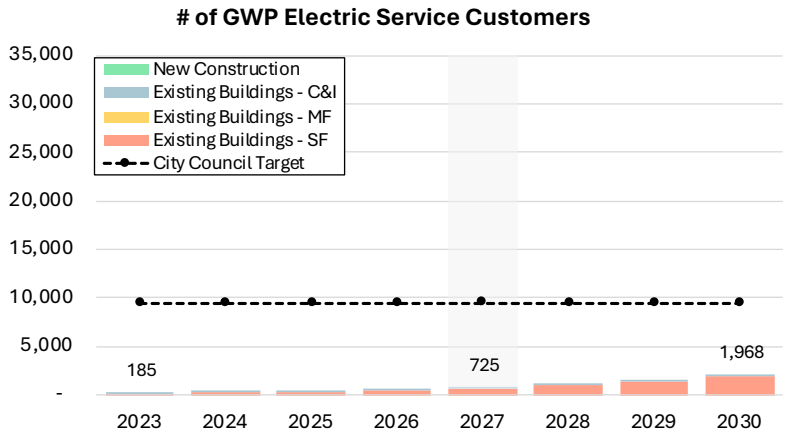
Customer Solar and Storage Adoption Modeling Results

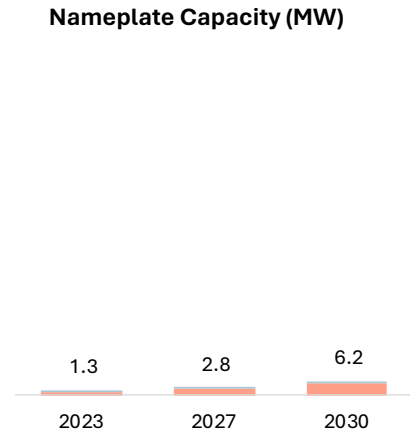
Scenario 0 – Business-as-Usual (Battery Storage)

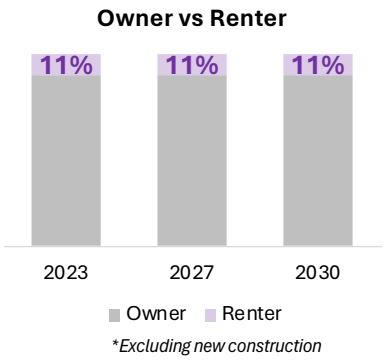
This scenario reflects current GWP policies without new incentive programs and without improved outreach, support, and improved permitting processes. The adoption forecast was developed using historical adoption data by customer segment, calibrated through a Bass Diffusion curve.

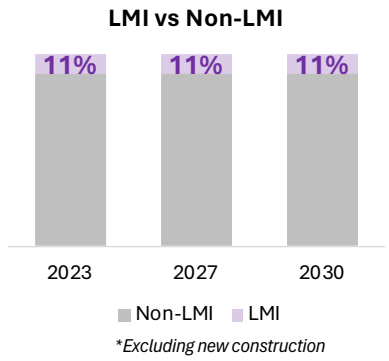
+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEM at retail rate without virtual net metering or off-site solar programs
  - No additional utility incentives and follow current feed-in-tariff program rules
  - No additional enhanced community outreach and support, along with improved permitting processes starting in early 2025
  - Split incentive issue for tenants persists throughout the analysis period
+ **Expected adoption level:**
  - **2027 customer penetration:** 0.8% *(14% attachment rate)*
  - **2030 customer penetration:** 2.0% *(27% attachment rate)*
  - **Nameplate capacity:** 3 MW by 2027, and 6 MW by 2030
+ **Key takeaways:**
  - **At the current rate of annual adoption, solar adoption is projected to reach 0.8% under business-as-usual conditions and achieve 2.0% by 2030. To achieve the goal, utility interventions are necessary to accelerate and further promote adoption.**
  - Adoption is dominated by owner-occupied, single-family, non-LMI households
  - Notable adoption mandate observed in new construction

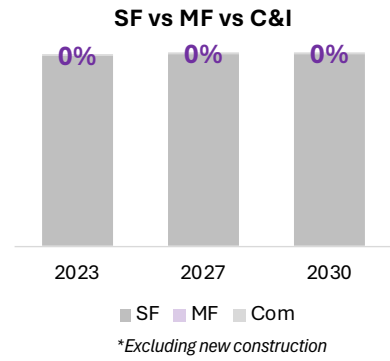
GWP Customer Storage Penetration - Business-as-Usual (BAU) Scenario











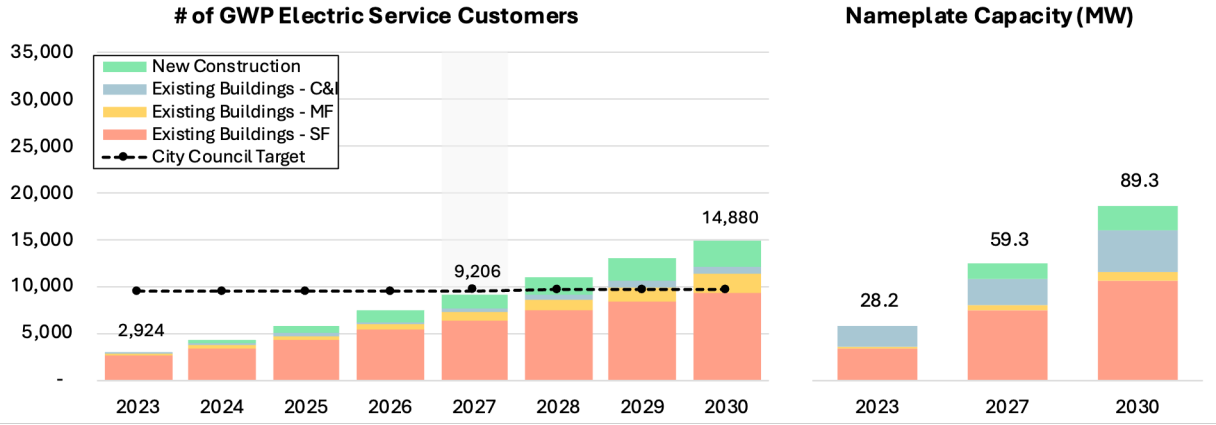
Customer Solar and Storage Adoption Modeling Results

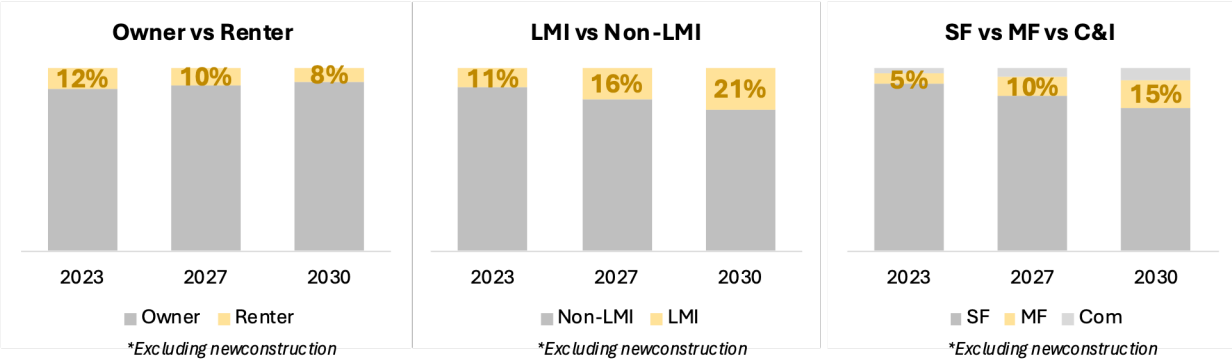
Scenario 1 – Continue Current NEM (Solar)

This scenario reflects current GWP policies without new incentive programs but with improved outreach, support, and permitting processes.

+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEM at retail rate without virtual net metering or off-site solar programs
  - No additional utility incentives and follow current feed-in-tariff program rules
  - Optimism regarding enhanced community outreach and support, along with improved permitting processes starting in early 2025
  - Split incentive issue for tenants persists throughout the analysis period
+ **Expected adoption level:**
  - **2027 customer penetration:** 9.6%
  - **2030 customer penetration:** 15.2%
  - **Nameplate capacity:** 60 MW by 2027, and 90 MW by 2030
+ **Key takeaways:**
  - **Enhancing customer outreach and support and simplifying the permitting process can boost adoption. Without further utility interventions, adoption may fall short of the 2027 target, but it would be enough to reach 10% adoption by 2030.**
  - Under current NEM, there is stable growth in SF adoption, particularly among owner-occupied, non-LMI households
  - Limited MF growth under current NEM due to split incentives, stemming from ownership dynamics
  - The C&I sector has fewer customers but larger average installations, making it a key contributor to reaching the 100 MW DER capacity target.
  - Notable adoption mandate observed in new construction

GWP Customer Solar Penetration - No New Program Scenario





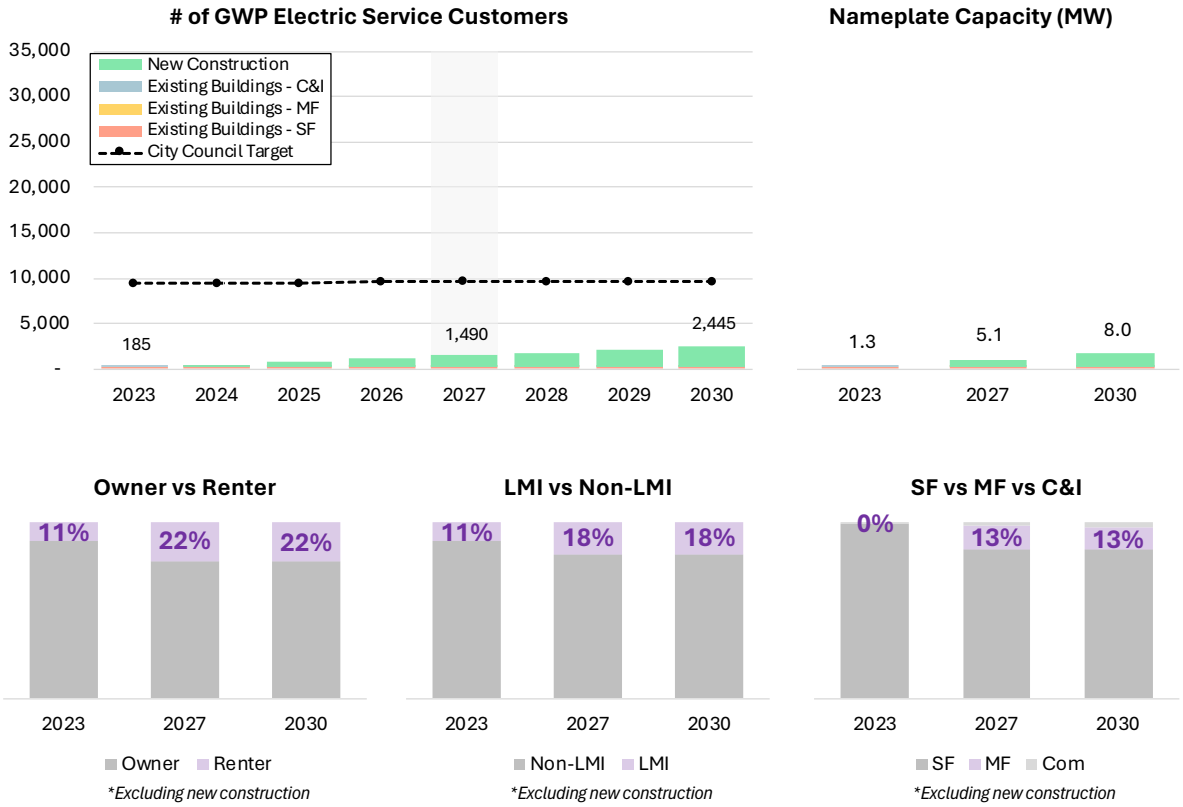
Customer Solar and Storage Adoption Modeling Results

Scenario 1 – Continue Current NEM (Battery Storage)

This scenario reflects current GWP policies without new incentive programs but with improved outreach, support, and permitting processes.

+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEM at retail rate without virtual net metering or off-site solar programs
  - No additional utility incentives and follow current feed-in-tariff program rules
  - Optimism regarding enhanced community outreach and support, along with improved permitting processes starting in early 2025
  - Split incentive issue for tenants persists throughout the analysis period
+ **Expected adoption level:**
  - **2027 customer penetration:** 1.5% *(16% attachment rate)*
  - **2030 customer penetration:** 2.5% *(16% attachment rate)*
  - **Nameplate capacity:** 5 MW by 2027, and 8 MW by 2030
+ **Key takeaways:**
  - **Enhancing customer outreach and support and simplifying the permitting process alone has limited impact on promoting adoption, mainly due to the poor economic performance of adding battery storage systems to customer solar.**
    - Substantial upfront costs
    - Comparatively diminished benefits including lack of energy arbitrage benefits (low TOU participation, symmetric NEM rate schedule, etc.) and less quantifiable resiliency benefits
  - Adoption is dominated by owner-occupied, single-family, non-LMI households
  - Most of the new adoption will come from building code-compliant system installation from new construction

GWP Customer Storage Penetration - No New Program Scenario



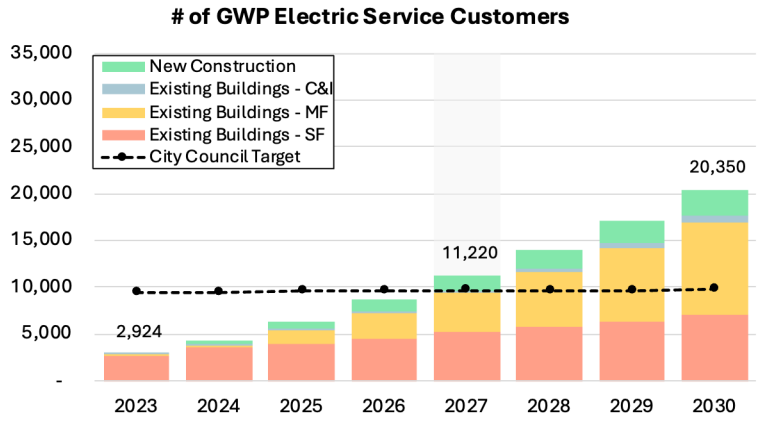
Customer Solar and Storage Adoption Modeling Results

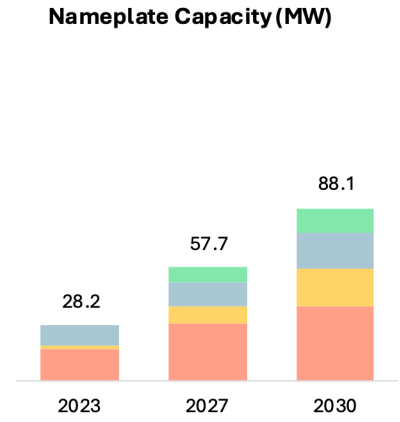
Scenario 2 – Targeted LMI MF Adoption (Solar)

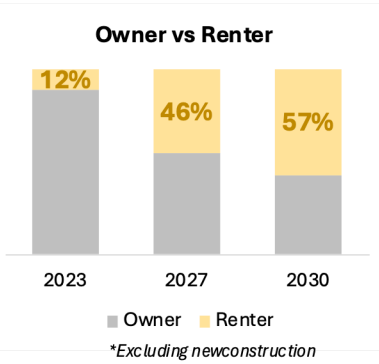
This scenario aims to reach as much adoption as possible while maintaining high standards for equitable implementation. Focus on minimal cost shifting and promoting LMI/DAC adoption via direct install programs.

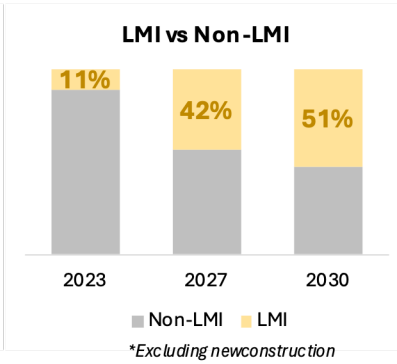
+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEB and VNEB programs are priced at avoided costs starting early 2025
  - Implementation of direct install program targeting MF LMI/DAC starting in early 2025
  - Optimistic outlook on enhanced community outreach and support, as well as improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 11.6%
  - **2030 customer penetration:** 20.8%
  - **Nameplate capacity:** 58 MW by 2027, and 88 MW by 2030
+ **Key takeaways:**
  - **Utility interventions to provide additional incentives and resolve split incentives are needed to reach the adoption target, along with improving customer outreach, support, and the permitting process. Unlocking adoption potential from the MF sector creates opportunities to maximize the equity of the current net metering mechanism, with co-benefits of increasing the cost-effectiveness of storage additions to customer solar systems *(discussed in the next slide)*.**
  - Lower SF growth under NEB due to lower export compensation rate, which improves equity by reducing cost shifts to non-adopters
  - With solutions to split incentives and direct install programs targeted at MF LM/DAC households, the multifamily sector has dramatic adoption growth since 2025, and solar access expands outside single-family and becomes balanced

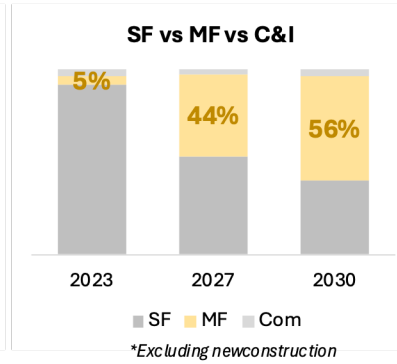
GWP Customer Solar Penetration - Targeted MF LMI Adoption Scenario











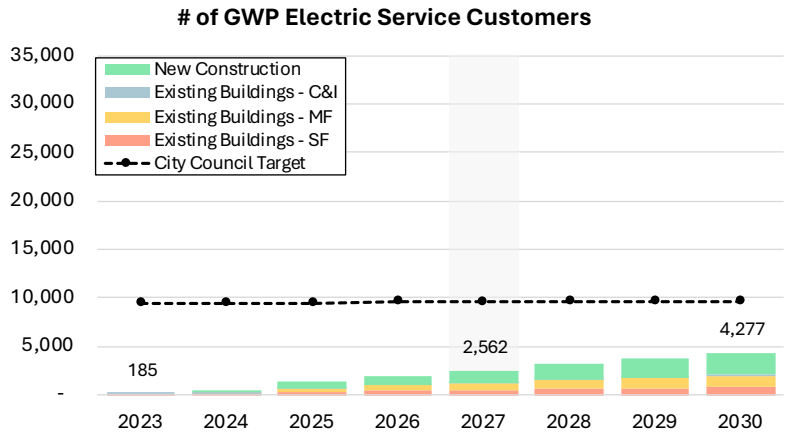
Customer Solar and Storage Adoption Modeling Results

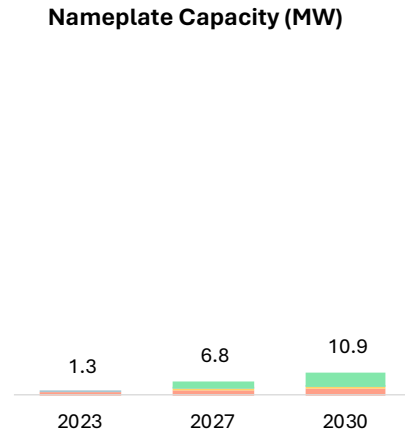
Scenario 2 – Targeted LMI MF Adoption (Battery Storage)

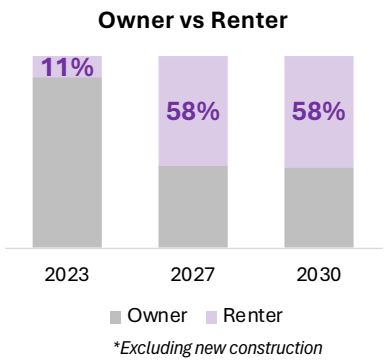
This scenario aims to reach as much adoption as possible while maintaining high standards for equitable implementation. Focus on minimal cost shifting and promoting LMI/DAC adoption via direct install programs.

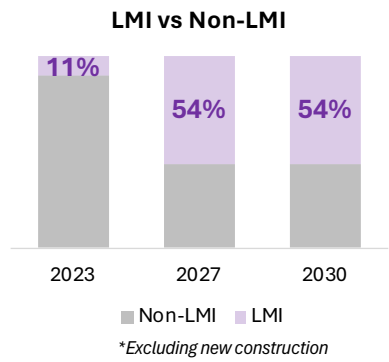
+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEB and VNEB programs are priced at avoided costs starting in early 2025
  - Implementation of a direct install program targeting MF LMI/DAC starting in early 2025
  - Optimistic outlook on enhanced community outreach and support, as well as improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 2.7% *(23% attachment rate)*
  - **2030 customer penetration:** 4.4% *(21% attachment rate)*
  - **Nameplate capacity:** 7 MW by 2027, and 11 MW by 2030
+ **Key takeaways:**
  - **Additional utility incentives through direct install programs, coupled with the enhanced value proposition under NEB, promote greater adoption of customer storage (mostly SF households). While the storage attachment rate to solar systems falls within the state average range (6%-19% by income level), it remains insufficient to meet the adoption target by 2027 and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.**
  - With the export rate being lower than the import rate under NEB/VNEB, storage systems are better off and have a higher value in maximizing household self-consumption, thus observing adoption growth from the residential and commercial sectors
  - MF growth increased as expected because of the targeted LMI MF direct install program that covers the initial upfront cost

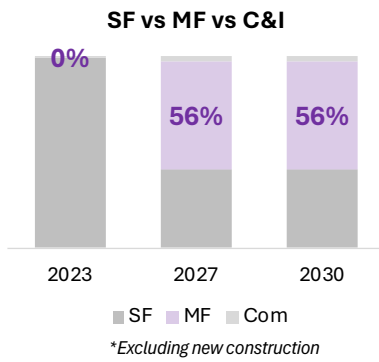
GWP Customer Storage Penetration - Targeted MF LMI Adoption Scenario











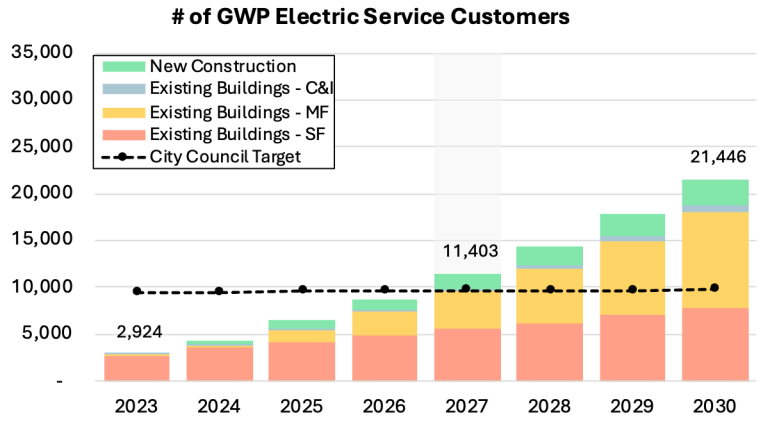
Customer Solar and Storage Adoption Modeling Results

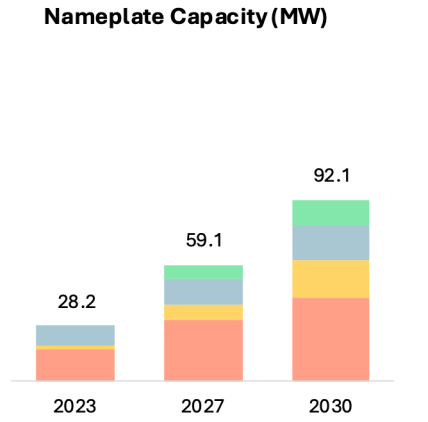
Scenario 3 – Balanced (Solar)

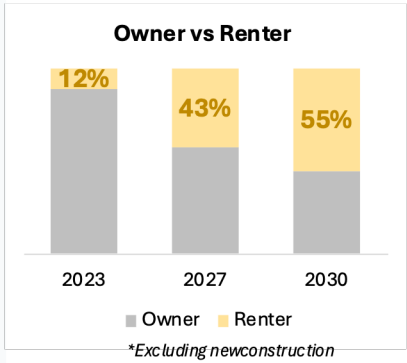
This scenario aims to reach a balance between S2 and S4, with a focus on increasing customer adoption while reducing cost shift, supplemented with MF LMI/DAC upfront incentives as needed.

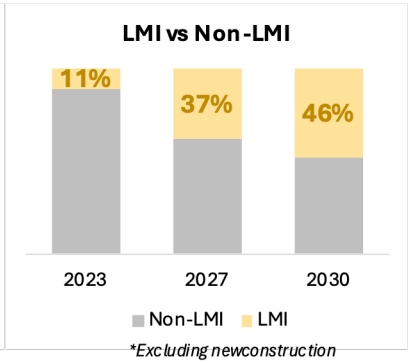
+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEB/VNEB programs priced at avoided costs with adders to achieve 7-year payback periods for solar to promote adoption starting in early 2025
  - Introduction of additional 7-yr payback incentives for solar and storage specifically aimed at MF LMI/DAC households starting early 2025
  - Optimistic anticipation of enhanced community outreach and support, coupled with improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 11.8%
  - **2030 customer penetration:** 22.0%
  - **Nameplate capacity:** 59 MW by 2027, and 92 MW by 2030
+ **Key takeaways:**
  - **Improving NEM equity with reasonable upfront incentives for MF LMI/DAC customers could also help reach the target, if implemented along with improving customer outreach, support, and the permitting process.**
  - Slightly lower SF growth under NEB (with adder) due to a slightly lower export compensation rate, which improves equity by reducing cost shifts to non-adopters. Encourages more adoption than S2 (Targeted MF LMI Adoption) because an adder to promote adoption is included.
  - With solutions to split incentives and upfront incentive programs targeted at MF LMI/DAC households, the MF sector has dramatic adoption growth since 2025. This upfront incentive program is less deep than the direct install program in S1 and less broad than S3 for all MF households, so there is lower adoption but enough to achieve the goal and expand solar access outside of the SF sector.

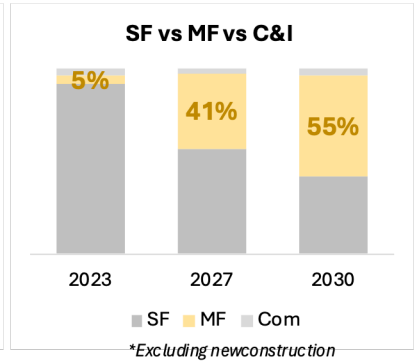
GWP Customer Solar Penetration - Balanced Scenario











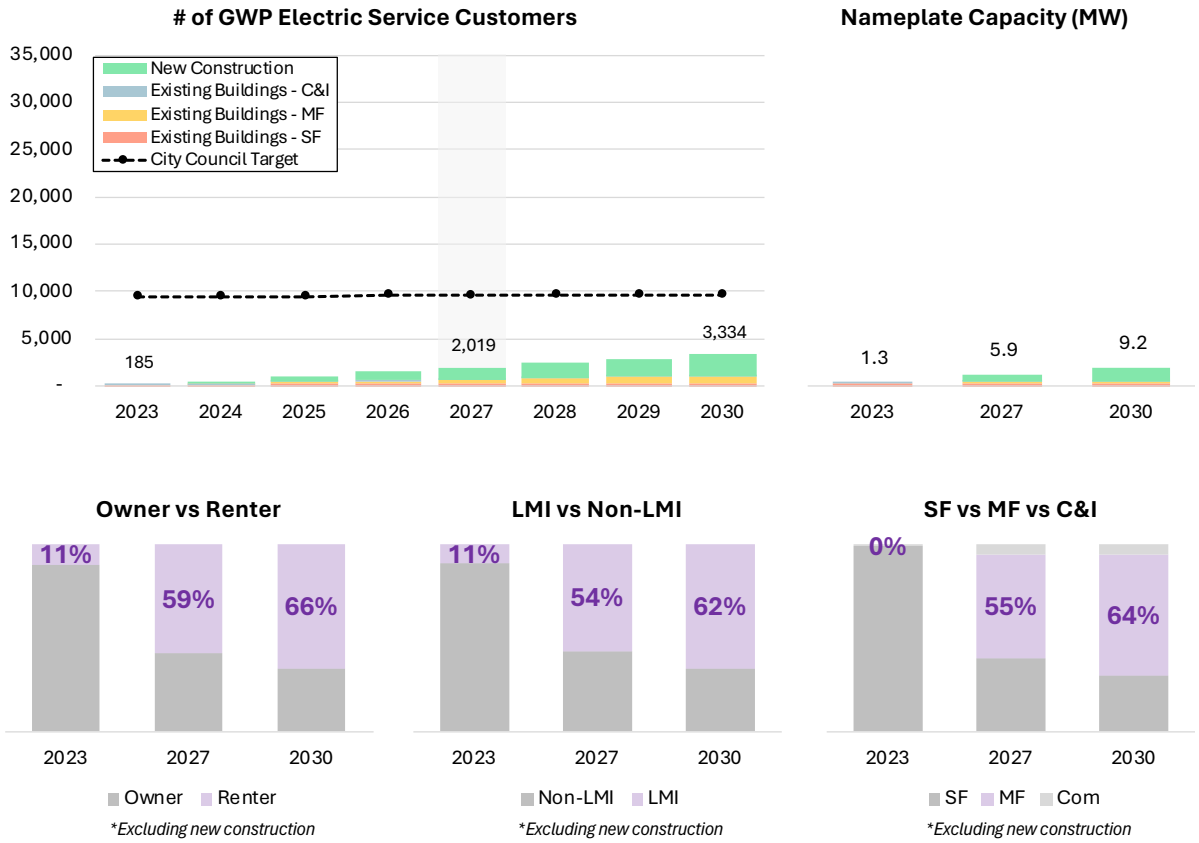
Customer Solar and Storage Adoption Modeling Results

Scenario 3 – Balanced (Battery Storage)

This scenario aims to reach a balance between S2 and S4, with a focus on increasing customer adoption while reducing cost shifts, supplemented with MF LMI/DAC upfront incentives as needed.

+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEB/VNEB programs priced at avoided costs with adders to achieve 7-year payback periods for solar to promote adoption starting in early 2025
  - Introduction of additional 7-yr payback incentives for solar and storage specifically aimed at MF LMI/DAC households starting early 2025
  - Optimistic anticipation of enhanced community outreach and support, coupled with improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 2.1% (18% attachment rate)
  - **2030 customer penetration:** 3.4% (16% attachment rate)
  - **Nameplate capacity:** 6 MW by 2027, and 9 MW by 2030
+ **Key takeaways:**
  - **Additional utility incentives through upfront incentives promote greater adoption of customer storage (mix of SF/MF households). While the storage attachment rate to solar systems falls within the average range, it remains insufficient to meet the adoption target by 2027 and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.**
  - With the export rate slightly lower than the import rate under NEB/VNEB, storage systems are slightly better off and have higher value in maximizing household self-consumption, thus observing adoption growth from the residential and commercial sectors
  - With additional upfront incentives for MF LMI/DAC households, more MF battery systems are expected to come online. This helps improve the equity distribution of storage access, though total adoption is still minimal due to customer storage's mediocre performance.

GWP Customer Storage Penetration - Balanced Scenario



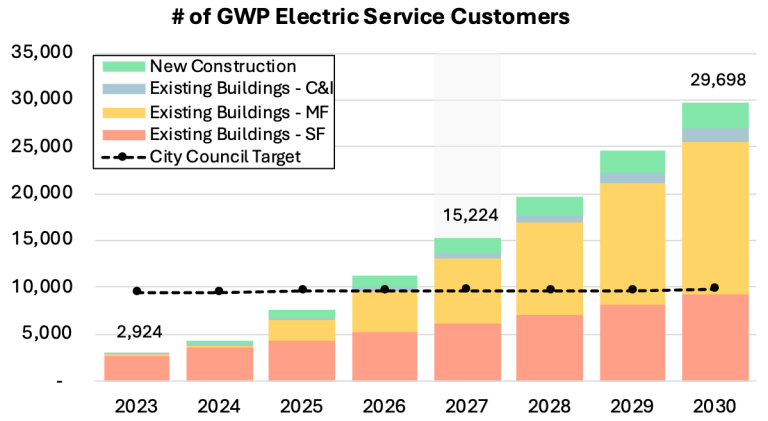
Customer Solar and Storage Adoption Modeling Results

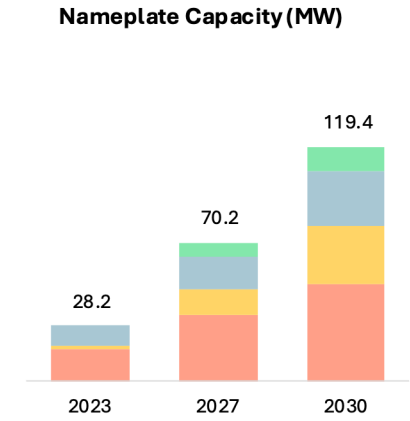
Scenario 4 – Widespread Adoption (Solar)

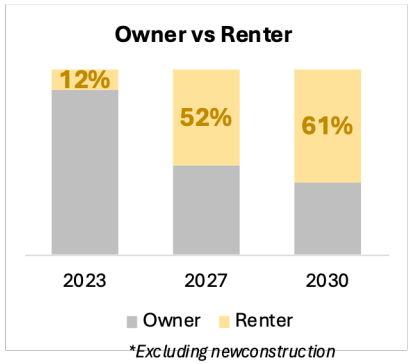
This scenario aims to reach the adoption goal with an emphasis on customer-sited solar and storage. Focus on maximizing adoption with supplemental upfront incentives as needed.

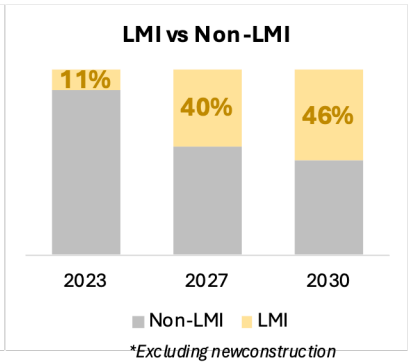
+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEM and VNEM are both set at retail rates starting in early 2025
  - Introduction of additional 5-yr payback incentives specifically aimed at MF households starting early 2025
  - Optimistic anticipation of enhanced community outreach and support, coupled with improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 15.8%
  - **2030 customer penetration:** 30.4%
  - **Nameplate capacity:** 70 MW by 2027, and 119 MW by 2030
+ **Key takeaways:**
  - **Maintaining current NEM policies with strong (lower but broader) upfront incentives for all MF customers could also help reach the target, if implemented along with improving customer outreach, support, and the permitting process.**
  - SF growth is forecasted to be the same as S1 since it is also under the current NEM at retail rates
  - With solutions to split incentives and upfront incentives targeted at all MF households, the multi-family sector has dramatic adoption growth since 2025, and solar access expands outside of the single-family sector and becomes balanced.

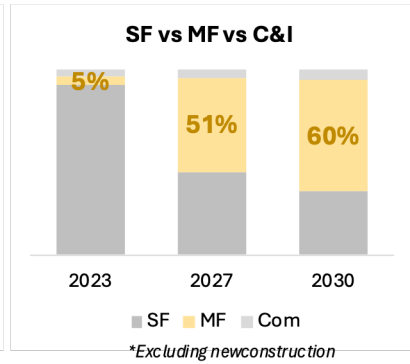
GWP Customer Solar Penetration - Widespread Adoption Scenario











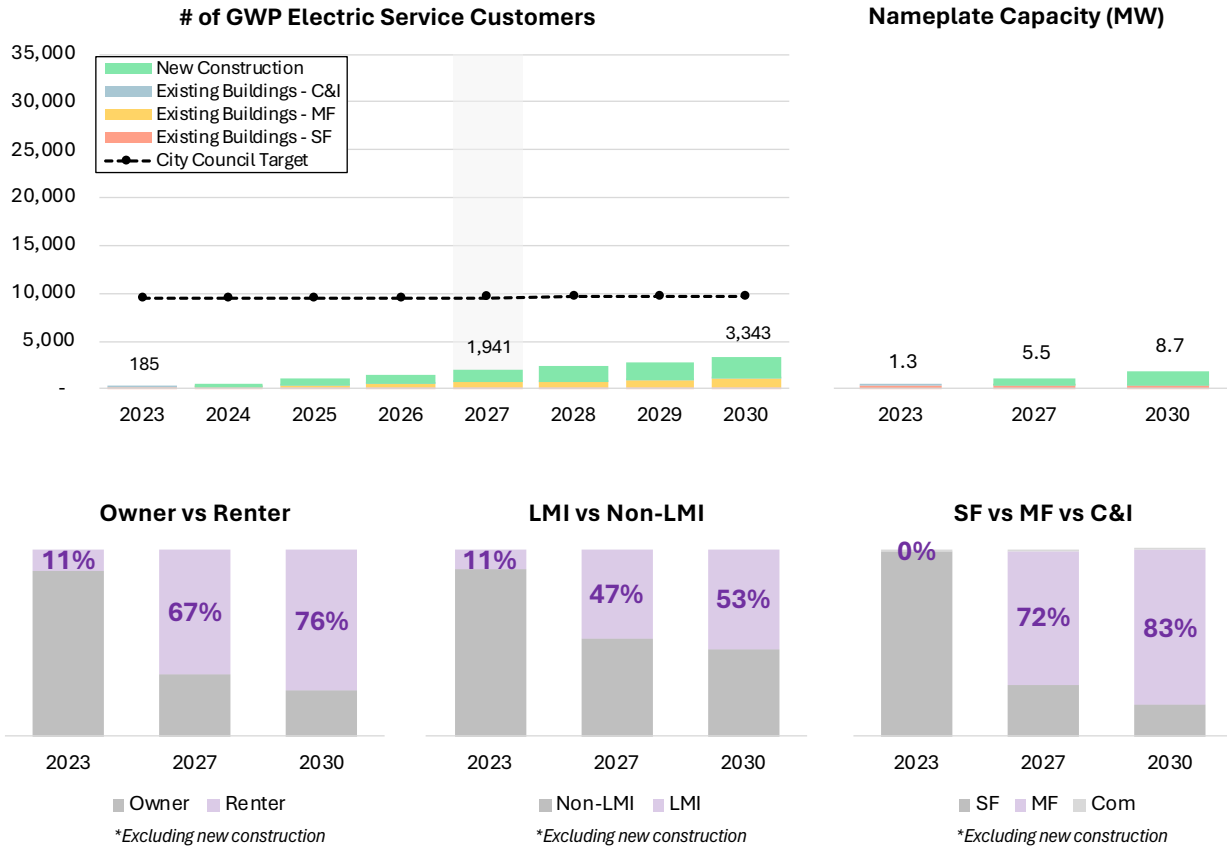
Customer Solar and Storage Adoption Modeling Results

Scenario 4 – Widespread Adoption (Battery Storage)

This scenario aims to reach the adoption goal with an emphasis on customer-sited solar and storage. Focus on maximizing adoption with additional upfront incentives as needed.

+ **This scenario is based on:**
  - Stacking of available federal and state funding and applicable tax credits
  - NEM and VNEM are both set at retail rates starting in early 2025
  - Introduction of additional 5-yr payback incentives specifically aimed at MF households starting early 2025
  - Optimistic anticipation of enhanced community outreach and support, coupled with improved permitting processes starting in early 2025
  - Assume split incentives are completely resolved starting in early 2025
+ **Expected adoption level:**
  - **2027 customer penetration:** 2.0% *(13% attachment rate)*
  - **2030 customer penetration:** 3.4% *(11% attachment rate)*
  - **Nameplate capacity:** 6 MW by 2027, and 9 MW by 2030
+ **Key takeaways:**
  - **Additional utility incentives through upfront incentives promote greater adoption of customer storage (mostly MF households). While the storage attachment rate to solar systems falls within the average range, it remains insufficient to meet the adoption target by 2027 and even by 2030. This is primarily attributed to historically low adoption rates and the continued mediocre economic performance of BTM storage systems.**
  - SF growth is forecasted to be the same as S1 since it is also under the current NEM at retail rates where storage systems do not provide the value-add of maximizing self-consumption.
  - With the additional upfront incentives targeted at the MF sector, more MF battery systems are expected to come online. This helps improve the equity distribution of storage access, though total adoption is still minimal due to mediocre customer storage performance.

GWP Customer Storage Penetration - Widespread Adoption Scenario

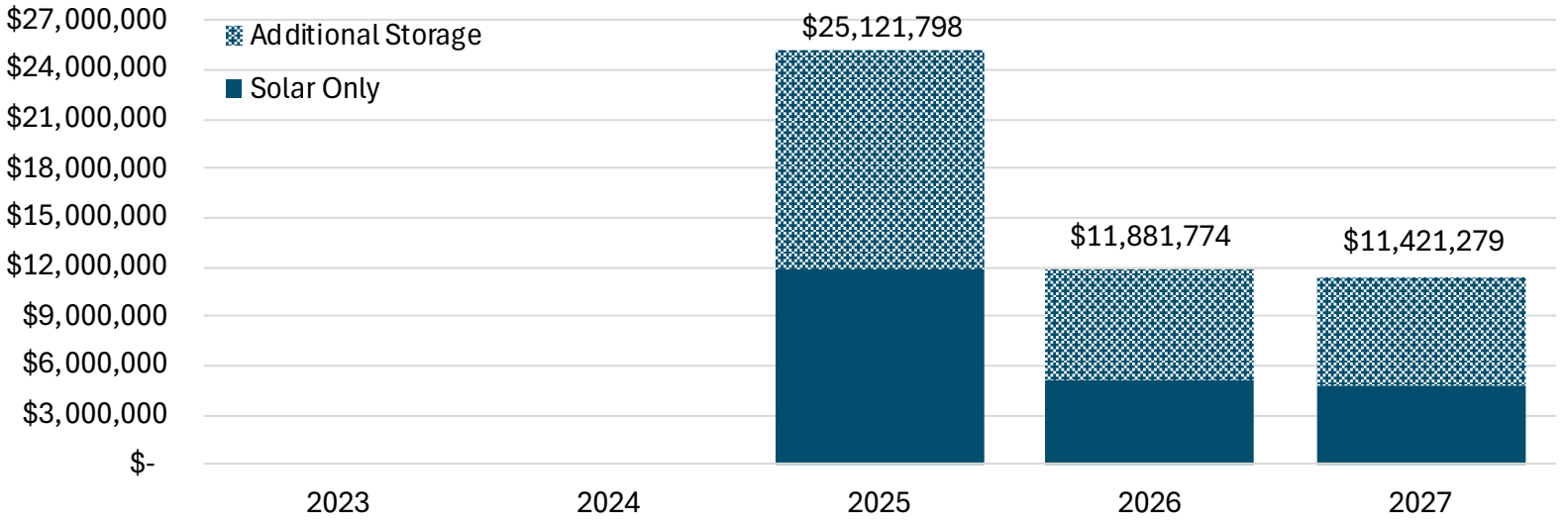


Customer Solar and Storage Adoption Modeling Results

Scenario 5 – Direct Install Adoption (Solar and Battery Storage)

- **As a hypothetical scenario, scenario 5 explores the feasibility and cost implications of a hypothetical GWP Direct Install Program covering upfront costs of solar and storage (net of available federal IRA tax credits) to achieve 10% adoption of each by 2027 focusing on multi-family, renter, and low- to moderate-income customers.**
- **Estimates build on the Business as Usual (Scenario 0) forecast and calculate the incremental system installations needed to reach the City Council Targets.**
- **Launching a direct install program would incur an estimated cost of $48 million for a program period of 2025-2027, covering upfront expenses alone (net of federal and state subsidies). This cost estimate does not cover NEM compensation for these systems which will be costly in the long run.**

Utility Upfront Costs of S5 Direct Install



These systems were allocated to the "Multi-family, Renter, Low- and Moderate-Income" customer types within the model.

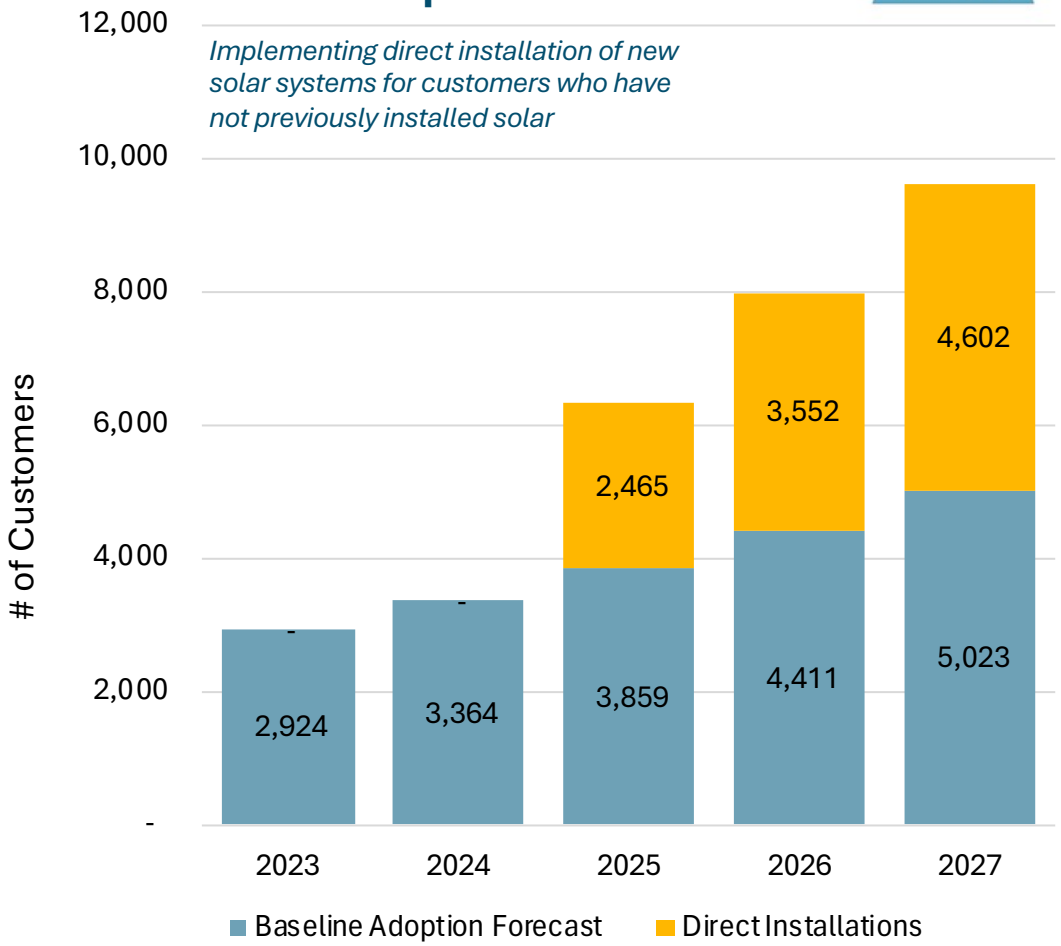
This was intended to increase access to customers historically excluded from solar and storage adoption. It is also more cost-effective from the utility program perspective, as it involves smaller system sizes per customer and allows multiple customers to benefit from installing a single system.

Customer Solar and Storage Adoption Modeling Results

Scenario 5 – Direct Install Adoption (Solar and Battery Storage)

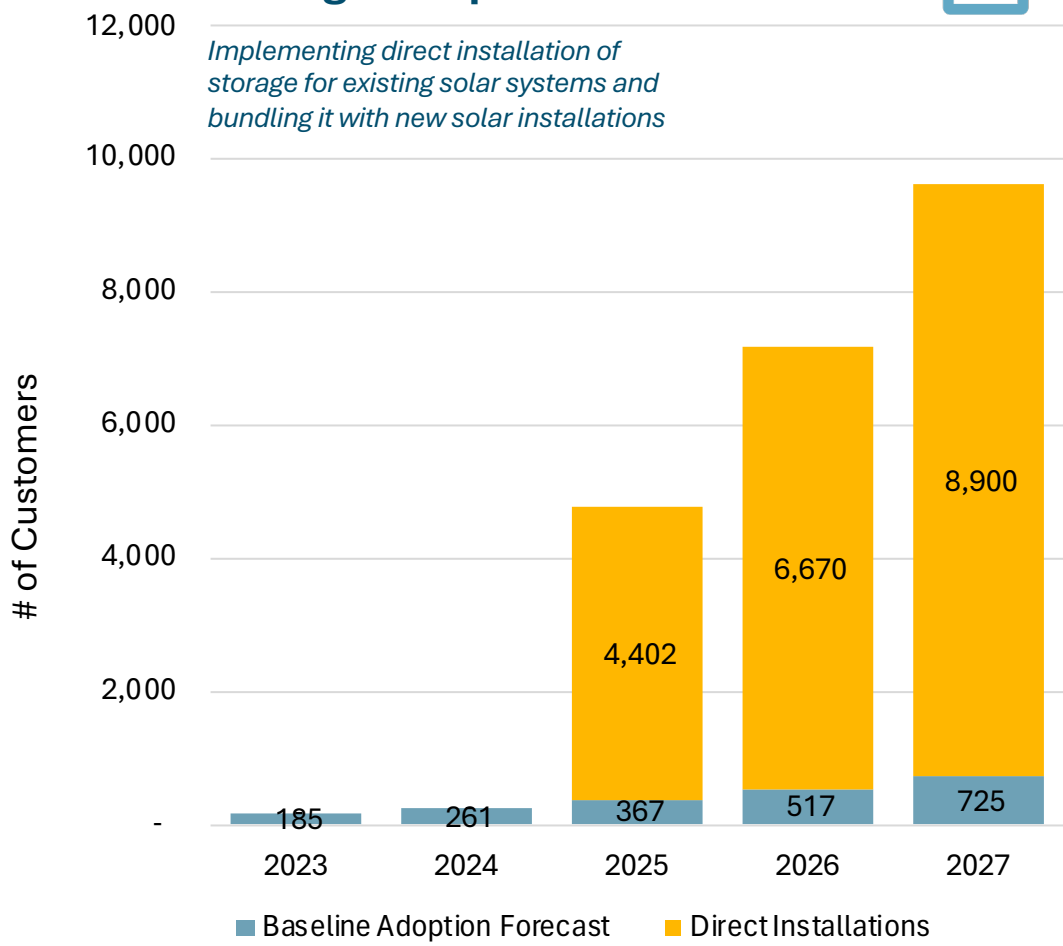
Solar Adoption

Implementing direct installation of new solar systems for customers who have not previously installed solar



Storage Adoption

Implementing direct installation of storage for existing solar systems and bundling it with new solar installations

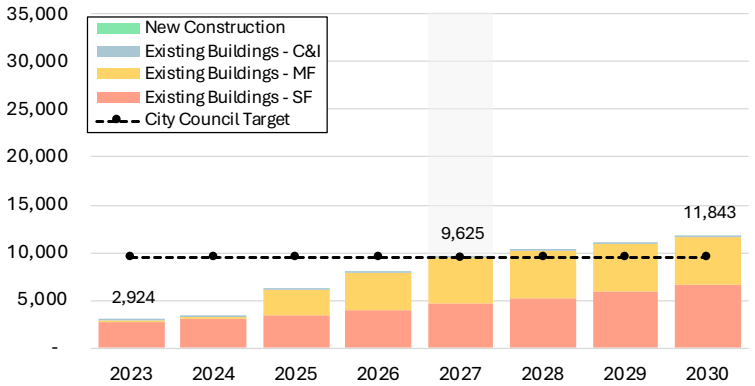


Customer Solar and Storage Adoption Modeling Results

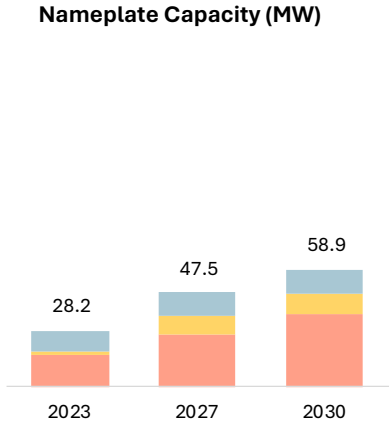
Scenario 5 – Direct Install Adoption (Solar and Battery Storage)

GWP Customer Solar Penetration - Direct Install Scenario

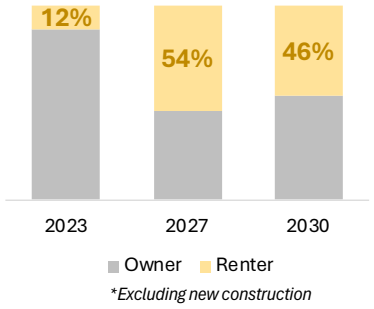
of GWP Electric Service Customers



Nameplate Capacity (MW)

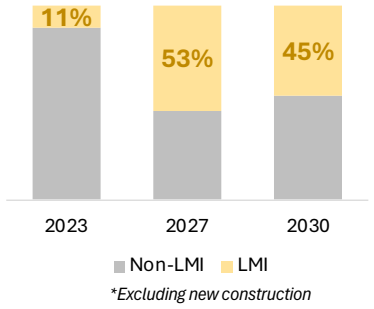


Owner vs Renter



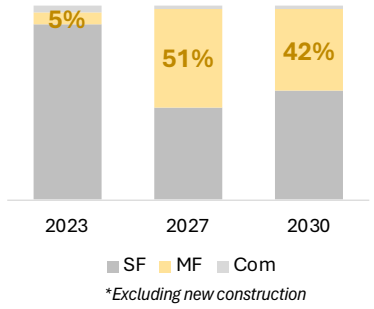
**Excluding new construction*

LMI vs Non-LMI



**Excluding new construction*

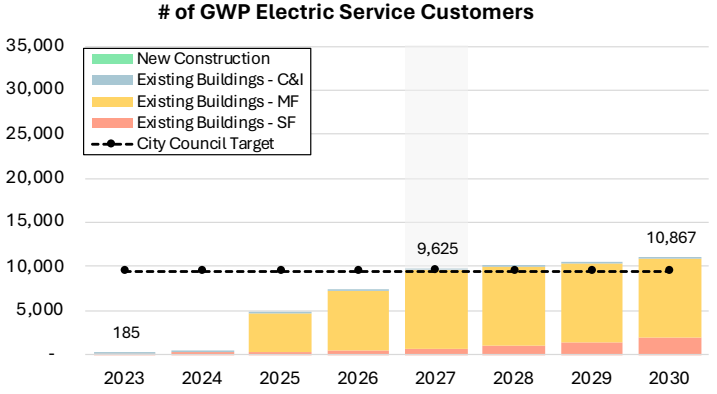
SF vs MF vs C&I



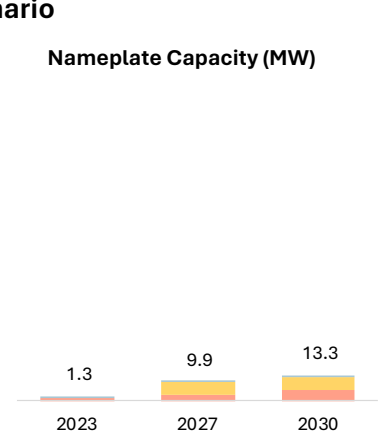
**Excluding new construction*

GWP Customer Storage Penetration - Direct Install Scenario

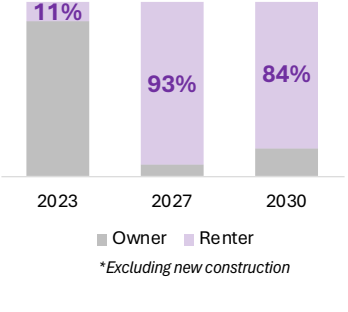
of GWP Electric Service Customers



Nameplate Capacity (MW)



Owner vs Renter

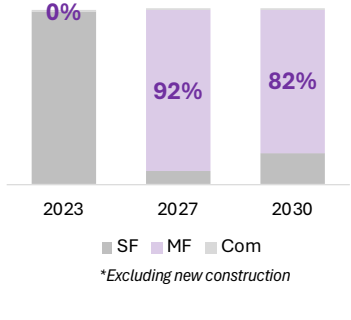


**Excluding new construction*

LMI vs Non-LMI

**Excluding new construction*

SF vs MF vs C&I



**Excluding new construction*

Section 7.6

Detailed Model Results: Utility Incentives & Bill Savings

Energy+Environmental Economics

Customer Solar Bill Savings

2025 Bill Savings ($/kWh)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.26	$0.13	$0.18	$0.26
Single-Family	Tenant	Non-LMI	$0.27	$0.16	$0.20	$0.27
Single-Family	Owner	LMI	$0.27	$0.13	$0.17	$0.27
Single-Family	Owner	Non-LMI	$0.28	$0.16	$0.20	$0.28
Multi-Family Low-Rise	Tenant	LMI	$0.23	$0.12	$0.16	$0.23
Multi-Family Low-Rise	Tenant	Non-LMI	$0.24	$0.15	$0.18	$0.24
Multi-Family Low-Rise	Owner	LMI	$0.24	$0.09	$0.15	$0.24
Multi-Family Low-Rise	Owner	Non-LMI	$0.24	$0.15	$0.19	$0.24
Multi-Family High-Rise	Tenant	LMI	$0.23	$0.13	$0.17	$0.23
Multi-Family High-Rise	Tenant	Non-LMI	$0.24	$0.16	$0.19	$0.24
Multi-Family High-Rise	Owner	LMI	$0.23	$0.11	$0.16	$0.23
Multi-Family High-Rise	Owner	Non-LMI	$0.26	$0.19	$0.22	$0.26
C&I Small	Tenant	N/A	$0.25	$0.14	$0.14	$0.25
C&I Small	Owner	N/A	$0.25	$0.14	$0.14	$0.25
C&I Medium	Tenant	N/A	$0.15	$0.11	$0.11	$0.15
C&I Medium	Owner	N/A	$0.15	$0.11	$0.11	$0.15
C&I Large	Tenant	N/A	$0.13	$0.11	$0.11	$0.13
C&I Large	Owner	N/A	$0.13	$0.12	$0.12	$0.13

2030 Bill Savings ($/kWh)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.32	$0.18	$0.23	$0.32
Single-Family	Tenant	Non-LMI	$0.33	$0.21	$0.25	$0.33
Single-Family	Owner	LMI	$0.33	$0.17	$0.22	$0.33
Single-Family	Owner	Non-LMI	$0.34	$0.21	$0.25	$0.34
Multi-Family Low-Rise	Tenant	LMI	$0.28	$0.16	$0.21	$0.28
Multi-Family Low-Rise	Tenant	Non-LMI	$0.29	$0.19	$0.23	$0.29
Multi-Family Low-Rise	Owner	LMI	$0.29	$0.14	$0.19	$0.29
Multi-Family Low-Rise	Owner	Non-LMI	$0.30	$0.20	$0.23	$0.30
Multi-Family High-Rise	Tenant	LMI	$0.28	$0.17	$0.21	$0.28
Multi-Family High-Rise	Tenant	Non-LMI	$0.29	$0.20	$0.24	$0.29
Multi-Family High-Rise	Owner	LMI	$0.28	$0.15	$0.20	$0.28
Multi-Family High-Rise	Owner	Non-LMI	$0.32	$0.24	$0.27	$0.32
C&I Small	Tenant	N/A	$0.31	$0.19	$0.19	$0.31
C&I Small	Owner	N/A	$0.31	$0.19	$0.19	$0.31
C&I Medium	Tenant	N/A	$0.18	$0.14	$0.14	$0.18
C&I Medium	Owner	N/A	$0.18	$0.14	$0.14	$0.18
C&I Large	Tenant	N/A	$0.16	$0.15	$0.15	$0.16
C&I Large	Owner	N/A	$0.16	$0.15	$0.15	$0.16

S1 Net energy metering at retail rates
Continue Current NEM

S2 Net energy billing at avoided costs
Targeted LMI MF Adoption

S3 Net energy billing above avoided costs but below retail rates
Balanced

S4 Net energy metering at retail rates
Widespread Adoption

S0 and S5 represent bookend scenarios derived from standalone, simplified back-of-envelope calculations, intended to provide a broad estimate of magnitude. Since these scenarios were not processed through the detailed adoption modeling (RESTORE), they do not include results related to bill savings or utility incentives.

Customer Storage Bill Savings

2025 Bill Savings ($/kWh)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.26	$0.18	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.27	$0.20	$0.00
Single-Family	Owner	LMI	$0.00	$0.26	$0.19	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.28	$0.21	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$0.08	$0.06	$0.00
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.24	$0.17	$0.00
Multi-Family Low-Rise	Owner	LMI	$0.00	$0.10	$0.07	$0.00
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.24	$0.17	$0.00
Multi-Family High-Rise	Tenant	LMI	$0.00	$0.08	$0.06	$0.00
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.24	$0.17	$0.00
Multi-Family High-Rise	Owner	LMI	$0.00	$0.10	$0.07	$0.00
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.26	$0.19	$0.00
C&I Small	Tenant	N/A	$0.00	$0.25	$0.25	$0.00
C&I Small	Owner	N/A	$0.00	$0.25	$0.25	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.14	$0.14	$0.00
C&I Medium	Owner	N/A	$0.00	$0.14	$0.14	$0.00
C&I Large	Tenant	N/A	$0.00	$0.12	$0.12	$0.00
C&I Large	Owner	N/A	$0.00	$0.10	$0.10	$0.00

2030 Bill Savings ($/kWh)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.26	$0.19	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.28	$0.21	$0.00
Single-Family	Owner	LMI	$0.00	$0.27	$0.19	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.29	$0.21	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$0.05	$0.03	$0.00
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.23	$0.16	$0.00
Multi-Family Low-Rise	Owner	LMI	$0.00	$0.08	$0.05	$0.00
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.24	$0.16	$0.00
Multi-Family High-Rise	Tenant	LMI	$0.00	$0.04	$0.03	$0.00
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.24	$0.17	$0.00
Multi-Family High-Rise	Owner	LMI	$0.00	$0.07	$0.05	$0.00
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.24	$0.17	$0.00
C&I Small	Tenant	N/A	$0.00	$0.26	$0.26	$0.00
C&I Small	Owner	N/A	$0.00	$0.26	$0.26	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.13	$0.13	$0.00
C&I Medium	Owner	N/A	$0.00	$0.13	$0.13	$0.00
C&I Large	Tenant	N/A	$0.00	$0.10	$0.10	$0.00
C&I Large	Owner	N/A	$0.00	$0.07	$0.07	$0.00

S1 Net energy metering at retail rates
Continue Current NEM

S2 Net energy billing at avoided costs
Targeted LMI MF Adoption

S3 Net energy billing above avoided costs but below retail rates
Balanced

S4 Net energy metering at retail rates
Widespread Adoption

S0 and S5 represent bookend scenarios derived from standalone, simplified back-of-envelope calculations, intended to provide a broad estimate of magnitude. Since these scenarios were not processed through the detailed adoption modeling (RESTORE), they do not include results related to bill savings or utility incentives.

Customer Solar Utility Incentives

2025 Utility Incentive ($/W)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$2.59	$1.36	$1.20
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.18
Multi-Family Low-Rise	Owner	LMI	$0.00	$2.59	$1.48	$1.18
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.13
Multi-Family High-Rise	Tenant	LMI	$0.00	$2.60	$1.34	$1.20
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.17
Multi-Family High-Rise	Owner	LMI	$0.00	$2.59	$1.42	$1.19
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.02
C&I Small	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Small	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Owner	N/A	$0.00	$0.00	$0.00	$0.00

2030 Utility Incentive ($/W)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$2.28	$0.72	$0.59
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.56
Multi-Family Low-Rise	Owner	LMI	$0.00	$2.28	$0.84	$0.56
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.51
Multi-Family High-Rise	Tenant	LMI	$0.00	$2.29	$0.69	$0.59
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.55
Multi-Family High-Rise	Owner	LMI	$0.00	$2.28	$0.77	$0.58
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.37
C&I Small	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Small	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Owner	N/A	$0.00	$0.00	$0.00	$0.00

S1 No utility incentives
Continue Current NEM

S2 Direct install for all MF LMI customers
Targeted LMI MF Adoption

S3 Guaranteed 7-yr payback for all MF LMI customers
Balanced

S4 Guaranteed 5-yr payback for all MF customers
Widespread Adoption

S0 and S5 represent bookend scenarios derived from standalone, simplified back-of-envelope calculations, intended to provide a broad estimate of magnitude. Since these scenarios were not processed through the detailed adoption modeling (RESTORE), they do not include results related to bill savings or utility incentives.

Customer Storage Utility Incentives

2025 Utility Incentive ($/W)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$1.65	$1.50	$1.72
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.72
Multi-Family Low-Rise	Owner	LMI	$0.00	$1.65	$1.46	$1.75
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.72
Multi-Family High-Rise	Tenant	LMI	$0.00	$1.65	$1.50	$1.72
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.72
Multi-Family High-Rise	Owner	LMI	$0.00	$1.65	$1.46	$1.73
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.73
C&I Small	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Small	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Owner	N/A	$0.00	$0.00	$0.00	$0.00

2030 Utility Incentive ($/W)

Building Type	Ownership Status	Income Class	S1	S2	S3	S4
Single-Family	Tenant	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Tenant	Non-LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	LMI	$0.00	$0.00	$0.00	$0.00
Single-Family	Owner	Non-LMI	$0.00	$0.00	$0.00	$0.00
Multi-Family Low-Rise	Tenant	LMI	$0.00	$1.58	$1.49	$1.67
Multi-Family Low-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.67
Multi-Family Low-Rise	Owner	LMI	$0.00	$1.58	$1.43	$1.71
Multi-Family Low-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.67
Multi-Family High-Rise	Tenant	LMI	$0.00	$1.58	$1.49	$1.67
Multi-Family High-Rise	Tenant	Non-LMI	$0.00	$0.00	$0.00	$1.67
Multi-Family High-Rise	Owner	LMI	$0.00	$1.58	$1.44	$1.68
Multi-Family High-Rise	Owner	Non-LMI	$0.00	$0.00	$0.00	$1.69
C&I Small	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Small	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Medium	Owner	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Tenant	N/A	$0.00	$0.00	$0.00	$0.00
C&I Large	Owner	N/A	$0.00	$0.00	$0.00	$0.00

S1 No utility incentives
Continue Current NEM

S2 Direct install for all MF LMI customers
Targeted LMI MF Adoption

S3 Guaranteed 7-yr payback for all MF LMI customers
Balanced

S4 Guaranteed 5-yr payback for all MF customers
Widespread Adoption

S0 and S5 represent bookend scenarios derived from standalone, simplified back-of-envelope calculations, intended to provide a broad estimate of magnitude. Since these scenarios were not processed through the detailed adoption modeling (RESTORE), they do not include results related to bill savings or utility incentives.

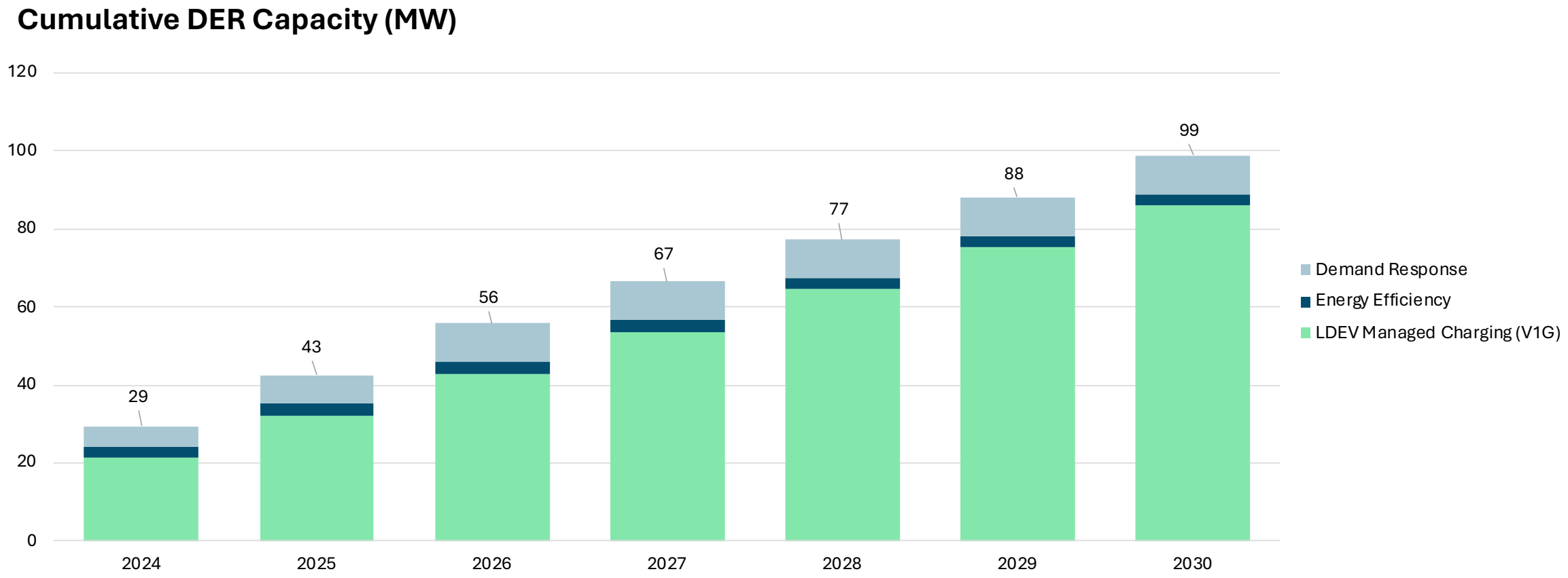
Section 7.7

Detailed Model Results: Other DER Technologies

Energy+Environmental Economics

Key Results: Adoption Forecast for Other DERs (MW)

- For this study, E3 modeled a single adoption scenario for electric vehicles (EVs), demand response (DR), and energy efficiency (EE) based on information from GWP's IRP
- These adoption forecast estimates were presented with a range in downstream analysis to account for uncertainties that were not fully addressed



Residential & Commercial Demand Response Adoption Forecast

- **For the purposes of this study, the DR adoption forecast was based on GWP's current plan of a 4-year residential and commercial DR program**
  - A four-year residential and commercial DR program with an online marketplace that aims to deliver up to 10 MW of load reduction during DR events by the end of the program term
  - At the end of FY 2022-2023, a total of 2.5 MW was under control, representing 25% of the 4-year program goal

EV Adoption Forecast

- For the purposes of this study, the EV adoption forecast was derived from the GWP IRP to ensure consistency in analysis assumptions
- GWP's IRP adopted the CEC's IEPR forecast's general assumptions without any modifications
- E3 made the following assumptions to approximate nameplate capacity from light-duty EV (LDEV) managed charging
  - 100% Light-duty BEV (LD-BEV)
  - 50% L1 and 50% L2
  - L1 Charger: 1.4 kW
  - L2 Charger: 7.2 kW

In 2021, GWP conducted a Clean Energy Analysis with Ascend Analytics, utilizing the electric vehicle projections provided by the CEC (below)

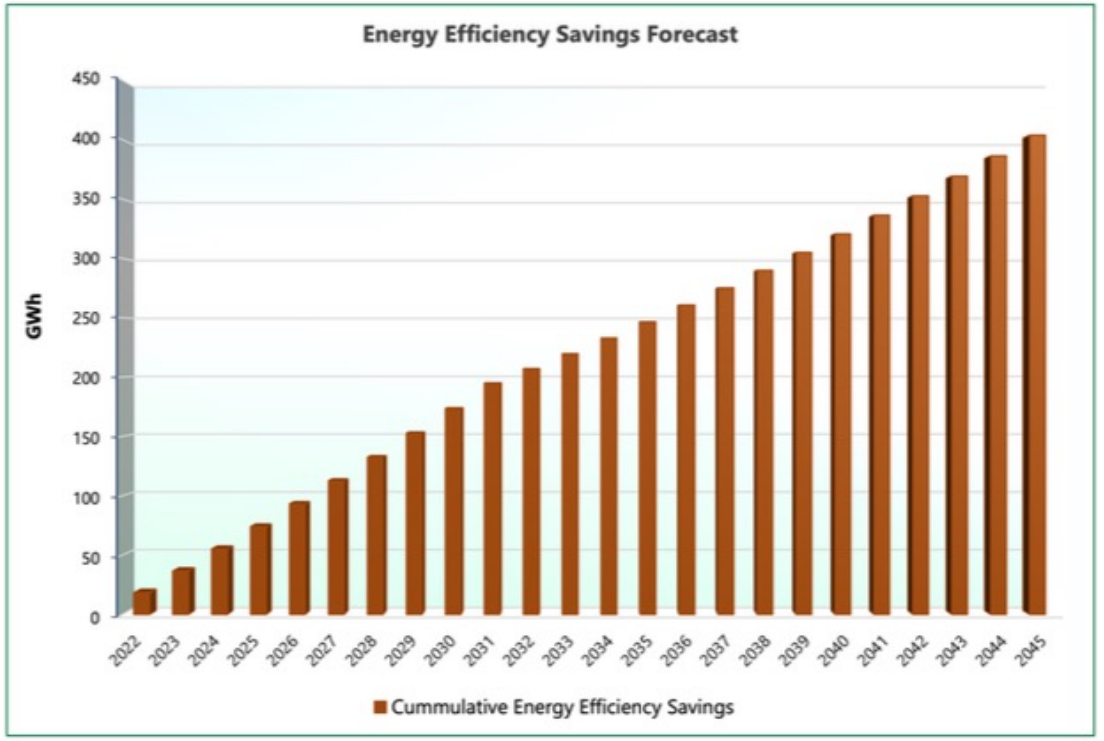
Year	EV Energy Load (MWh)	GHG Emissions (MT)	Number of EVs	Equivalent Emissions from Gas Vehicles (MT)
2024	85,998	36,549	5,000	97,049
2025	99,656	42,354	7,500	112,462
2026	113,921	48,417	10,000	128,560
2027	128,522	54,622	12,500	145,037
2028	143,540	61,004	15,000	161,985
2029	158,089	67,188	17,500	178,403
2030	173,026	73,536	20,000	195,260
2031	181,677	77,213	22,500	205,023
2032	190,761	81,074	25,000	215,274
2033	200,299	85,127	27,500	226,038
2034	210,314	89,384	30,000	237,340
2035	220,830	93,853	32,500	249,207
2036	231,872	98,545	35,000	261,667
2037	243,465	103,473	37,500	274,750
2038	255,638	108,646	40,000	288,488
2039	268,420	114,079	42,500	302,912
2040	281,841	119,783	45,000	318,058
2041	295,933	125,772	47,500	333,961
2042	310,730	132,060	50,000	350,659
2043	326,267	138,663	52,500	368,192
2044	342,580	145,596	55,000	386,601
2045	359,709	152,876	57,500	405,931

Energy Efficiency Peak Saving Forecast

- For the purposes of this study, the peak savings forecast for Energy Efficiency was derived from the GWP IRP to ensure consistency in analysis assumptions
- In 2021, the California Municipal Utilities Association (CMUA) hired GDS Associates, Inc. to analyze and quantify the potential impact of energy efficiency in CMUA member electric service territories
- The CMUA study serves as the foundation for energy efficiency targets for fiscal years 2022 through 2031, aiming to achieve 17,978 MWh per year in energy savings and 2,860 kW per year in demand response savings
- These figures were derived from the 10-year average of the forecasted figures developed by GDS

2022-2031 Forecast

- Energy Saving: 17,978 MWh/yr
- Peak Saving: 2,860 kW/yr
- *Assume peak saving already accounts for capacity contributions (i.e., after ELCC adjustment)*



Section 8
Cost and Benefit Analysis

Energy+Environmental Economics

Section 8.1

GWP Benefit-Cost Analysis Approach

Energy+Environmental Economics

Cost-Effectiveness and Cost Test Perspectives

- **The CPUC defines "cost-effective" and "cost-effectiveness" as a set of well-defined "cost tests in the California Standard Practice Manual (SPM)"***
- **These cost tests provide a methodological framework to examine the benefits and costs of a particular measure from different perspectives and have become a standard in many other jurisdictions**

Cost Test	Primary Question
PCT Participant Cost Test	Net benefit for customers who adopt solar?
RIM Ratepayer Impact Measure	Will utility rates increase or decrease?
PACT Program Administrator Cost Test	Will utility costs increase or decrease?
TRC Total Resource Cost Test	Net benefits to City of Glendale?
SCT Societal Cost Test	Net benefit to society as a whole?

* California Standard Practice Manual

Challenges and Strategies for DER Cost-Effectiveness

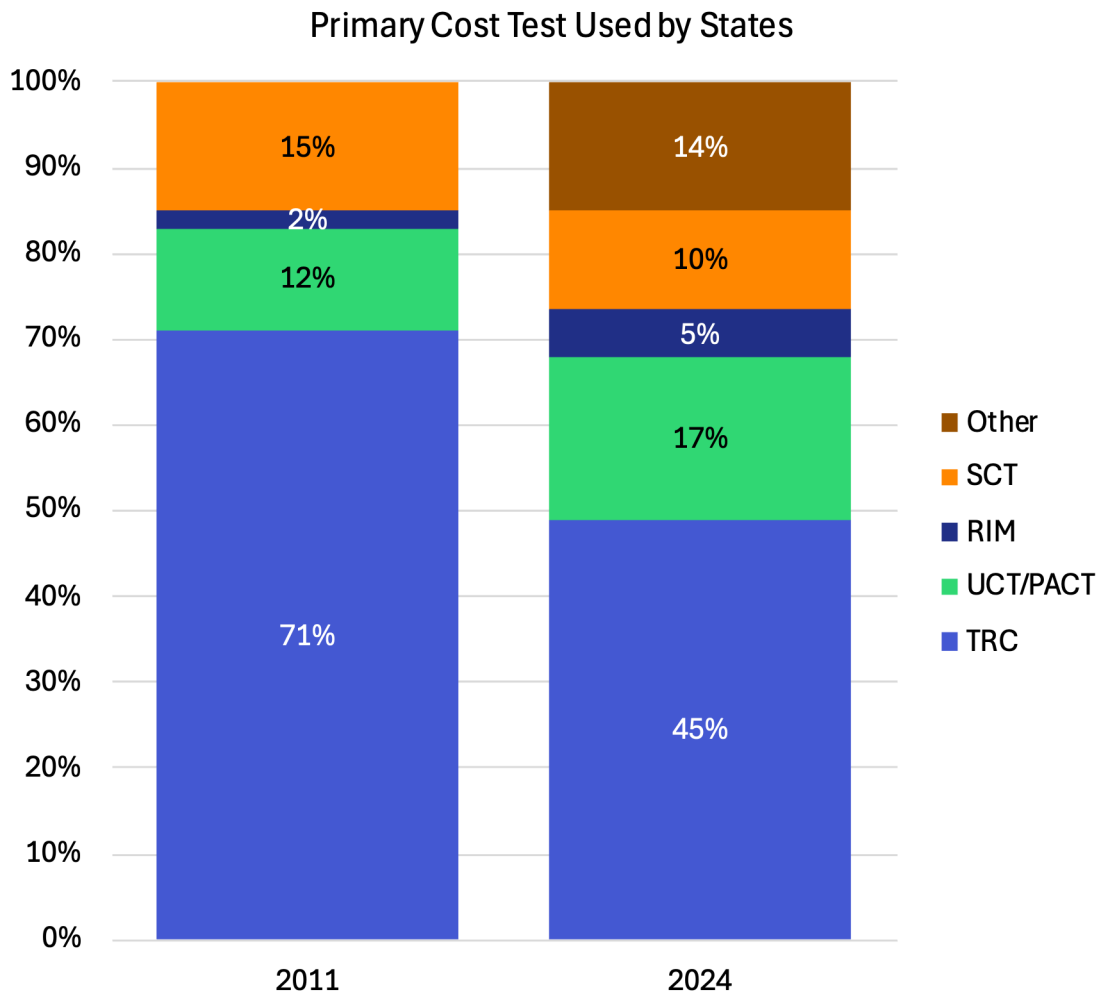
- **Jurisdictions have recently faced challenges considering DER cost-effectiveness as the zero GHG emission planning paradigm has emerged**
- **Causes for challenges for DER cost-effectiveness are:**
  - The cost-effectiveness of many EE/DER programs is decreasing due to increasingly stringent building codes and standards, coupled with declining marginal energy costs
  - The cost-effectiveness of building electrification can be difficult to achieve given the high upfront costs of appliances
  - Increased focus on resiliency and equity for local communities in driving interest in DERs
- **As a result of these challenges, jurisdictions have developed strategies for DER program evaluations, which have included:**
  - **Program Buckets:** Create separate categories for market transformation, policy, and equity programs, each with less stringent benefit-cost thresholds
  - **Update Avoided Costs:** Adjust to better reflect the decarbonized grid planning paradigm
  - **Consider Additional Benefit Categories:** Include societal, community, and non-energy benefits

State primary cost tests are shifting away from TRC

+ Many states continue to use the TRC as a primary cost test, but fewer than 10 years ago

- More states (CT, ME, MD, NH, NJ, RI) are shifting to state-specific costs tests that incorporate elements of the SCT and TRC
- Many additional states have modified traditional cost tests to better fit changing needs of electrification and fuel switching (CA, CO, MA, IL, WA, WI)
- Some states have multiple primary cost tests (MS, NC, OR, VA) that incorporate TRC along with UCT, PCT, and/or RIM
- Not all states have a dedicated primary cost test (AL, AK, NE, ND, SC, WV)

+ Some states use different cost-effectiveness criteria for low-income EE programs

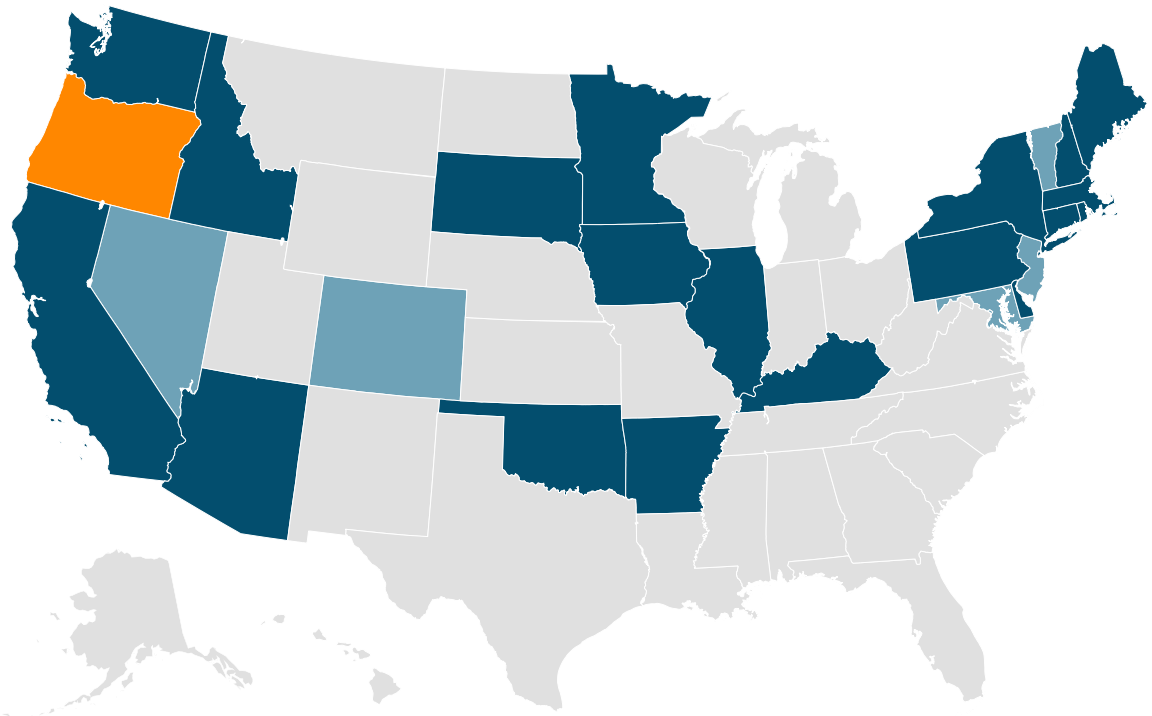


Cost-Effectiveness Testing for Energy Efficiency Programs
Database of Screening Practices (National Energy Screening Project, E4TheFuture)
Analysis of State Approaches to Cost-Effectiveness Testing

Non-Energy Benefit (NEB) Inclusion in Cost Tests

+ **Current types of NEBs included by other jurisdictions:**
  - **Monetized:** a dollar value per physical unit of impact for a specific NEB
  - **Quantitative:** metrics for physical units of impacts, but no dollar value
  - **Proxy:** a percent or dollar adder to account for unincluded qualitative NEBs
+ **Most jurisdictions and groups interested in NEBs are working on moving towards quantification as a more precise method of valuing all types of benefits**
+ **Not all types of cost tests can incorporate NEBs:**
  - **TRC**: utility and participant NEBs only
  - **SCT:** all NEBs, including societal
  - **UCT/PAC, PCT, RIM:** no NEBs included

Participant Non-Energy Benefits in U.S. States



Quantitative
Proxy (%)
Monetized

Applying DER cost-effectiveness challenges from other jurisdictions to GWP's adoption targets

- **GWP is not subject to the same regulatory requirements as IOUs for DER cost-effectiveness tests. However, demonstrating cost-effectiveness remains valuable for gaining City Council and public support.**
- **A benefit-cost analysis can be used to assess the costs and benefits under different perspectives (participants, ratepayers, society) for GWP to achieve its 10% solar and energy storage adoption target.**
- **A benefit-cost analysis can be used to inform appropriate incentive levels.**
  - Can inform incentives needed for customers to find DER adoption cost-effective
  - Can inform the amount of program funding that can prevent or minimize cost-shift to non-participants
  - Can inform the amount of program funding that can promote societal benefits of DERs
- **Given these use cases for GWP, E3 conducted a benefit-cost analysis under three key perspectives:**
  - Participants (Participant Cost Test, or "PCT")
  - Ratepayers (Ratepayer Impact Measure, or "RIM")
  - Society (Societal Cost Test, or "SCT")

Benefit-Cost Analysis Approach

E3 conducted a benefit-cost analysis for several representative GWP customer types

Results for individual representative customers were scaled up according to their share of GWP DER adoption, providing cost-effectiveness results for GWP's entire service territory

The analysis covers various scenarios that reflect GWP's implementation of different programs and incentives for DER adoption

The benefit-cost analysis assumes that GWP will introduce programs and/or incentives at the start of 2025 and evaluates all systems adopted from 2024 to 2030

E3 concentrated the analysis on solar and solar + storage systems, as these are the primary DER resources relevant for adoption target compliance

Building Types

- Single-Family
- Low-Rise Multi-Family
- High-Rise Multi-Family
- Small C&I
- Medium C&I
- Large C&I

Income Classes

- Low- to Moderate-Income (LMI)
- Non-LMI (general market)

Resiliency Values

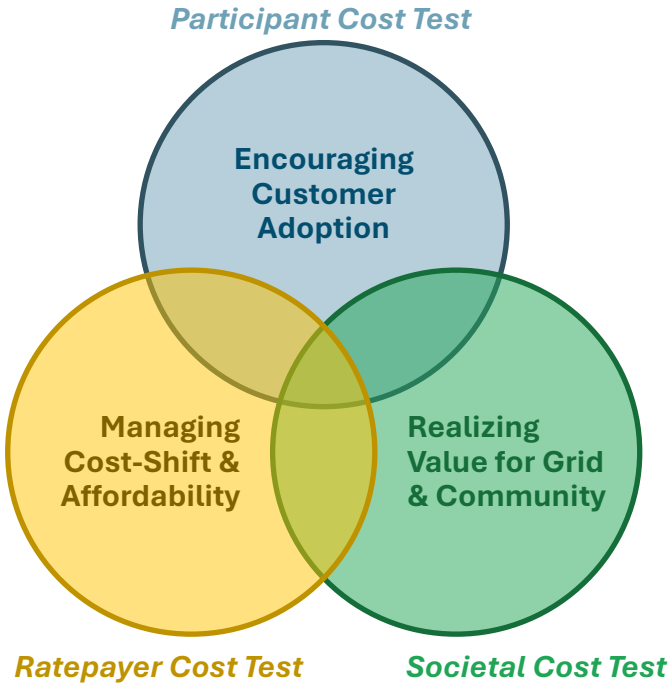
- Base resiliency value
- High resiliency value

Benefits and Costs Components by Cost Test Perspective

N/A
Cost
Benefit

Note: Administrative costs were not included in the cost tests. When interpreting the results, please consider these additional costs from both the ratepayer and administrator perspectives to ensure that all program implementation expenses are fully accounted for.

Component	Participant Cost Test (PCT)	Ratepayer Impact Measure (RIM)	Societal Cost Test (SCT)
Bill Savings	+	–	
Upfront Costs	–		–
Fixed Operations and Maintenance Costs	–		–
Federal and State Incentives	+		+
GWP Incentives	+	–	
Utility Avoided Costs		+	+
Resiliency Benefits	+		
Additional Societal Benefits			+



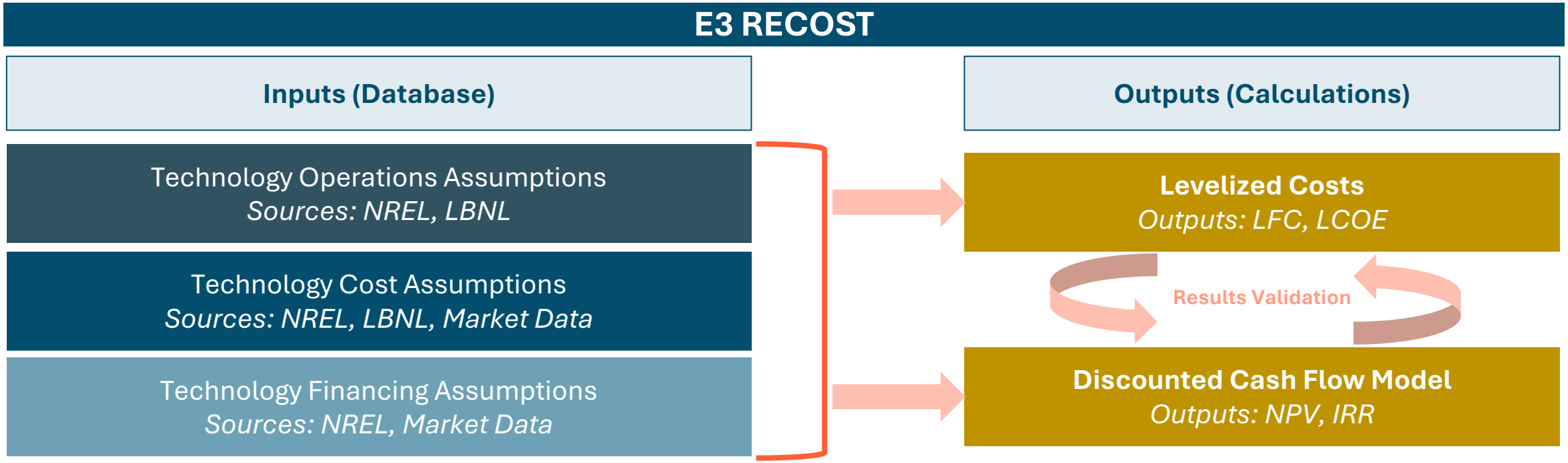
Section 8.2

GWP Benefit-Cost Analysis Inputs & Assumptions

Energy+Environmental Economics

Benefit-Cost Analysis Inputs: Upfront Costs

- Upfront costs for rooftop solar and behind-the-meter (BTM) storage systems were calculated based on the system sizes for each customer segment. These costs were used to determine the total upfront cost for system installations.
- The values used in this calculation were derived from RECOST, E3's internal resource pricing model, which incorporates inputs from various sources. For this study, the NREL ATB version used in RECOST was ATB 2023.



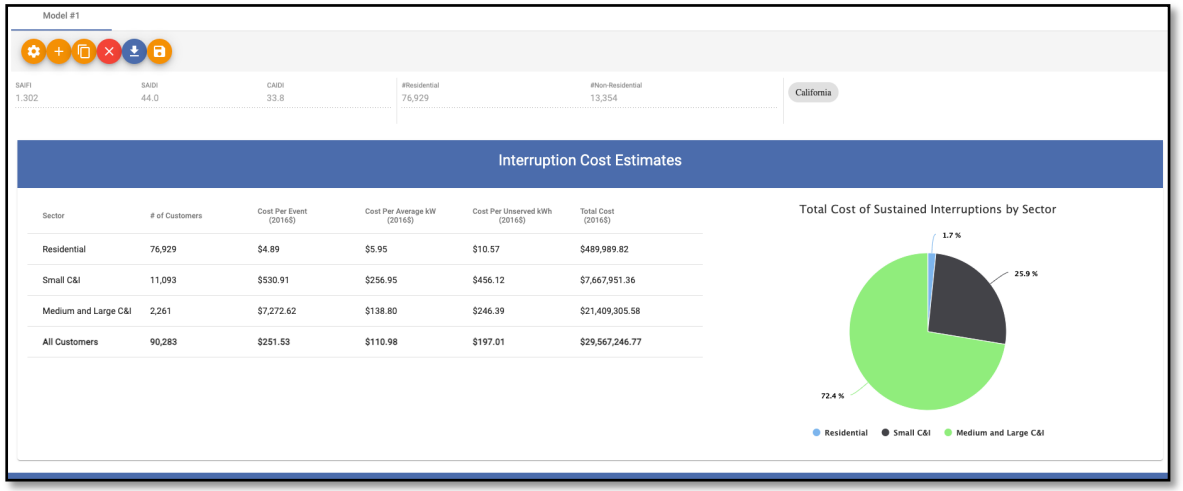
Benefit-Cost Analysis Inputs: Federal and State Incentives

- **Federal and state incentives were used to offset the upfront costs of solar and storage installations. These were applied prior to any additional GWP incentives.**
- **In scenarios with GWP direct install, incentives were assumed to still apply, leaving GWP to pay the difference between the full upfront cost and the applicable incentives.**

Discount Name	Jurisdiction	Amount	Timeline	Applicable Technologies
Solar Investment Tax Credit (ITC)	Federal	30%	30% expires in 2026, ITC is reduced to 22% in later years	Solar and/or storage
Self-Generation Incentive Program (SGIP)	California	$0.45/W as a general approximation	2024 and 2025 only	Storage only, not including new buildings

Benefit-Cost Analysis Inputs: Societal Benefits - Customer Resiliency Value

- **LBNL's Interruption Cost Estimate Calculator (ICE Calculator) uses user inputs to calculate the $ per kWh of lost load**
  - Number of Customers: GWP 2024 IRP
  - SAIDI and SAIFI: EIA-861
- **$ per kWh of lost load was converted to $ per total kWh annual load by multiplying by the probability of an outage in each minute**
  - Solar and storage gets the full value since it is assumed that a BTM solar and storage system would eliminate the number of outages per year to 0
  - Solar-only systems get no resiliency value
- **For this study, E3 developed sensitivities around resiliency values:**
  - **Base Resiliency**: default assumption in final analysis
  - **High Resiliency**: applies a 10x multiplier to the base resiliency values



Source: [LBNL Interruption Cost Estimate Calculator]

EIA 2016 Data on California Utilities

Utility Name	Ownership	SAIFI with MED	SAIDI with MED (m)	CAIDI with MED (m)	Number of Customers
Pacific Gas & Electric Co	Investor Owned	1.102	122	111	5,481,869
Southern California Edison Co	Investor Owned	1.100	134	122	5,060,528
Los Angeles Department of Water & Power	**Municipal**	**0.820**	**117**	**142**	**1,596,912**
San Diego Gas & Electric Co	Investor Owned	0.673	86	127	1,435,814
Sacramento Municipal Util Dist	Political Subdivision	1.560	95	61	618,193
Imperial Irrigation District	Political Subdivision	0.790	78	99	150,382
City of Anaheim - (CA)	Municipal	0.690	27	39	119,277
Modesto Irrigation District	Political Subdivision	0.450	30	67	114,183
City of Riverside - (CA)	Municipal	0.990	48	49	108,656
Turlock Irrigation District	Political Subdivision	0.540	57	106	85,650
City of Glendale - (CA)	Municipal	1.302	44	33	85,313

Source: [US Energy Information Administration, EIA-861 File]

Benefit-Cost Analysis Inputs: Societal Benefits - Social Costs of Carbon

- **The Social Cost of Carbon (SCC) represents the net value to society of increasing or reducing carbon dioxide levels**
  - The SCC is based on monetizing damages incurred by temperate changes, sea level rise, and CO2 concentrations as a product of increased emissions
- **Social Cost of Carbon is calculated using the EPA's 2022 "External Review Draft of Report on the Social Cost of Greenhouse Gases"**
  - The 2.0% discount rate option was selected as a mid-option
- **This value was converted to nominal dollars using historical and forward-looking inflation rates. It was then multiplied by the amount of CO2e avoided by solar and storage to calculate the final value.**

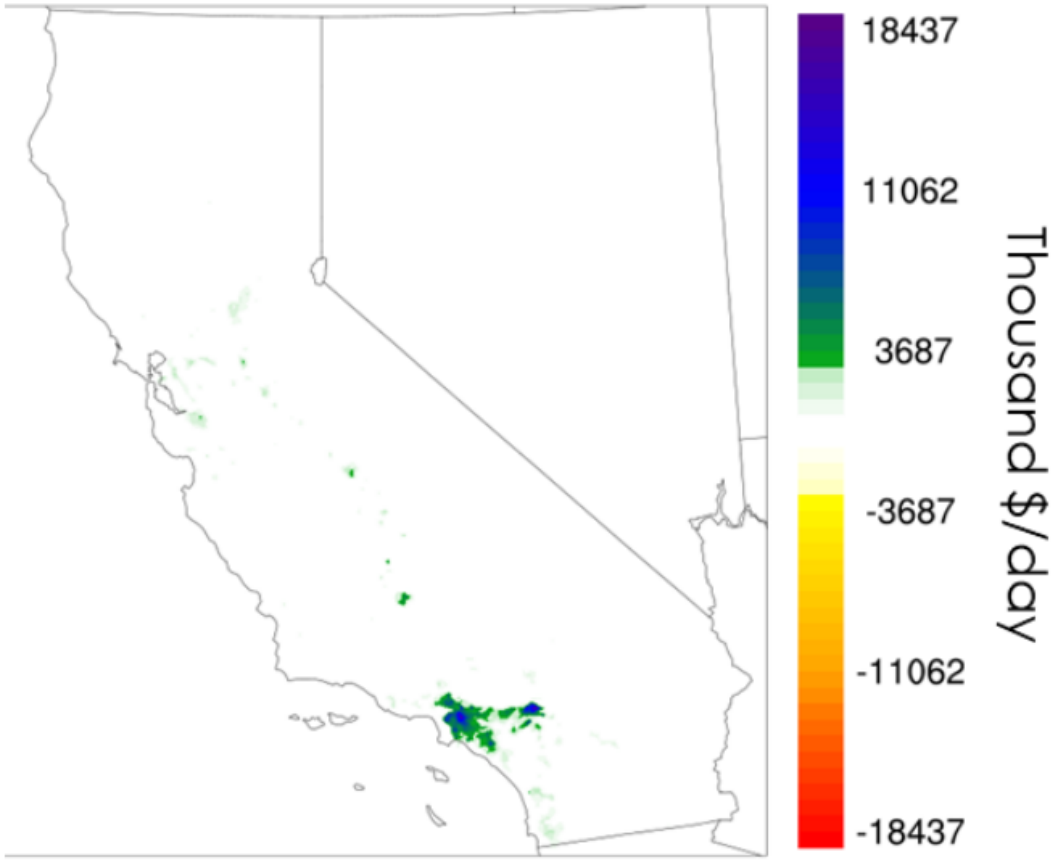
Emission Year	SC-CO_2 (2020 dollars per metric ton of CO_2) 2.5%	2.0%	1.5%
2020	120	190	340
2030	140	230	380
2040	170	270	430
2050	200	310	480
2060	230	350	530
2070	260	380	570
2080	280	410	600

Table ES.1: Estimates of the Social Cost of Greenhouse Gases (SC-GHG), 2020-2080 (2020 dollars), link to source.

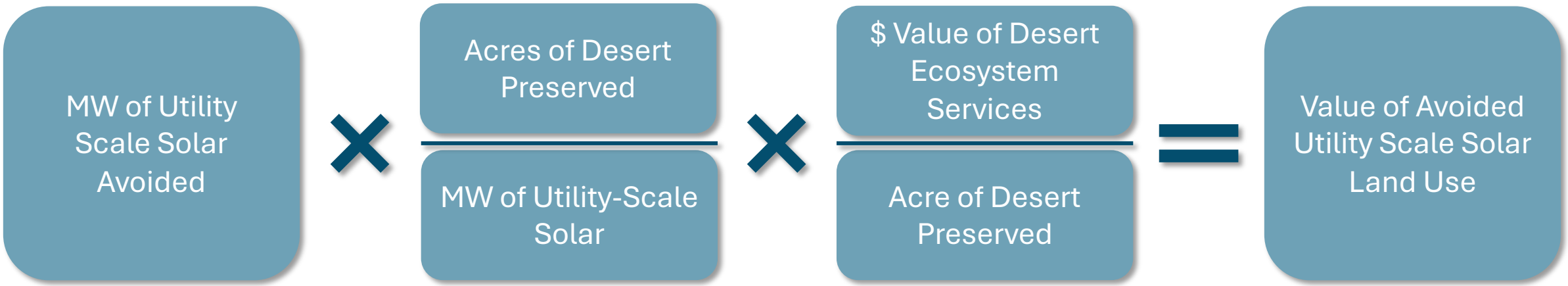
Benefit-Cost Analysis Inputs: Societal Benefits - Air Quality Adder (AQA)

- **Impacts of emissions on human health were calculated using the statewide Air Quality Adder (AQA). This value is recognized by the CPUC for the state societal cost test.**
- **The AQA value of $14/MWh of avoided gas generation was determined by the state-of-the-art air quality modeling done for the IDER proceeding in 2020/2021.**
- **Although the actual impact varies by region, the CPUC uses a single statewide value.**
  - Gas units may need to run for local reliability where impact is highest due to existing air quality concerns, weather patterns, and high population density (e.g., LA Basin).
  - E3 was unable to calculate a more spatially granular value within this scope of work.

Monetized Health Impact of Gas Generation by Location



Benefit-Cost Analysis Inputs: Societal Benefits - Land Use Impacts



Calculated using internal assumptions about capacity factors of rooftop and utility-scale solar and the assumed replacement resource of rooftop solar from the avoided costs workstream

Calculated using NREL research on single-axis large solar

Calculated using research from Chen and Costanza (2024) that includes potential ecosystem benefits such as raw material provisioning, surface water value, soil fertility, and generic diversity

Final calculated value is $3,768/MW-year of rooftop solar installed (in $2024)

Benefit-Cost Analysis Inputs: Additional Inputs

Input	Source
Customer loads	Building load shapes from NREL's ResStock and ComStock models
Solar generation profiles	Localized solar profiles from NREL's PVWatts model
Solar and storage system sizing	Internal DER potential and market segmentation analysis
Retail rates	GWP's latest residential and commercial retail rates, pulled from the GWP website
Storage dispatch schedule	Simulated by E3's RESTORE model in the adoption and impact analysis

+ **These additional inputs were run through RESTORE, E3's internal adoption and impact analysis model, to create bill savings, avoided costs, and emissions impacts of various levels of solar and storage adoption**

Section 8.3

GWP Benefit-Cost Analysis Key Results

Energy+Environmental Economics

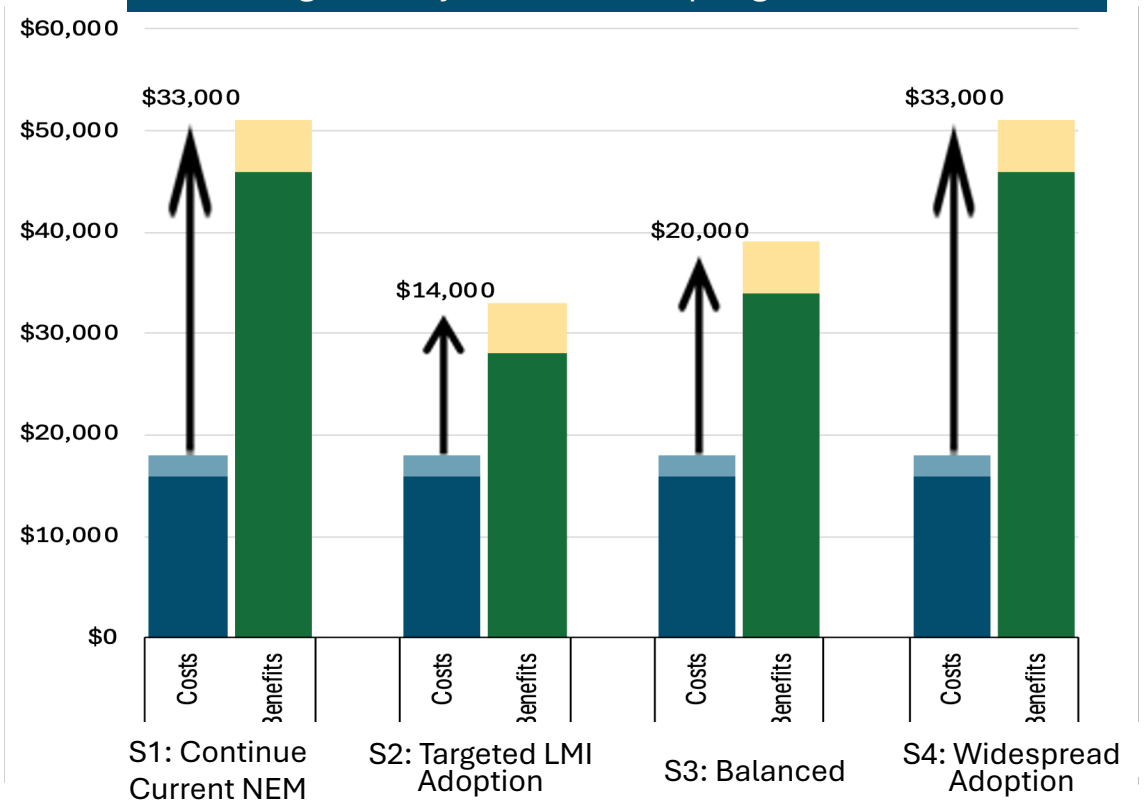
Participant Perspective (PCT)

Net Present Value of Per Customer Costs and Benefits

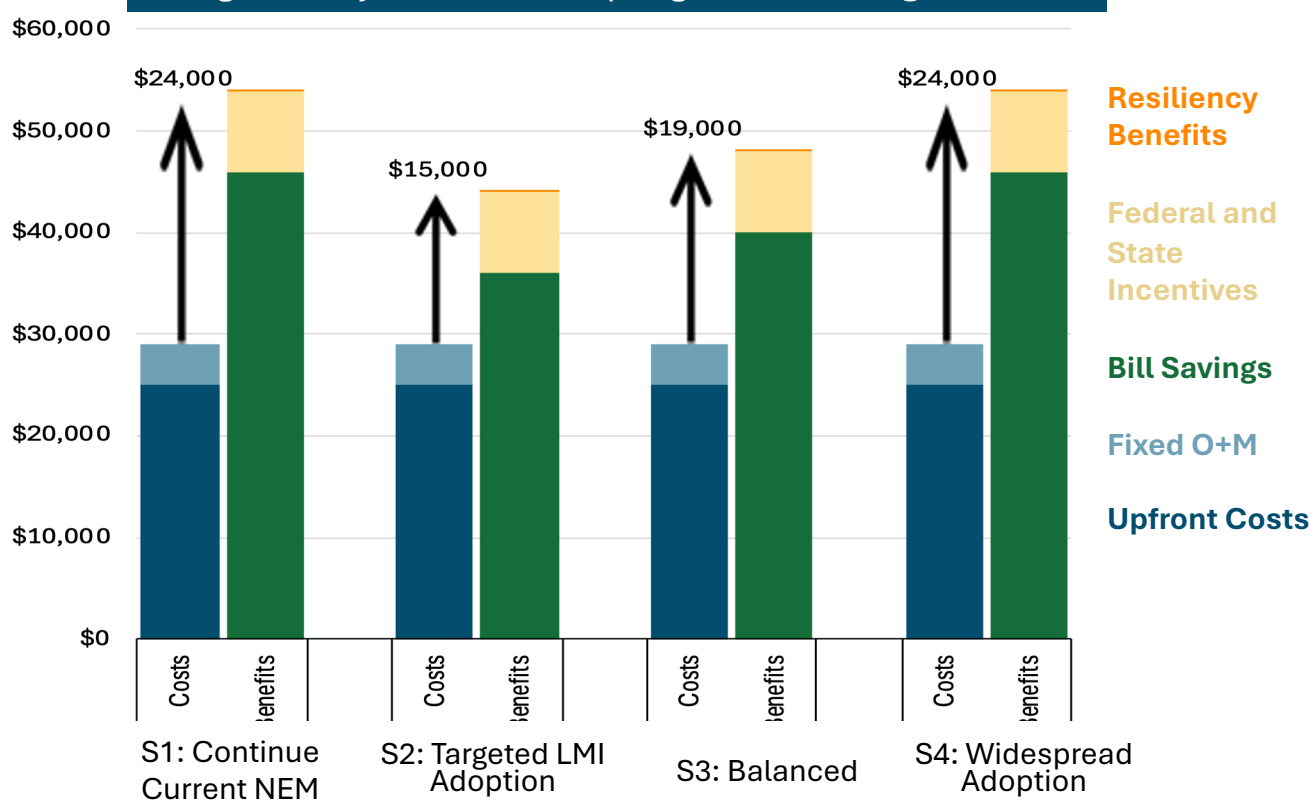
- Participant benefits include bill savings, federal and GWP incentives, and resiliency benefits
- Participant costs include upfront costs, maintenance costs, and interconnection fees

- In all scenarios, solar and solar + storage provide net benefits over the system's lifetime
- Driven by high bill savings under various billing mechanisms, even under net billing
- Despite lifetime savings, high upfront costs of solar and solar + storage may still pose barriers to adoption

Single-family customer adopting ***solar*** in 2025



Single-family customer adopting ***solar + storage*** in 2025



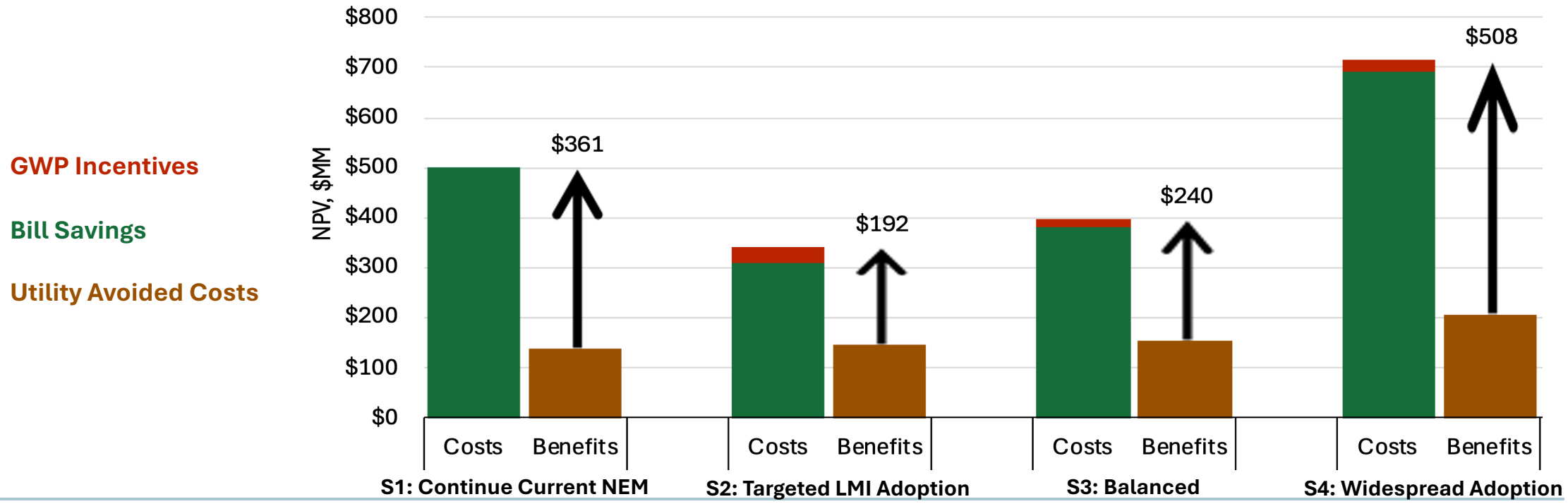
Perspective of All GWP Ratepayers (RIM)

(Participants + Non-Participants)

Total Glendale Ratepayer Costs and Benefits

For Solar and Solar + Storage Systems Adopted in 2024-2030

+ **Lifetime costs and benefits for compensating new solar and storage adopters from 2024 to 2030**
+ **Determined by the number of adopters, net metering/billing compensation level, and the level of additional utility incentives provided**
+ **Predictably, all scenarios have net ratepayer costs that increase GWP rates in order to accelerate DER adoption**



Glendale Societal Perspective (SCT)

+ The societal perspective captures benefits that accrue to society at large

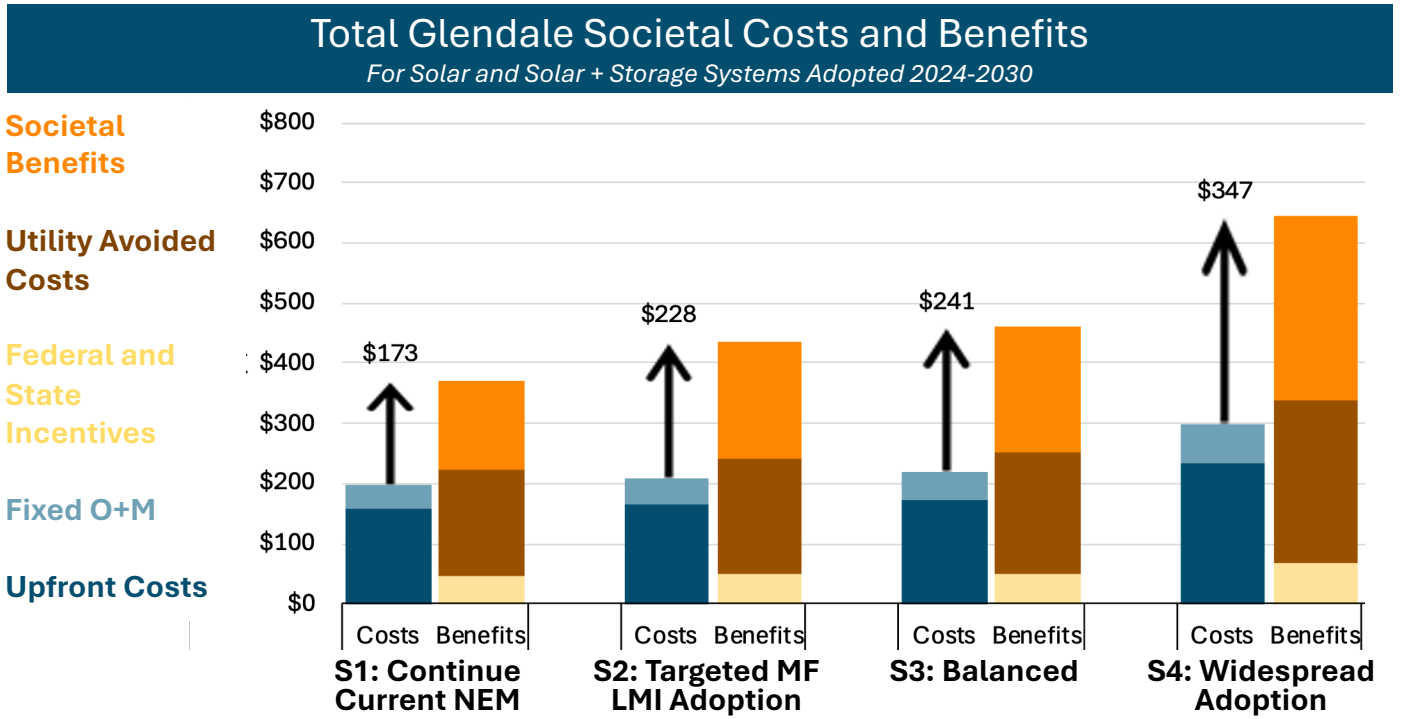
- Societal benefits include federal incentives, GWP avoided costs, and other societal benefits that can be monetized including reduced land use, air quality impacts, and reduced emissions
- Societal costs include upfront system costs and maintenance costs

+ Benefits or costs transferred within the boundaries of Glendale are not included

- For example, customer bill savings offered by GWP are not included

+ Solar and solar + storage provide net benefits to society across all scenarios

- Net benefits are driven by avoided utility costs and avoided CO_2 emissions



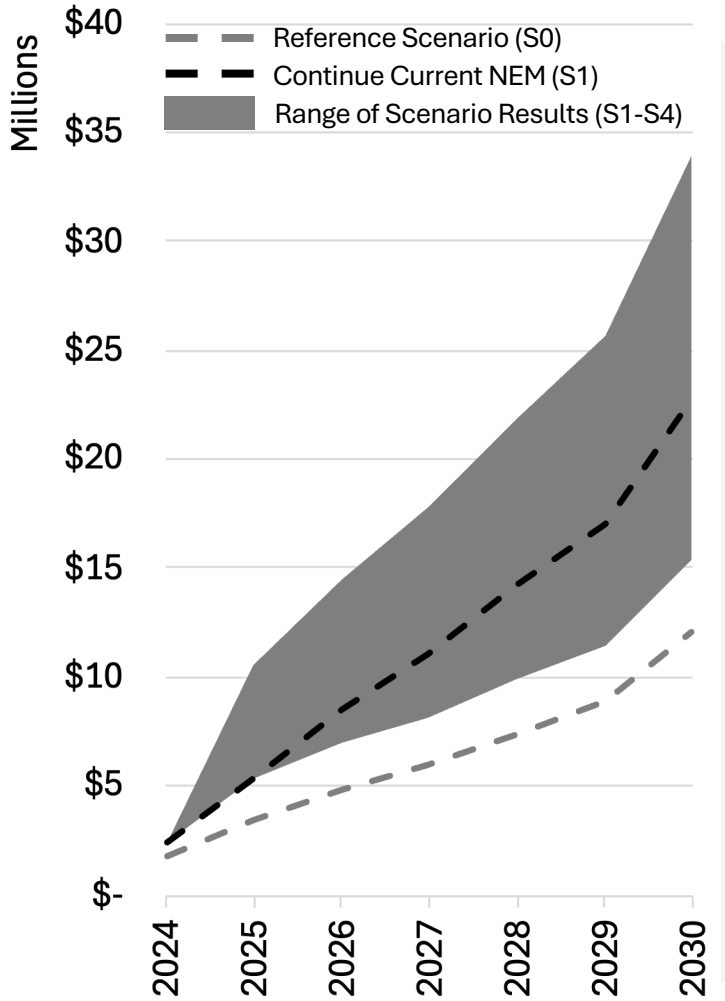
Economic Analysis of Scenarios: Cost Test Scores

$$\frac{Benefits}{Costs} \geq 1.0$$

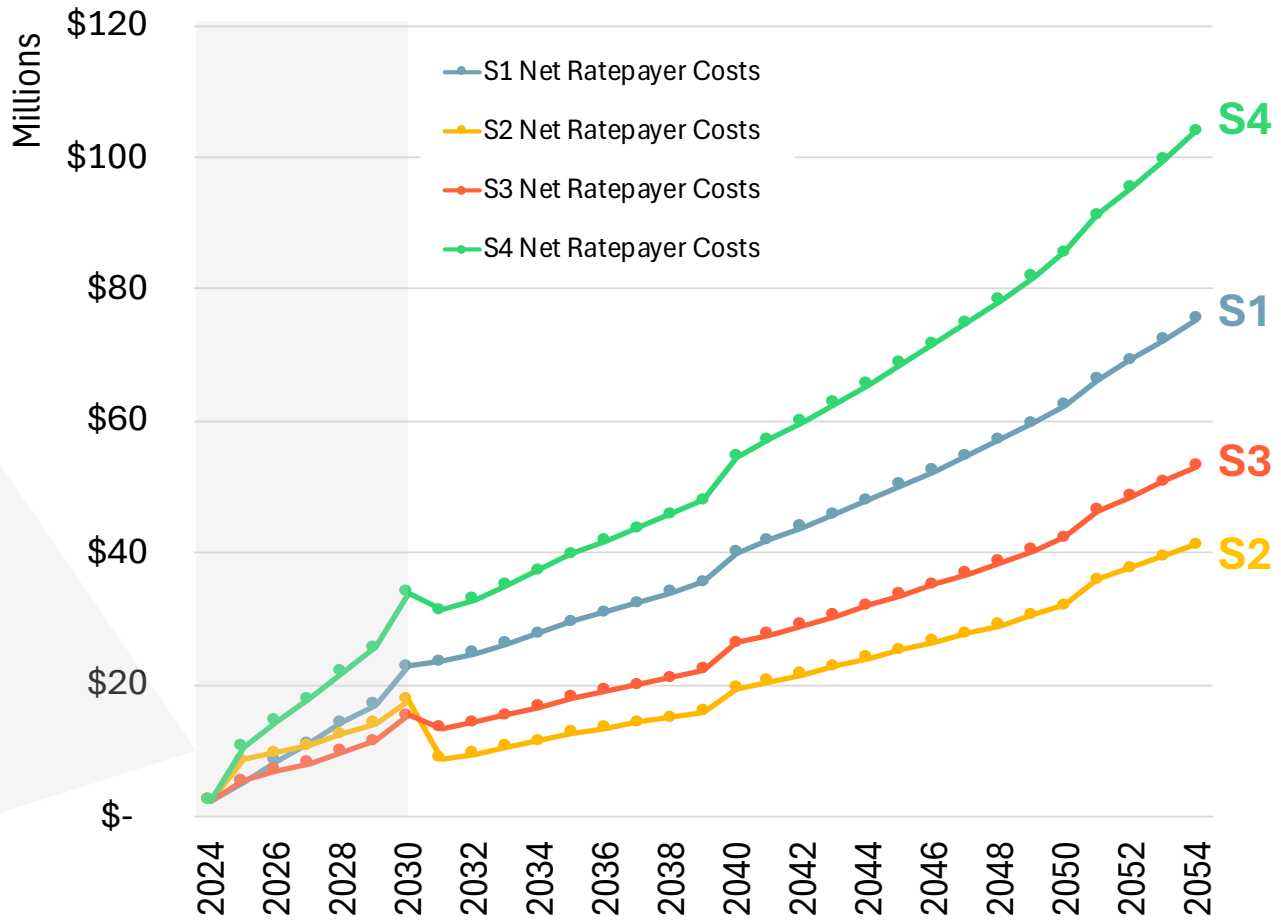
	Participant Cost Test	Societal Cost Test	Ratepayer Impact Measure
S1 Continue Current NEM	3.04	1.87	0.28
S2 Targeted LMI/MF Adoption	2.16	2.09	0.45
S3 Balanced	2.25	2.11	0.39
S4 Widespread Adoption	3.04	2.17	0.29

Annual Net Ratepayer Costs

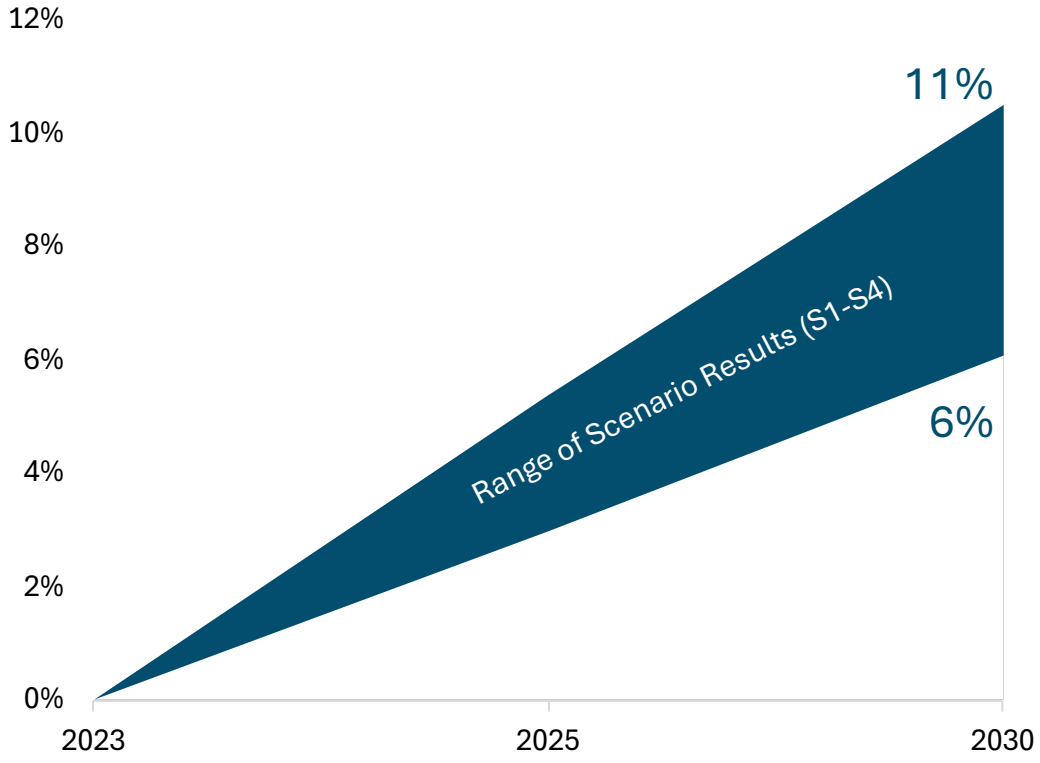
Annual Net Ratepayer Costs ($)

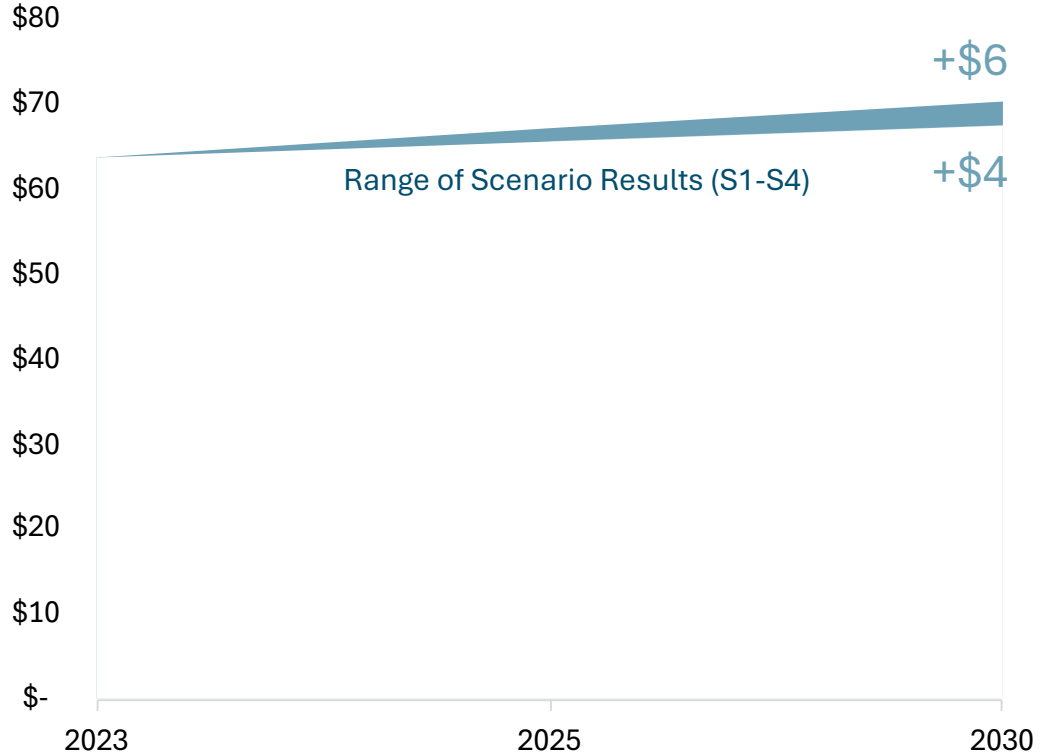


+ All scenarios have annual net ratepayer costs that increase GWP rates due to accelerating DER adoption



Retail Rate and Customer Bill Impacts





- Across the scenarios 1 through 4, rates are anticipated to increase between 6% and 11% due to solar and storage programs on top of other anticipated sources of rate growth
- This means that the average low- or moderate-income (LMI) customer will now be paying between $4 and $6 more per month on electricity, or $48 to $72 per year

Section 9
Potential Program and Policy Options

Energy+Environmental Economics

Section 9.1
Overview

Energy+Environmental Economics

Qualitative screening analysis prioritizes program and policy options crucial for achieving City Council targets over others

+ Program proposals ranked by overall qualitative performance
+ Reasonable DER compensation levels that mitigate cost shifts are preferred

Priority Level

Program Ideas	Involved Technologies	Overall Priority	Low Administrative Cost	Correctly Values DER Compensation	Program Matureness	Promote Adoption (Solar/Storage Penetration)	Promote Adoption (DER Capacity)	Ease of Implementation
Outreach, Education, & Support	All	High	High	None	High	High	High	High
Net Metering	Solar, Storage	High	High	Low	High	High	High	Mid
Base Rebate	Solar, Storage	High	Mid	Low	High	High	High	High
Net Billing	Solar, Storage	High	High	High	Mid	Mid	Mid	Mid
Community Solar	Solar, Storage	High	Mid	High	Mid	High	Mid	Mid
Streamline Permitting Process	Solar, Storage	High	Mid	None	Mid	High	High	Mid
Feed-in Tariff	Solar	High	Mid	High	High	Low	High	Mid
VNEM	Solar, Storage	High	Mid	Low	Mid	High	Mid	Mid
Performance-based Incentive	Storage	Mid	Low	High	Mid	Mid	Mid	Mid
Load Shedding DR	All	Mid	Mid	High	High	Low	Low	Mid
TOU	All	Mid	Low	None	High	Mid	High	Low
Buy-all, Sell-all	Solar, Storage	Low	High	High	Low	Low	Low	Mid
VPP	All	Low	Low	High	Low	Low	Mid	Low
Load Shifting DR	All flexible loads	Low	Low	High	Low	Low	Mid	Low
VGI	EVs	Low	Low	High	Low	None	Low	Low

Potential Program and Policy Options

+ **In addition to adoption impact modeling, which captures prioritized programs and policies, the following potential program design options are presented for prioritized programs**

Outreach Education & Support

Streamline & Improve Permitting Process

Net Metering vs. Net Billing

Incentive Design

For example, upfront/base rebates, performance-based incentives

Feed-in Tariff (FiT)

Solutions for Renter and LMI Customers

For example, community solar, virtual solar

Equity and Justice Concerns Within DER Adoption

Recognition

Not all customers receive equal treatment from the electric grid. *Some customers see more frequent outages than others. How can utilities work to repair this injustice with DERs that can provide resiliency benefits?*

Many customers face already high bills, some are prohibitively high. *How can utilities create programs and policies that do not increase rates for non-participants? How can utilities ensure energy affordability for all customers?*

Distributional

Most solar- and storage-adopting customers across Glendale and the United States are high income homeowners. *How can utilities ensure that LMI renters are also eligible for technologies that produce bill savings?*

Historically, some solar and storage programs have seen a disproportionate number of incentives going to high-income customers. *How can utilities ensure that incentives are aligned with those who need them most?*

Procedural

Involving all types of customers in decision-making and planning yields more equitable policies. *How can utilities highlight marginalized voices in the decision-making process?*

Not all customers know about available programs. *How can utilities spread knowledge about programs to those who need them most?*

Providing Access for Renter and LMI Customers

+ **Under traditional NEM programs, a landlord would pay upfront solar and storage costs, but tenants would see the bill-savings benefits. This "split incentive" problem has led to much lower solar and storage adoption rates for renters than homeowners. Solutions to the "split incentive" problem focus on allowing customers to gradually pay back the upfront costs of solar or storage.**

On-Bill Financing	Solar or Storage Lease	Green Rates	Community Solar	Virtual Solar
Utility pays the upfront costs, which are then recovered on customer bills.	*Customers pay a monthly fee for solar panels or storage to be installed on their roof.*	*Customers pay a higher electricity rate to opt for 100% clean energy.*	*Customers subscribe to a share of a larger solar installation and pay a monthly fee to receive bill savings.*	*Customers in multi-unit buildings can subscribe to a shared solar installation.*

+ **Some, but not all, of these programs also allow customers without roof space (i.e., apartments and condos) to adopt solar and storage.**

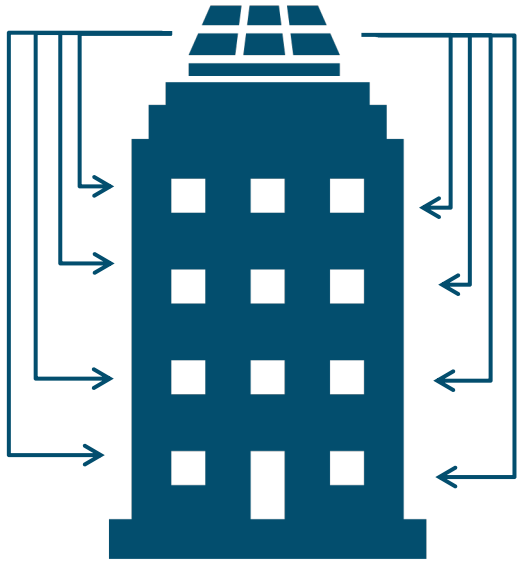
For solar, multiple types of programs could exist in Glendale

Net Energy Metering (NEM)

Individual customers install solar or storage in their own buildings.

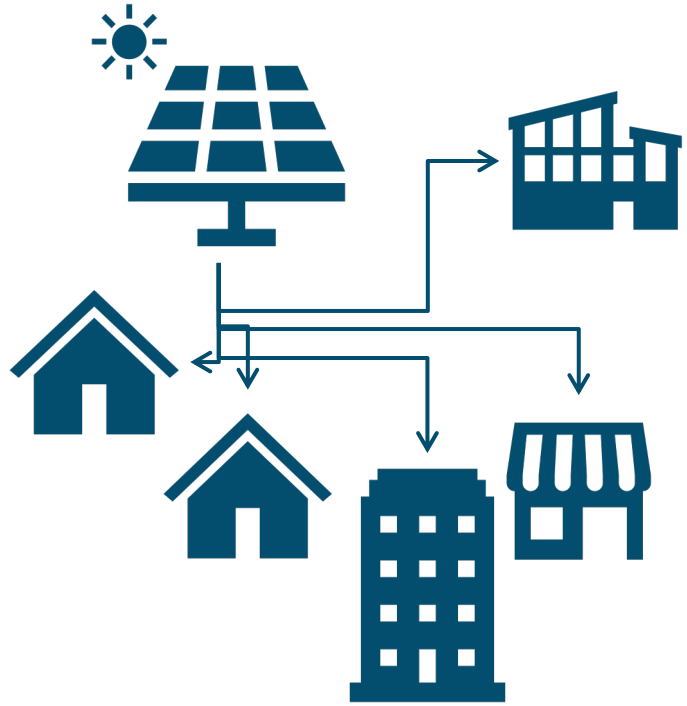
Virtual Solar

Customers in multi-unit buildings share a single solar and storage installation across all units.



Community Solar (CS)

Customers subscribe to a share of an off-site larger solar installation.



Section 9.2

Program Deep Dive: Incentive Design

Energy+Environmental Economics

Incentive design can be diverse and can be used to encourage beneficial behaviors

High incentives in the near term and lower incentives in later years could encourage early adoption.

Additional incentives for bundling solar and storage installations could be used to increase storage adoption.

Apart from performance-based incentives, upfront incentives can also be offered in exchange for optimal storage dispatch.

Explore the possibility of direct install programs for multifamily, low- and moderate-income, or disadvantaged communities.

Utilize state and federal level support to help residents secure the California Self-Generation Incentive Program (SGIP) incentives through SoCalGas, considering that most Glendale residents might use their gas service.

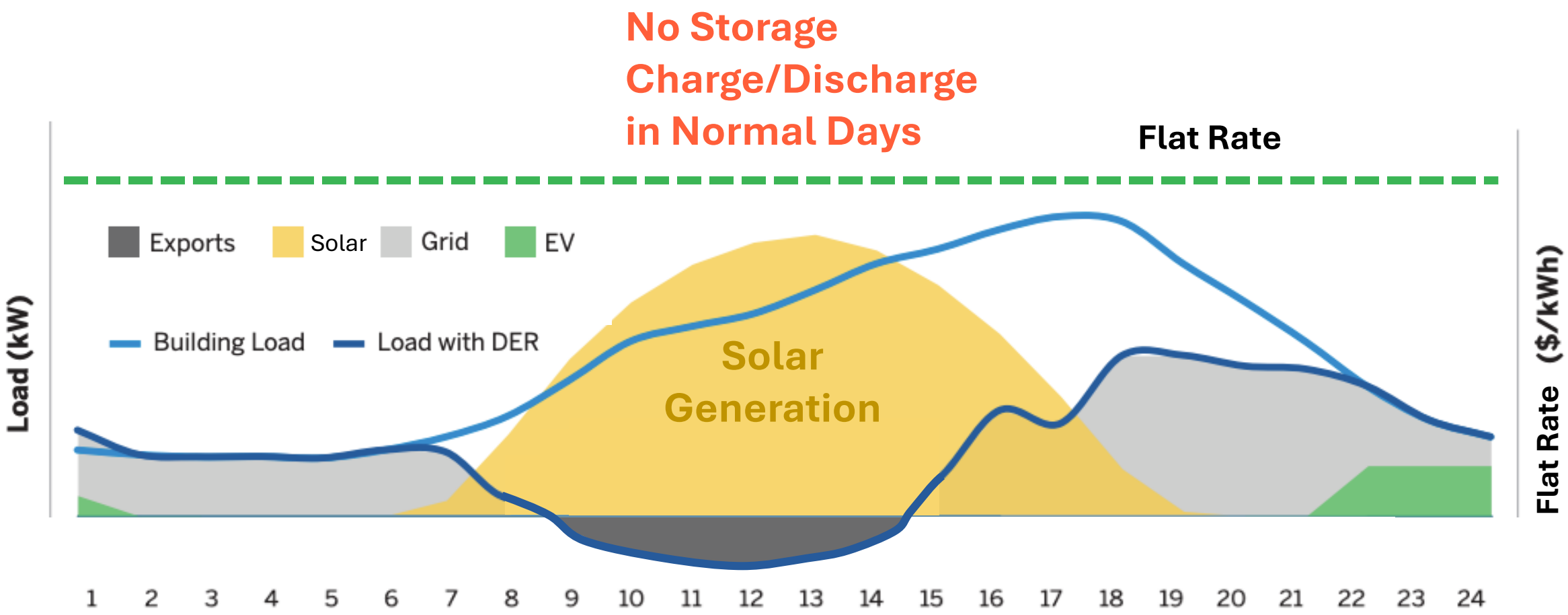
Explore including tax abatements (e.g., property tax) such as NYC's property tax abatement for solar and storage.

Consider alternative funding mechanisms or sources that mitigate the burden to low-income and disadvantaged communities (e.g. , property tax or Income Graduated Fixed Charges).

Encouraging customers to dispatch storage for grid needs increases community benefits

ILLUSTRATIVE

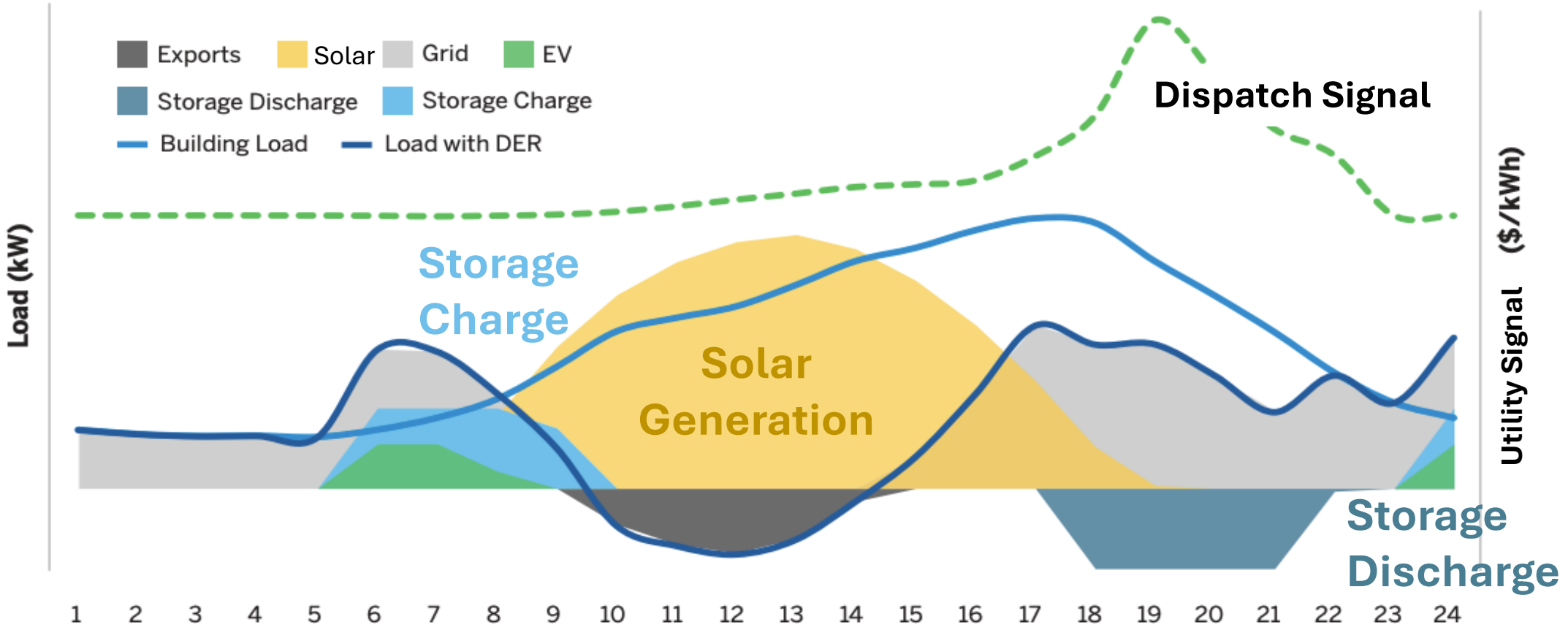
+ Customer-owned storage used for back-up power or bill reductions provides little or no benefit for the Glendale community



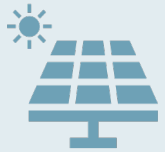
Encouraging customers to dispatch storage for grid needs increases community benefits

ILLUSTRATIVE

+ Programs that provide price signals to customer-owned storage for a limited number of hours in the year can increase community benefits substantially



Additional incentives lessen costs for DER adoption



- Additional incentives from GWP would allow customers to install solar and storage at lower costs, mitigating the upfront cost barrier or improving lifetime investment return.
- These incentives could be partial upfront/base rebates, full direct install programs, or performance-based incentives that encourage customers to dispatch battery storage for grid needs and increase community benefits.
- These incentives could be offered to all residents or targeted at specific types of customers, such as low-income multi-family apartment buildings.
- The City of Glendale offered incentives for solar in the past, but they have been phased out.

Benefits:

- Reducing the cost to install solar and storage increases access for **low- and moderate-income customers**.
- Reductions in upfront costs and improved lifetime investment return increase **adoption** across all customers.

Possible Concerns:

- Upfront incentives alone cannot solve **physical and technical constraints** faced by many renters and condo owners, and performance-based incentives might require additional tele-communication technology support.
- High incentives increase the revenue that GWP recovers, which in turn **increases rates**.
- Restarting the incentive program may pose an issue for customers who did not receive the incentive between the end of the old program and the beginning of the new program.

Section 9.3

Program Deep Dive: Rooftop Solar Compensation

Energy+Environmental Economics

Glendale's Current Approach to Solar Compensation

NEM 1.0

Glendale uses Net Energy Metering (NEM) to compensate customers for their rooftop solar. This tariff is called the "Customer Owned Generation" tariff.

- Under NEM, solar exports and self-consumption are compensated at the exact value of solar imports.
- This type of policy, like the CPUC's NEM 1.0, has high compensation values and creates a strong incentive for customers to adopt solar.
- NEM leads to a significant cost shift since solar exports and self-consumption are compensated above the avoided cost of the utility not having to procure that energy.

5%

The "Customer Owned Generation" tariff is capped at 5% of GWP's total peak demand.

- The tariff is first-come, first-serve for customers.

110%

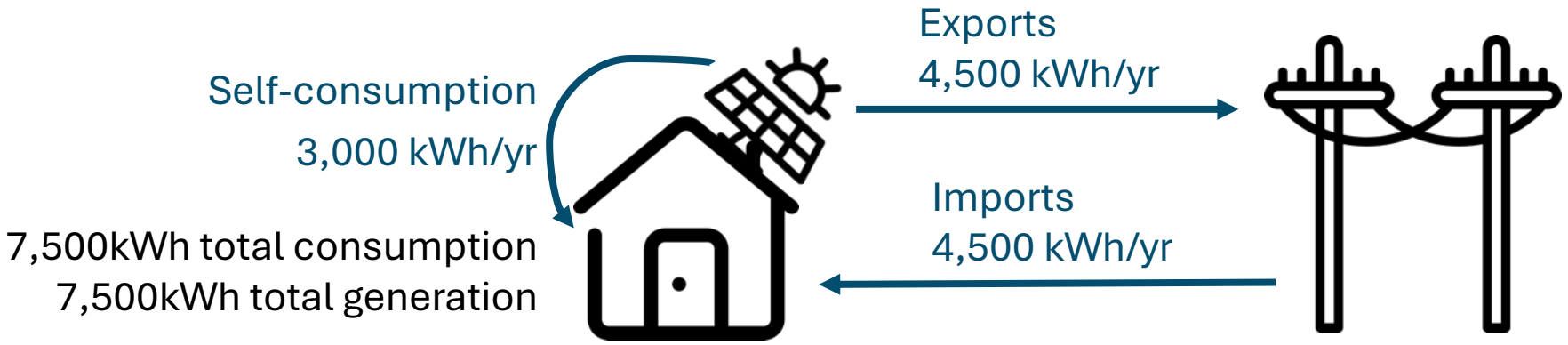
GWP caps large solar systems (<10kW) at 110% of annual load or 1 MW-AC.

<2%

Very few customers in Glendale (<2%) are subscribed to time-of-use (TOU) rates.

- GWP has faced technical difficulties installing electric meters compatible with TOU rates.

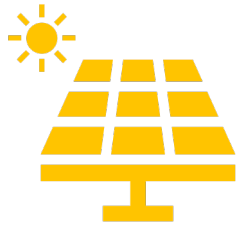
Rooftop solar can be compensated by the utility in many different ways



Tariff	Self-Consumption	Exports	Bill Savings	Cost Shift
Net Energy Metering (NEM)	All generation (both self-consumption and exports) credited at the customer's **import rate**		**+++**	**+++**
Net Billing (NEB)	Self-consumption credited at the **import rate**	Exports credited at a reduced **export rate**	**++**	**++**
Buy-All, Sell-All (BA, SA)	All generation (both self-consumption and exports) credited at a reduced **export rate**		**+**	**+**

Note: "Net Metering / NEM" is often used erroneously/colloquially to describe all tariffs for crediting exports from customer-generators

Options for Program Improvements: Rooftop Solar Compensation



Compensation Rates

Shift solar and storage compensation to a net billing tariff structure.

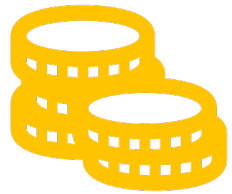
Align export compensation with GWP avoided costs.

Require TOU rates for solar and storage program enrollment.

Program Sizing Constraints

Expand total program size by allowing more customers to be subscribed to the customer generation tariff.

Relax constraints on system sizing.



Retail Rate Reform for All Customers

Promote or mandate a switch from flat rates to TOU rates.

Consider non-bypassable and fixed charges to minimize cost shifts.

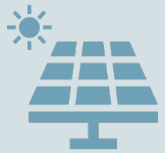
Align TOU rate peak and off-peak periods with underlying system costs.

Section 9.4

Program Deep Dive: Virtual Solar

Energy+Environmental Economics

Virtual solar allows building owners to share solar and storage credits with multiple units



- Virtual solar creates an economic, but not necessarily physical, connection between multiple units within a single building.
- This type of program is modeled after the California Public Utility Commission's VNEM program but could be implemented in many different ways.

Benefits:

- Virtual solar allows **renters and apartment owners** who cannot install solar or storage on shared roofs to access the benefits of solar and storage.
- Upfront **customer costs may be lower** than single-unit solar installations due to economies of scale.

Possible Concerns:

- Property owners may require **high compensation or incentives** to consider installing virtual solar.
- The utility's billing could be **complicated**.

Section 9.5

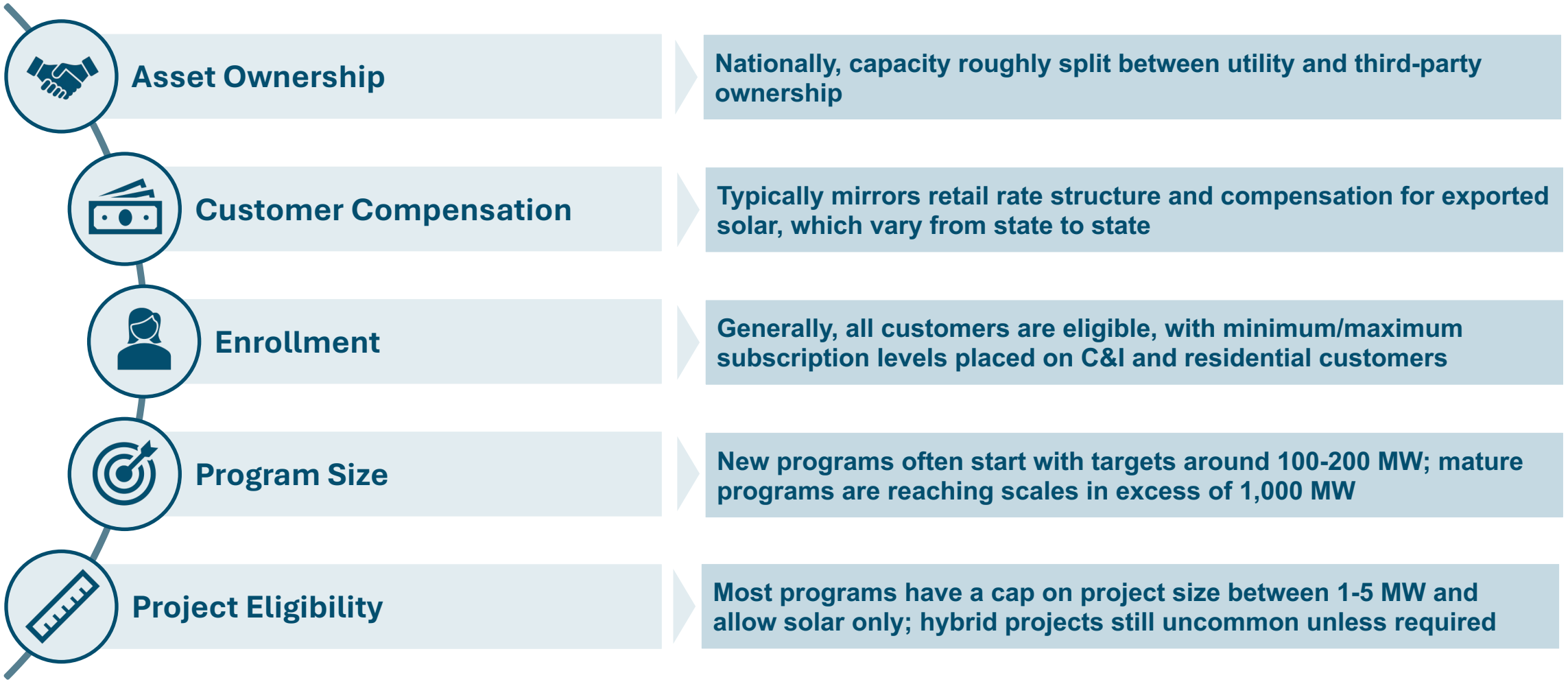
Program Deep Dive: Community Solar

Energy+Environmental Economics

Avoiding high rates/bills, especially for low- to-moderate income customers, is a driving force for policy action

+ **Enabling customer choice and providing a "green" or "clean" option to ultimately reduce low-to-moderate income (LMI) customer energy burdens is the key driving force behind state- and federal-level policy action → 10-30% bill reductions are the target**
  - Federal policy has taken the form of large incentives for community solar installations via the 2022 Inflation Reduction Act
    - LMI Bonus Credits (10% ITC bonus for siting in LMI communities and an additional 20% ITC bonus for directly serving LMI customers) for up to 1.8 GW-DC of installations in 2023 and 2024
      - Results in up to 50% ITC benefits
    - Interconnection costs included in ITC for under 5 MW projects
    - $7B in state funds to create/expand distributed solar programs
  - State policy actions have been broader and more diverse in terms of scale/scope ranging from small pilots to large multi-GW/$billion programs
    - Explicit trade-offs and competing interests between providing distributed solar access to underserved communities like LMI and/or renters at least cost vs. creating a robust "market" for non-utility electricity providers like 3rd party community solar developers/owners

Design choices vary by state but follow common archetypes



Common Community Solar Ownership and Compensation

- **Two prevailing models for ownership of community solar facilities:**
  - **Third-party ownership:** a third party (developer, retail electric provider) builds, owns, and operates the array and enrolls/manages customers
  - **Utility ownership:** The utility owns the solar array and sells portions of the project to customers, who receive monthly bill credits
- **Utilities often purchase projects that have been developed by third parties via build-own-transfer agreements**
  - In some cases, utilities market to customers while third parties retain ownership
- **Preferred ownership structures vary from state to state; in some cases, states have used hybrid models for ownership**
- **Asset owner is typically responsible for enrollment and contracting with customers**
  - Customers pay either subscription or energy charges and receive credits towards their electricity bills
  - Different mechanisms are used for customer bill offsets
- **Credit value calculations vary by state:**
  - **Value of solar:** credits based on administratively determined "value of solar" calculations
  - **Full retail rate:** customers' bill credits offset kWh consumed on a 1:1 basis
  - **Discounted retail rate:** customers' bill credits offset kWh consumed on a discounted basis
  - **Other:** negotiated and/or competitively determined rate
  - Additional incentive value "adders" possible
- **REC ownership varies based on program design**

Other elements of community solar program design

Program Enrollments

Programs typically require a share to be contracted with residential/low to moderate-income (LMI) customers

Programs may have limits on shares allocated to individual C&I customers

Developers often use subscription management companies to market and manage customer operations

Program Size

Program sizes range from 50 MW to GW+ in more mature markets

Programs often begin around 100-200 MW but very much depends on the potential size of the market

Voluntary markets (those without policy directives) do not have program limitations

Project Eligibility

Project sizes in programs across the U.S. are typically five MW or less

Some states have minimum project sizes that are 1-2 MW

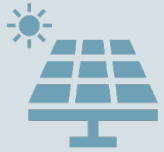
Voluntary markets do not have size limitations

Section 9.6

Program Deep Dive: Feed-in-Tariff

Energy+Environmental Economics

Feed-in-tariffs (FiT) provide economic certainty to developers interested in interconnecting solar or storage in Glendale



- A feed-in tariff (FiT) is a guaranteed price for renewable power producers that ensures their long-term compensation.
- Unlike NEM, which is focused on sizing solar to serve onsite load, FiTs are designed to allow participants to maximize their site's solar potential, unlocking properties within city limits that are not eligible for NEM, such as carports and parking canopies.
- Examples: LADWP has a FiT program that allows eligible sites to sell energy directly to the utility, rather than using it to offset load. LADWP's "Carport and Canopy" incentive is a one-time rebate for large parking lot owners.

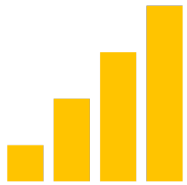
Benefits:

- FiTs have significantly increased investment in renewables in other jurisdictions.
- Most developers are unlikely to build resources without a long-term contract in place to guarantee payment for their energy.
- FiTs encourage solar and storage development on underutilized surfaces, such as brownfields, landfills, and parking canopies.

Possible Concerns:

- By entering a contract, Glendale cannot change compensation to align with the market in future years.

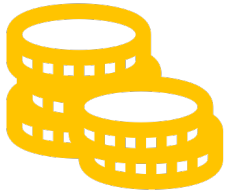
Options for Program Improvements: Feed-in-Tariff



Program Sizing Constraints

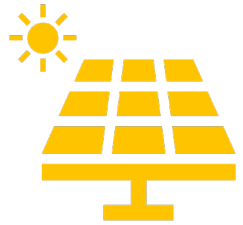
Expand total program size beyond 4.2 MW.

Remove the 1.4 MW constraint on system sizing.



Long-Term Rate Guarantees

Consider long-term rate guarantees. GWP's current feed-in-tariff only locks in compensation for a single year, preventing developers from conducting economic analyses over the resource's lifetime.



Location-Specific Incentives

Consider incentivizing the usage of underutilized space for solar, including carports (parking canopies), landfills, and other large flat surfaces. This could be in the form of an adder to the feed-in-tariff or an upfront rebate.

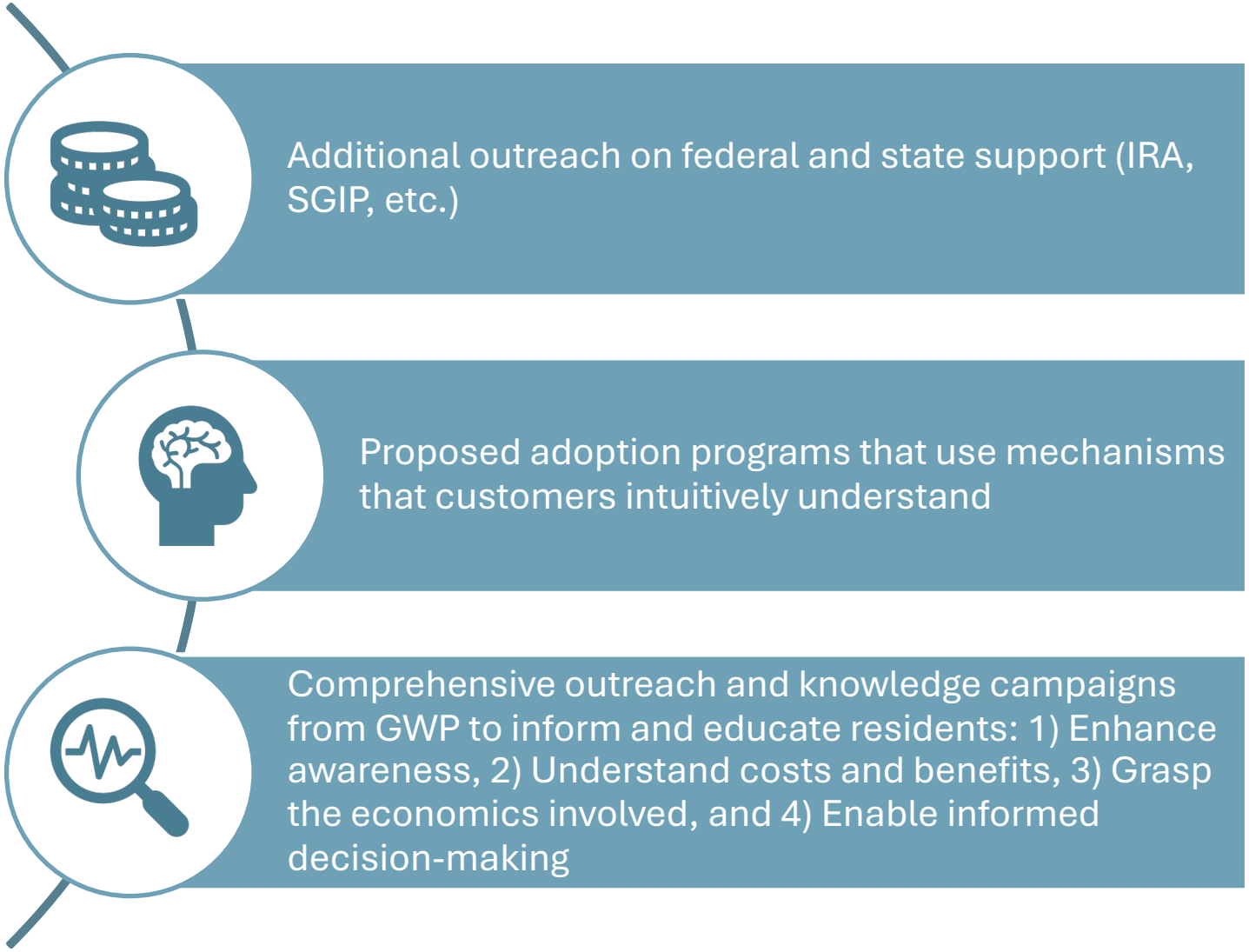
Section 9.7

Robust Customer Outreach, Education, and Resource Support

Energy+Environmental Economics

Enhance outreach and educational campaigns to improve customer awareness and empower residents

Conduct comprehensive outreach and educational campaigns to enhance awareness and empower residents to make informed decisions with an understanding of the underlying economics



Examples of improving support and guidance via web resources

How to Work with Developers

Xcel Energy

EV Electricians List: Provides lists of certified electricians for EV customers.

Solar and DER Basics

PG&E

Battery Storage Guidance: comprehensive webpages providing detailed guidance on battery storage and solar solutions

SAN JOSE CLEAN ENERGY
A Program of the City of San José

Going Solar Webpage: offers guidance on installing solar, finding contractors, and lists federal and state incentive support

Certified/Approved Contractors

NEW YORK STATE | NYSERDA

NYSERDA Approved Contractors

Illinois Shines

ABP Approved Vendors

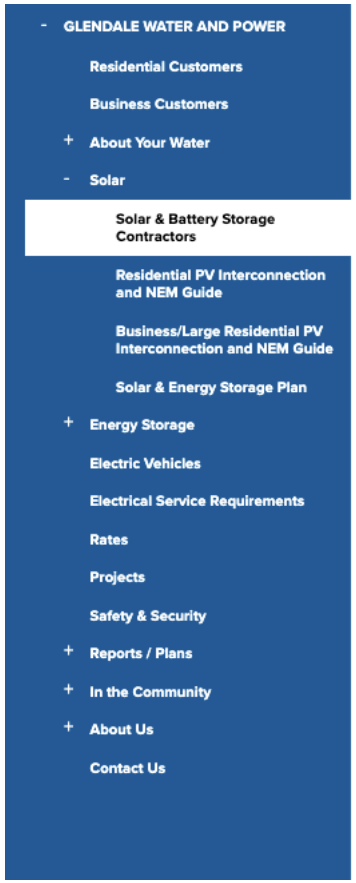
Useful Data

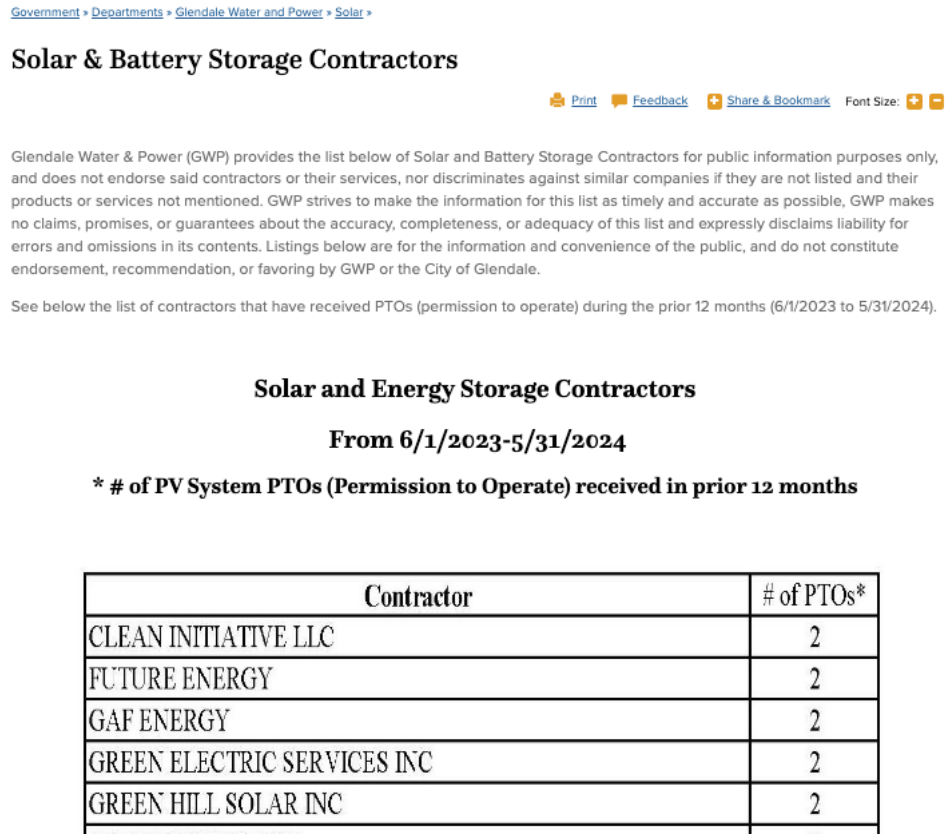
California DGStats Database: Includes data for solar NEM/NBT and energy storage interconnection applications within PG&E, SCE, and SDG&E territories, providing valuable starting information for Glendale customers. Check this SCE example.

GWP already took actions to improve their resource support

+ **Information on solar and battery storage contractors is now available on the GWP website**

www.glendaleca.gov/SolarContractors





Government » Departments » Glendale Water and Power » Solar »

Solar & Battery Storage Contractors

Print Feedback Share & Bookmark Font Size:

Glendale Water & Power (GWP) provides the list below of Solar and Battery Storage Contractors for public information purposes only, and does not endorse said contractors or their services, nor discriminates against similar companies if they are not listed and their products or services not mentioned. GWP strives to make the information for this list as timely and accurate as possible, GWP makes no claims, promises, or guarantees about the accuracy, completeness, or adequacy of this list and expressly disclaims liability for errors and omissions in its contents. Listings below are for the information and convenience of the public, and do not constitute endorsement, recommendation, or favoring by GWP or the City of Glendale.

See below the list of contractors that have received PTOs (permission to operate) during the prior 12 months (6/1/2023 to 5/31/2024).

Solar and Energy Storage Contractors

From 6/1/2023-5/31/2024

*** # of PV System PTOs (Permission to Operate) received in prior 12 months**

Contractor	# of PTOs*
CLEAN INITIATIVE LLC	2
FUTURE ENERGY	2
GAF ENERGY	2
GREEN ELECTRIC SERVICES INC	2
GREEN HILL SOLAR INC	2

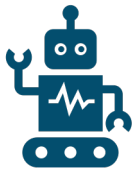
Section 9.8

Improved Permitting, Interconnection, and Approval Process

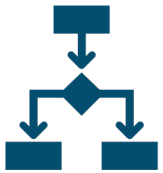
Energy+Environmental Economics

Automate and simplify the process of installing solar and battery storage

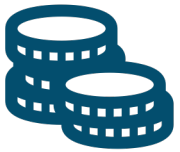
- **A significant volume of permits must be processed in the near term when customers begin installing DERs; this volume has the potential to overwhelm the existing City of Glendale processes.**
- **GWP needs a faster, easier, and more scalable permitting, interconnection, and approval process to reduce barriers and constraints to DER adoption.**



Automated review and approval of customer projects can reduce costs and speed up timelines. NREL's SolarAPP+ is a free software platform offering process automation. GWP has adopted SolarAPP+.



Simplify inspection processes with straightforward checklists for residential solar and energy storage permits to avoid delays and extra costs. Virtual inspections can further streamline utility review, permitting, inspection, and interconnection.



Reduce permitting and interconnection fees and provide waivers for low-income customers.

Allow solar systems to be sized for future load growth from electric vehicles and appliances.

Section 9.9

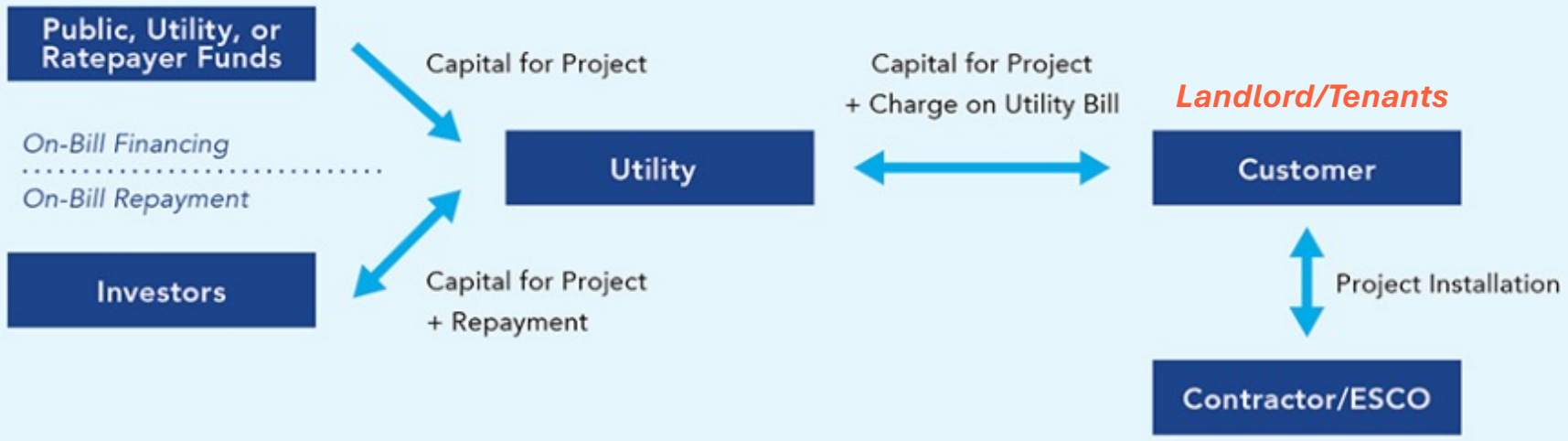
On-Bill Financing & Repayment

Energy+Environmental Economics

On-Bill Financing/On-Bill Repayment (OBF/OBR)

+ **On-bill financing (OBF) and repayment (OBR) are methods where a utility or private lender provides funds for energy efficiency, renewable energy, or other generation projects. Repayment is made through regular charges on the customer's utility bill.**
  - OBF/OBR offers advantages such as low or zero interest rates, straightforward contracts, and easy repayment.
  - However, these options are only available in areas where utilities offer on-bill programs.

Typical On-Bill Financing or Repayment Structure



Better Buildings, an initiative of the U.S. Department of Energy (DOE), provides a comprehensive guide on OBF/OBR with how it works, procs and cons, state of the market, case studies, and additional resources: link

PG&E Supports Restaurant Business Customers via OBF: PG&E offers 0% interest loans for replacing old and worn-out equipment with more energy-efficient models to qualified non-residential PG&E customers.

- PG&E OBF Handbook
- Assistance summary

PG&E requested authorization for an OBF/OBR Pilot starting in March 2021 to support K-12 schools installing clean power projects. The pilot will finance the SGIP-eligible storage components to improve resiliency during power outages: link

Note: Materials in this slide are adapted and customized from Better Buildings Solution Center.

Expanding and customizing OBF/OBR to address split incentive issues for landlords and tenants

- **OBF/OBR typically targets homeowners, but a well-designed program can also address split incentive issues between landlords and tenants with necessary modifications and customizations.**
- **To increase access for renters, project costs and incentives in the form of electric bill savings could accrue to both landlords and tenants to provide proper incentive signals.**
- **Here is one *conceptual* program framework:**

As part of the agreement, tenants are responsible for covering the loan payments and can benefit from savings on their energy bills. A net monthly saving for tenants can reduce tenants' energy costs while supporting their transition to cleaner energy sources.

Provide small financial incentives to landlords to offset the costs associated with managing and overseeing the upgrade process, thereby encouraging their active participation.

- For example, a small portion of the tenant's monthly bill savings can be shared with landlords in the form of a small monthly payment on the tenant's utility bill for the first five years, which would help reinforce and make tangible the benefits of participating in the program for landlords.

Example OBF/OBR Scheme for Rental Unit(s)

Loan amount:	$6000
Financing:	3% @ 15 years (interest rate subsidized)
Financing cost per month:	$43
Landlord Incentive per month:	$10 (first 5 years)
Projected energy savings per month:	$67 in electricity and heating costs
Monthly Savings for Tenant:	$14 (first 5 years) $24 (years 6-15) $67 (years 16 and on…)
Landlord Incentive	5 x $120 yearly payments total: $600

- *Adopted and customized from Bird, S., & Hernández, D. (2012). Policy options for the split incentive: Increasing energy efficiency for low-income renters. Energy Policy, 48, 506-514. https://doi.org/10.1016/j.enpol.2012.05.053*

Overview of Typical OBF/OBR Structure

More Information on Basic and Contract Structure Attributes

- **Project Type:** which project types can be financed using this option?
- **Applicable Sectors:** which customer sector does it commonly serve?
- **Geographic Scope:** is it available throughout the U.S. or only in limited areas with supporting policies?
- **Building Ownership:** does it work well for leased, owned, or both?
- **Typical Project Size:** what range of project sizes does it commonly serve?
- **Contract Complexity**: how complex is it from the customer's perspective?
- **Parties Involved:** what type of organizations are typically involved in executing this option?
- **Payment Type:** are customer payments fixed over time or typically variable?

BASIC ATTRIBUTES	Project Type	Other Generation
	Applicable Sectors	Affordable Multifamily, Commercial & Industrial, Multifamily, Non-profit, Private Universities / Schools / Hospitals
	Geographic Scope	Available only in certain areas
	Building Ownership	Better for Owned
	Typical Project Size	Other
CONTRACT STRUCTURE	Contract Complexity	Low
	Parties Involved	Customer, Utility, Contractor/ESCO, Private Financier (if OBR), Government Funder (if OBF)
	Payment Type	Typically Fixed
TAX & BALANCE SHEET	Budget Source	Internal (Opex)
	Balance Sheet Treatment	Variable
	Tax Deductions	Variable
	Equipment Ownership	Variable
	Collateral Source	Equipment + Service Termination
CONTRACT TERMS	Typical Duration	2-15 years
	Typical Close Time	Short (A few months)
MARKET ATTRIBUTES	Market Size	Under $3B
	Time in Market	Since the 1970s-1990s

Note: Materials in this slide are adapted and customized from "On-Bill At-A-Glance" in Better Buildings Solution Center.

Overview of Policy Responses to the Split Incentive Problem

	Description	Benefits	Concerns
Contracts			
Contracts			
Green or energy efficiency lease	Landlord and tenant agreement to conserve energy, where landlord retrofit investments are trickled down to tenant.	• Higher rents offset by lower utility costs. • Mutual commitment to conservation.	• Requires cooperation from landlord and tenant. • Continual capital improvements and maintenance necessary. • Currently geared toward commercial leases.
Energy efficiency mortgages (PACE financing)	Externally funded loan attached to the property.	Capital improvements can be done at one time and paid in installments.	• Benefits remain with the property and lien complicates property resale. • Liability for property owner.
On-bill financing	Capital improvements are tied directly to utility company payments.	Capital improvements can be done at one time and paid in installments with no lien issues.	Usually focused on live-in homeowners, not tenants.
Regulation			
Regulation			
Green building codes	Application of higher energy standards for new construction.	Potential to benefit all new housing developments, including buildings for low-income tenants.	• Only applies to new construction. • Higher rent prospects along with higher construction and maintenance cost can create bias against low-income tenants.
Low-income rental mandates	Mandate of higher energy standards for low income housing.	Potential for high scale implementation in low-income rental housing.	Creates serious disincentive to provide low-income housing.
All-in Services			
All-in Services			
Weatherization assistance program	• National weatherization program, usually implemented as grants. • Differs from state to state.	• Has highest reach; especially under the U.S. Stimulus Program. • Variety of policy programs and state differentiation/experimentation.	• Cannot be implemented at scale because of cost; inefficient. • No follow-up for maintenance. • Hardly used for low-income rental housing.
Concierge Services	Small niche programs designed to provide comprehensive efficiency assistance with education.	Highest success rate for efficiency gains and behavioral improvements; addresses poverty concerns effectively.	• Cannot be implemented at scale because of cost. • Highest expense.

- *Adopted and reformatted from Bird, S., & Hernández, D. (2012). Policy options for the split incentive: Increasing energy efficiency for low-income renters. Energy Policy, 48, 506-514. https://doi.org/10.1016/j.enpol.2012.05.053*

Section 10
Discussion

Energy+Environmental Economics

Metrics of Success by Adoption Scenario

- Scenarios are shaped by stakeholder input, policy directives, and GWP's goals. Each scenario's proposed program portfolio was evaluated based on how effectively it addresses these values from various perspectives.
- Continuing the current NEM structure may lead to higher costs. However, a strategically planned program and incentive portfolio could drive greater solar and storage adoption, improve distributional equity, and reduce ratepayers' costs.

	Solar Adopter Impacts		Distributional Equity Impacts		Societal and Ratepayer Impacts			GWP Impacts
	Increased Adoption	Adopter Financial Value	Renter Adoption	LMI Customer Adoption	Minimize Cost Shift	Net Economic Societal Benefit	Reduction of GHG Impacts	Ease of Implementation
S1 Continue Current NEM	Mid	Very High	Low	Low	Very Low	High	Mid	Mid
S2 Targeted LMI MF Adoption	High	High	High	High	Mid	High	High	Low
S3 Balanced	High	High	High	High	Low	High	High	Low
S4 Widespread Adoption	Very High	Very High	High	High	Very Low	High	Very High	Very Low

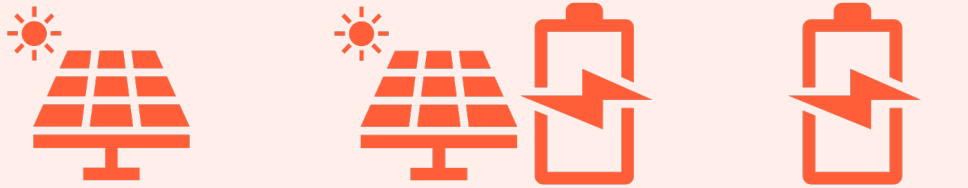
Clarifications on how to correctly interpret the City Council's adoption targets are necessary

At least 10% of GWP customers adopt solar and energy storage systems by 2027

10% adoption target for solar + storage systems vs. 10% for either solar or solar + storage systems?

Develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW

Which systems qualify?

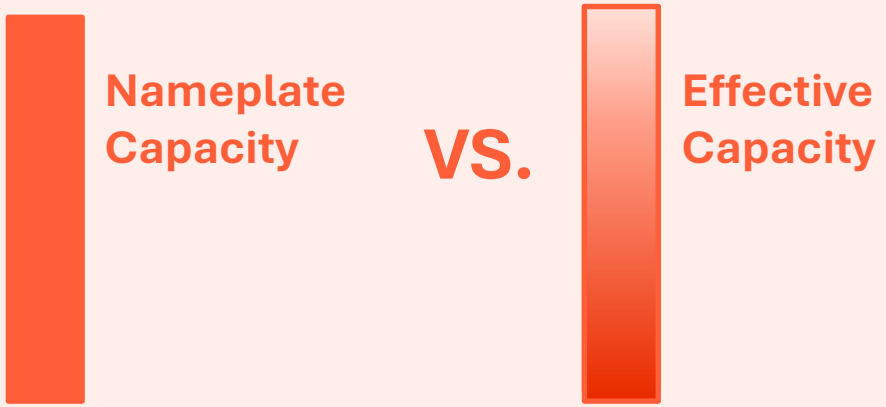


Standalone Solar

Solar + Storage

Standalone Storage

100 MW nameplate or effective capacity?



Can GWP reach 10% customer solar adoption by 2027?

Including solar-only and solar + storage systems

Achieving 10% Adoption by 2027

+ **The goal is not realistically achievable by 2027**
+ **The projected net cost to GWP ratepayers is $23-$45 million from 2024 to 2027. This estimate accounts for bill savings, utility incentives, and avoided costs.**
+ **Electric rates could increase in various adoption scenarios, in addition to other sources of anticipated rate growth**
  - By 2025: 3%-6%
  - By 2027 (interpolated): 4%-8%
  - By 2030: 6%-11%
+ **Prerequisites needed:**
  1. Robust community outreach and support
  2. Improved permitting processes
  3. Available solutions to address split incentives

Eligible Solar System Configurations

1. Rooftop solar owned, financed, or leased by single-family customers (one system for one electric customer)
2. Rooftop solar owned, financed, or leased by multi-family property owners/managers under virtual net metering programs and shared among tenants and unit owners (one system for multiple electric customers)
3. Subscribers of off-site solar solutions like community solar, solar share, and green rate options (one project for numerous electric customers)

All options must be carefully evaluated for cost-effectiveness against other solar solutions, particularly lower-cost utility-scale city-owned options.

- **Achieving 10% adoption by 2030 is theoretically feasible, but with a significant investment and retail rate impact on GWP ratepayers.**
- **The adoption level results will be further limited by implementation barriers, customer adoption behavior, and other financial and non-economic barriers that customers face. As a result, utility program costs are expected to be higher to account for those factors.**

Can GWP reach 10% customer storage adoption by 2027?

Including solar + storage systems

Achieving 10% Adoption by 2027

- **The goal is not theoretically feasible considering upfront costs and storage attachment rates in California.**
- **The impact of incentives on accelerating storage adoption is limited since battery storage has historically been driven by resiliency considerations rather than economic factors.**
- **Substantial upfront costs and diminished benefits, including low TOU participation and symmetric NEM rate schedules, hinder adoption.**
- **Only 7% of customer solar systems in Glendale have battery storage. Across California, only 6%- 19% of customer solar systems have storage, varying by income level. Achieving 100% attachment rates requires significant utility interventions.**

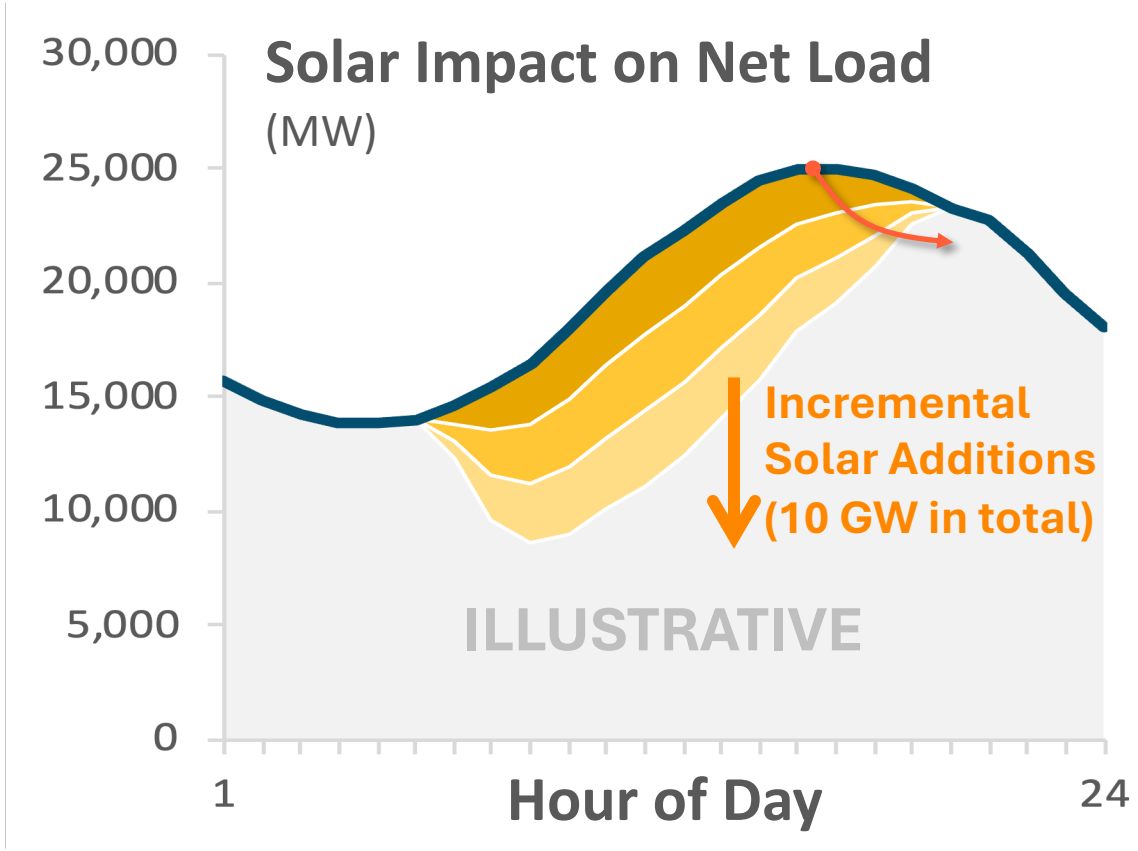
Eligible Storage System Configurations

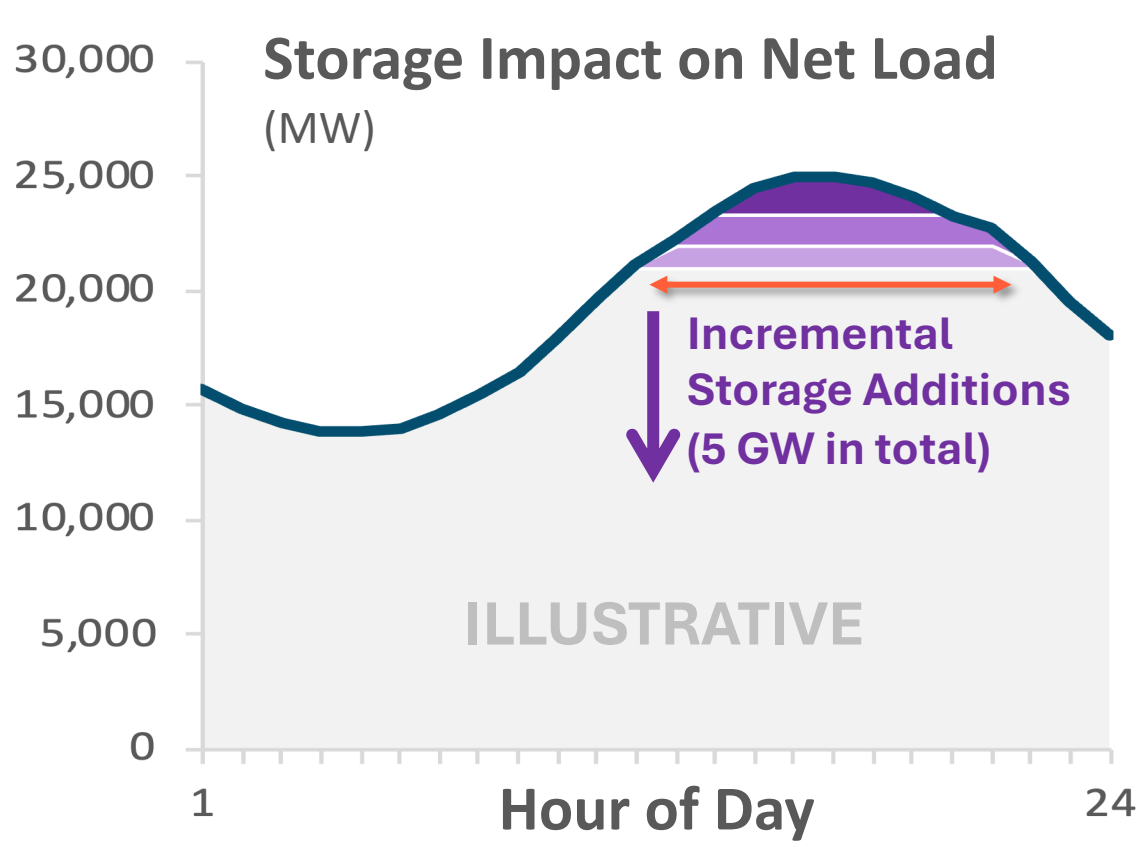
1. Customer storage owned, financed, or leased by single-family and multi-family property owners/managers and commercial and industrial customers
2. Subscribers of off-site solar and storage solutions like community solar/storage, solar/storage share, and green rate options
3. To fill in the gap, options like distribution grid storage, customer storage at city-controlled sites, or GWP-installed storage hosted on customer sites could be explored

All options must be carefully evaluated for cost-effectiveness against other storage solutions, particularly lower-cost utility-scale city-owned options.

- **Achieving 10% customer storage adoption by 2027 is very ambitious and not theoretically feasible considering the realistic level of storage attachment rates in California.**
- **Additional study is needed to determine a more realistic and achievable target.**

Peak load reductions decline with increasing solar and storage adoption





- Net peak load shifts to after sunset

- Effective capacity per MW of storage declines

Can GWP reach 100 MW dispatchable and peak load reduction capacity by 2027?

Achieving 100 MW additional effective capacity, considering DER's ability to reduce GWP system peak demand, will require 200-300 MW DER nameplate capacity coming online by 2027. Additional study is needed to determine a more realistic and achievable target.

- Customer-owned solar and storage would provide reliable peak load reductions of 10 MW or less by 2027
- Including other DERs such as demand response, managed electric vehicle charging, and energy efficiency could theoretically provide peak load reductions of 20-44 MW by 2027
- **Effective Capacity:** achieving 100 MW of reliable peak load reduction could require 200-300 MW customer solar, 40-60 MW customer storage, and other DERs
- **Nameplate Capacity:** theoretically feasible with significant utility investment and a later target year

Can GWP reach 100 MW dispatchable and peak load reduction capacity by 2027?

Achieving 100 MW Additional DER by 2027:

- + Customer-owned solar and storage would provide reliable peak load reductions of 10 MW or less by 2027
- + Including other DERs such as demand response, managed electric vehicle charging, and energy efficiency could theoretically provide peak load reductions of 20-44 MW by 2027
- + **Effective Capacity:** requires approximately 200-300 MW customer solar, 40-60 MW customer battery storage, and other DERs by 2027
- + **Nameplate Capacity:** theoretically feasible with significant utility investment, suggest considering a MW nameplate capacity goal and a later target year

DER Contributions by 2027

DER	Nameplate Capacity (MW)	Approx. ELCC (%)	Effective Capacity (MW)
Customer Solar	39-70	0-7	0-5
Customer Storage	3-10	35-45	1-5
LDEV Managed Charging	50-55	28-38	14-21
Energy Efficiency	0-5	100*	0-5
Residential and C&I DR	8-12	68-78	5-9
Total MW	**100-152**		**20-44**

- Achieving 100 MW additional effective capacity, considering DER's ability to reduce GWP system peak demand, will require 200-300 MW DER nameplate capacity coming online by 2027.
- A more realistic target is achieving 100 MW additional DER nameplate capacity with a later target year.

** EE capacity here represents 'peak saving' forecast from GWP IRP, E3 assumes peak saving already accounts for capacity contributions (i.e. after ELCC adjustment)*

Key Takeaways: Cost and Benefit Analysis

Participant Perspective

- In all scenarios, solar and solar + storage provide net benefits over the system's lifetime
- Net benefits are driven by high bill savings under various billing mechanisms, even under net billing
- Despite lifetime savings, high upfront costs of solar and solar + storage may still pose barriers to adoption

Societal Perspective

- Solar and solar + storage provide net benefits to society across all scenarios

Ratepayer Perspective

- All adoption scenarios have net ratepayer costs, meaning compensation provided to solar and solar + storage customers higher than the cost savings for GWP
- A strategically planned program and incentive portfolio can achieve higher solar and storage adoption with lower impacts on GWP ratepayers

Findings: Achieving the adoption goals by 2027 is not feasible

Achieving a goal of 10% customer solar adoption by 2027 is not feasible. The goal is theoretically feasible by 2030 with a significant increase in utility costs and effort, but real-world barriers remain.

Achieving a goal of 10% customer storage adoption in the near future is not feasible.

Achieving a goal of 100 MW of reliable peak load reduction with DERs is not feasible.

Industry studies suggest that achievable potential is 20%-40% of the technical potential.

Recommendations

- Set an adoption goal in terms of MW of installed capacity rather than a percentage of customers.
- Perform additional analyses of realistically achievable potentials for customer-owned, community, and utility-scale solar and storage.
- Develop an integrated resource plan with the potential and MW targets for each resource type.

Findings: Adoption of customer-owned solar and storage increases GWP rates

The scenarios achieving 10% solar adoption would result in a projected net cost of $23-$45 million to GWP ratepayers from 2024 to 2027.

The resulting rate increase would be 6-11% by 2030, with a low- and moderate-income (LMI) customer monthly bill increase of $4-$6.

Recommendations

- Implement a Net Billing Tariff to reduce the cost shift.
- Develop and implement non-bypassable charges and fixed customer charges to reduce the cost shift.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement a Net Billing Tariff.

Findings: Current customer-owned solar and storage adoption is predominately by single-family homeowners above the median income

Customer solar adoption in Glendale to date is above 10% for single-family homes and below 1% for renters and LMI customers.

84% of customer solar adoption is in households above the median income.

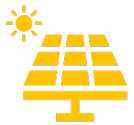
88% of customer solar adoption is by property owners.

90% of customer solar adoption is in single-family homes.

Recommendations

- Allow lower cost community solar and storage to count towards achieving the adoption goal.
- Evaluate virtual solar programs that renters and LMI customers can subscribe to.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement virtual solar programs.

Findings: Customer-owned solar and storage provides limited reliable peak capacity reduction



The effective capacity of customer-owned solar is less than 10% of the installed capacity.

The effective capacity of customer-owned storage is less than 50% of the installed capacity.

The maximum projected reliable peak load reduction from customer-owned solar and storage is 10 MW by 2027.

When including other DERs such as demand response, managed electric vehicle charging, and energy efficiency, the maximum projected reliable peak load reduction is 44 MW by 2027.

Recommendations

- Implement TOU rates that encourage customer storage adoption and dispatch for peak capacity reductions.
- Study and expand demand response, electric vehicle, energy efficiency, utility dispatchable DER, and other programs for peak load reductions.
- Evaluate the cost and feasibility of changes to GWP's billing and metering systems needed to implement TOU rates and utility dispatchable DER.

Findings: Additional costs not included in this study will be required

Achieving the 10% customer solar adoption goal by 2030 will require increasing the pace of annual adoption from 438 customers last year to over 1,000 customers per year.

Community feedback requested enhanced customer outreach and support as well as a streamlined permitting process.

Additional overhead and incentives will be needed to reach renters, LMI, and DAC customers that face larger barriers to solar and storage adoption.

Changes to GWP billing and metering systems will be required.

Recommendations

- Evaluate Glendale-specific program elements that will be the most effective for increasing DER adoption by renter, LMI, and DAC customers.
- Evaluate the cost and feasibility of necessary changes to GWP's billing and metering systems.
- Consider the cost of additional program overhead and customer outreach.

Findings: Adoption Strategies

Utility interventions are necessary (utility support + utility incentives).

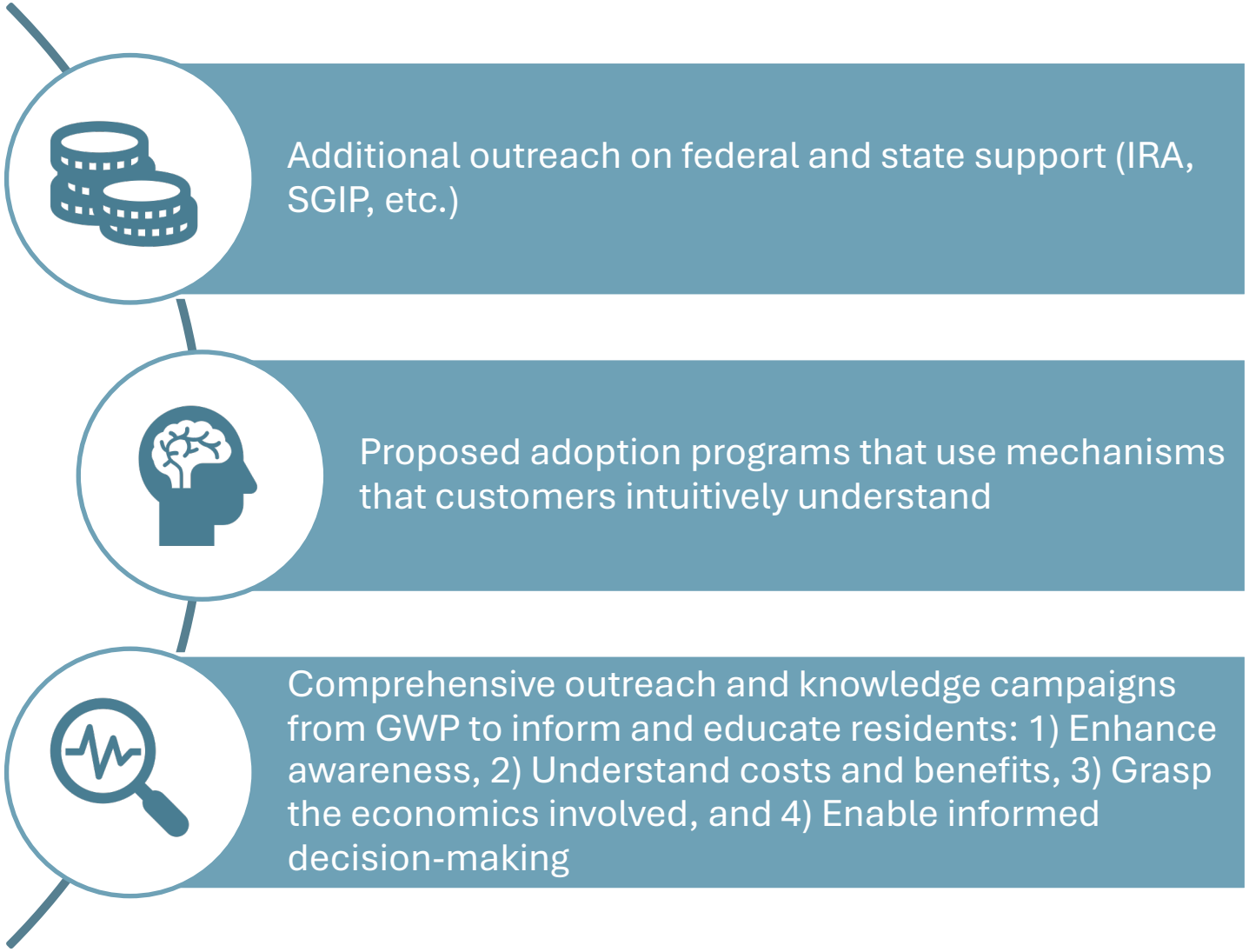
- Utility interventions are necessary to accelerate customer adoption.
- Enhancing customer outreach, support, and simplifying the permitting process alone can boost solar adoption to reach 10% adoption by 2030 without further utility interventions but have a limited impact on promoting battery storage adoption.
- Providing additional utility incentives and access for renter and LMI customers are also needed to accelerate customer adoption, along with improving utility support.

Building code-compliant solar and storage adoption from new construction contributes significantly to achieving the adoption target.

- By the end of 2027, the adoption of building code-compliant customer solar and storage systems could account for 15% to 20% of the total customer adoption required to meet the 2027 target, assuming a 90% compliance rate (due to exceptions and waivers).

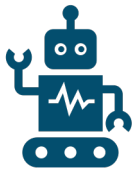
Enhance outreach and educational campaigns to improve customer awareness and empower residents

Conduct comprehensive outreach and educational campaigns to enhance awareness and empower residents to make informed decisions with an understanding of the underlying economics

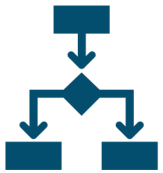


Automate and simplify the process of installing solar and battery storage

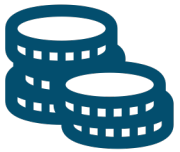
+ **A significant volume of permits must be processed in the near term when customers begin installing DERs; this volume has the potential to overwhelm the existing City of Glendale processes.**
+ **GWP needs a faster, easier, and more scalable permitting, interconnection, and approval process to reduce barriers and constraints to DER adoption.**



Automated review and approval of customer projects can reduce costs and speed up timelines. NREL's SolarAPP+ is a free software platform offering process automation. GWP has adopted SolarAPP+.



Simplify inspection processes with straightforward checklists for residential solar and energy storage permits to avoid delays and extra costs. Virtual inspections can further streamline utility review, permitting, inspection, and interconnection.



Reduce permitting and interconnection fees and provide waivers for low-income customers.

Allow solar systems to be sized for future load growth from electric vehicles and appliances.

Findings: Program Options

The balance between cost, affordability, and adoption impact must be carefully considered when selecting program portfolios to ensure that GWP equitably meets its adoption targets.

- Continuing current NEM will have higher costs - continuation of the current NEM policy primarily benefits single-family homeowners, with a projected rate increase of 6% by 2030.

A strategically planned program and incentive portfolio can achieve higher solar and storage adoption with lower impacts on GWP ratepayers.

NEM Rate Design Evolution

- Lower costs can be attained through the adoption of the **Net Energy Billing (NEB)** system with lower export compensation that better aligns with system costs (along with adders to protect customer investment payback period), which is more equitable than Glendale's current NEM program.
- Customers will receive lower bill savings, which could slow adoption from single-family households. However:
  - Expanding program eligibility to the multi-family sector will create a new source of customer adoption
  - Cost shifts are reduced
  - Additional incentive programs can be implemented to increase the adoption rate

Additional Incentive Programs

- **Improve customer economics:** Adoption from multifamily, rental, and LMI/DAC households and customers in pollution-burdened areas can be accelerated by additional utility incentives, such as:
  - Upfront incentives and performance-based incentives that secure customer payback for 5-7 years
  - Direct install programs targeted at these customer segments
- **Prioritize breadth over depth:** Direct install in targeted customer sectors is less cost-effective than incentive programs that have lower incentive levels but with broader customer eligibility
  - Strength in numbers!

Strategically planned programs and incentives could boost solar and storage adoption while reducing impacts on GWP ratepayers

Consider Alternatives to NEM

Adopting a ***Net Billing Tariff*** can reduce cost shifts to other GWP ratepayers and be more equitable than Glendale's current NEM program

- Lower export compensation to align with system avoided costs
- Consider avoided cost adders to improve the customer's payback period

Provide Additional Incentives

To accelerate adoption among ***multifamily, renter, and LMI/DAC/pollution-burdened*** customers, consider the following:

- Upfront or performance-based incentives to improve payback to 5-7 years
- Offer $1.0-1.5/W incentives for both solar and storage
- Broader customer eligibility with lower incentives are typically most cost effective than targeted customer groups with higher incentives

Provide More Utility Support

Enhance customer outreach and support, and simplify the permitting process

Provide Access for Renter and LMI Customers

Provide off-site solar, virtual solar, and financing programs to address split incentives between owners and tenants:

On-Bill Financing

The utility pays the upfront costs, which are then recovered on customer bills.

Solar Lease

Customers pay a monthly fee for installing solar panels on their roofs.

Green Rates

Customers pay a higher electricity rate to opt for 100% clean energy.

Community Solar

Customers subscribe to a share of a larger solar installation and pay a monthly fee to receive bill savings.

Virtual Solar

Customers in multi-unit buildings can subscribe to a shared solar installation.

Practical challenges in implementing recommended program options must be considered

- **While E3's analysis outlines several promising options to accelerate DER adoption, it is important to recognize the practical limitations GWP faces.**
- **Achieving the ideal program outcomes will require addressing these implementation challenges and balancing *what should be done* with *what can realistically be achieved*, considering GWP's existing infrastructure and resources.**

NEM Compensation

Customer Billing System Limitations: GWP's current billing system currently cannot deploy TOU rates to all customers. Upgrading the system to handle TOU rates will take considerable time and investment, delaying full implementation.

NBT Adoption: Adopting a NBT requires City Council approval. This includes filing a regulatory-grade avoided cost analysis to determine export rate compensation. The filing process could be lengthy and complex, making it unlikely to be available by early 2025.

Renter and LMI Customers

Virtual Solar Option: providing virtual solar options for renter and LMI customers is essential for addressing financing and split incentive challenges, but it will require a major billing system upgrade, which will include budgeting for development costs, determining staff requirements, and setting realistic timelines for deployment.

Provide More Utility Support

Enhanced Community Outreach: Managing a more robust community outreach program will require significant internal resources, including staff and potentially new tools or partnerships to engage a broader segment of GWP customers.

Permitting Improvements: Improving the permitting process will require coordination across departments, external stakeholders, and potentially new tools for the inspection process, adding complexity to timelines.

Customer Support Programs: Expanding GWP's capacity to provide direct customer support, such as education on DER options and financial assistance, will require substantial operational changes, including new staffing, training, and communication workflows.

Section 11
Appendix

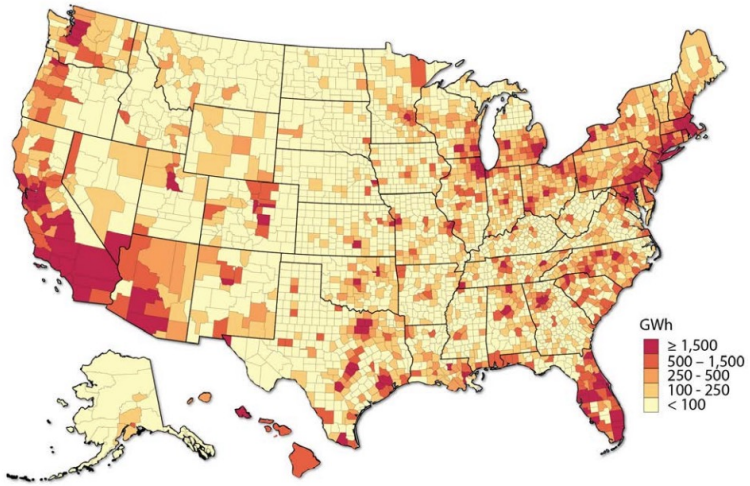
Energy+Environmental Economics

NREL Rooftop Energy Potential of Low-Income Communities in America (REPLICA)

- **NREL REPLICA dataset provides estimates of *residential* rooftop solar technical potential at the U.S. census tract level with emphasis on low-to-moderate income (LMI) populations**
  - Derived from rooftop suitability modeling for 128 U.S. cities and metropolitan areas using LiDAR data from the Department of Homeland Security, representing approximately 40% of the population
  - A statistical model trained on areas with data coverage was used to estimate technical potential for the rest of the nation
- **Includes estimates of the number of households, number of suitable buildings, number and area of developable planes (m^2), total capacity potential (MW), and total annual generation potential (MWh) for each of 20 demographic combinations:**
  - Area Median Income (0-30% AMI, 30-50% AMI, 50-80% AMI, 80-120% AMI, >120% AMI)
  - Housing Type (multi-family vs. single-family)
  - Tenure (renter vs. owner)
- **Demographic data from 2011-2015 American Community Survey (ACS) 5-Year Estimates combined with LiDAR data to estimate solar technical potential at tract level by income, building type, and tenure**

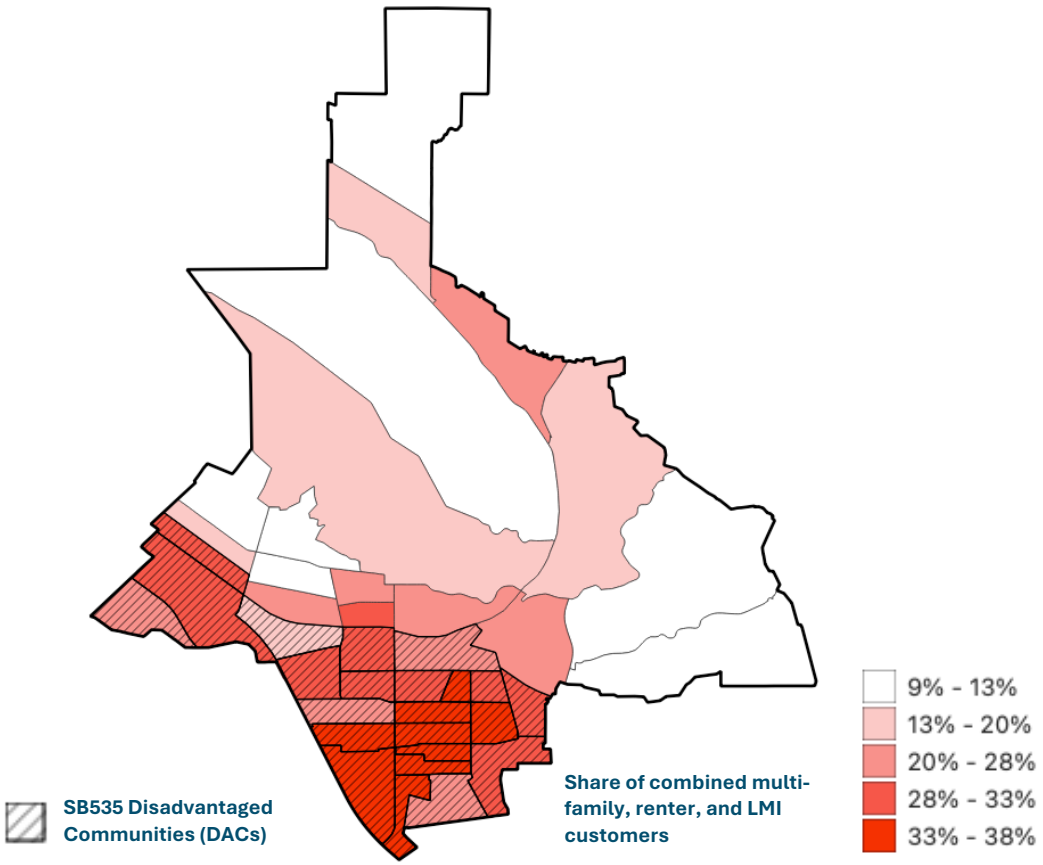
LiDAR Data Coverage

Residential Rooftop Solar Technical Potential (GWh)

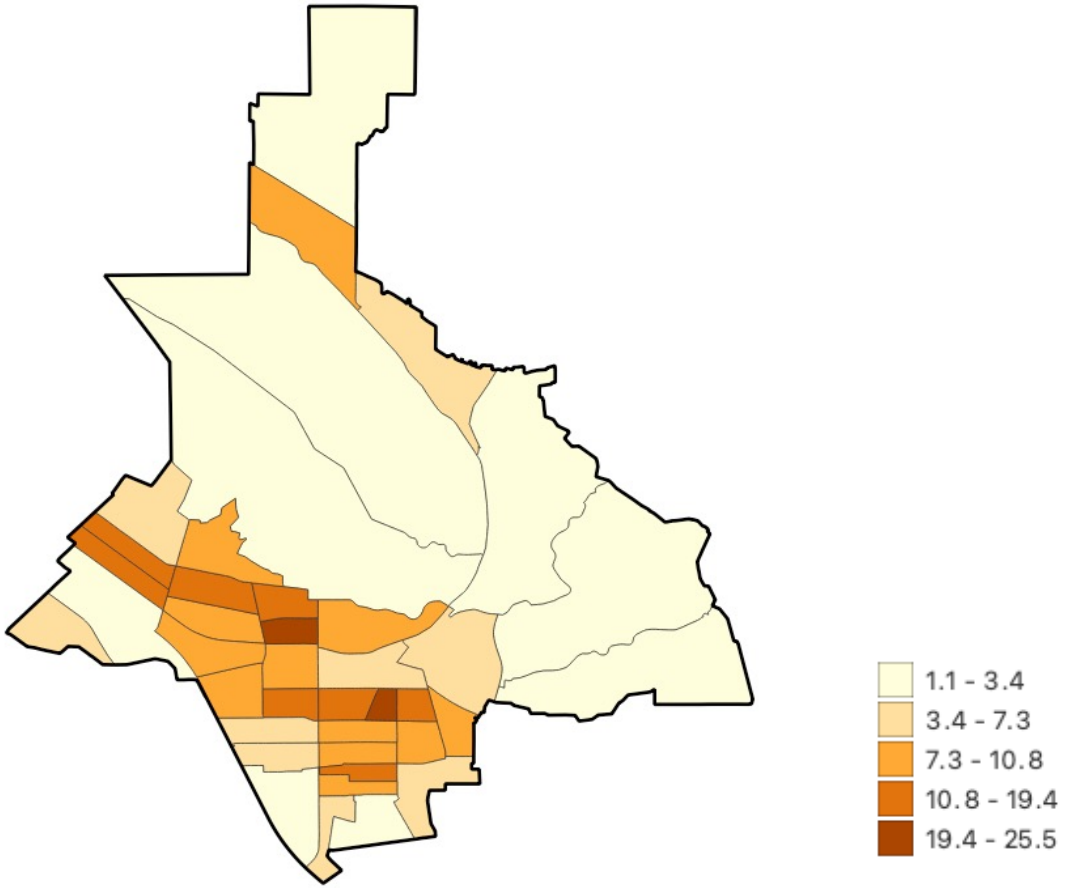


NREL REPLICA Residential Rooftop Solar Technical Potential in Glendale

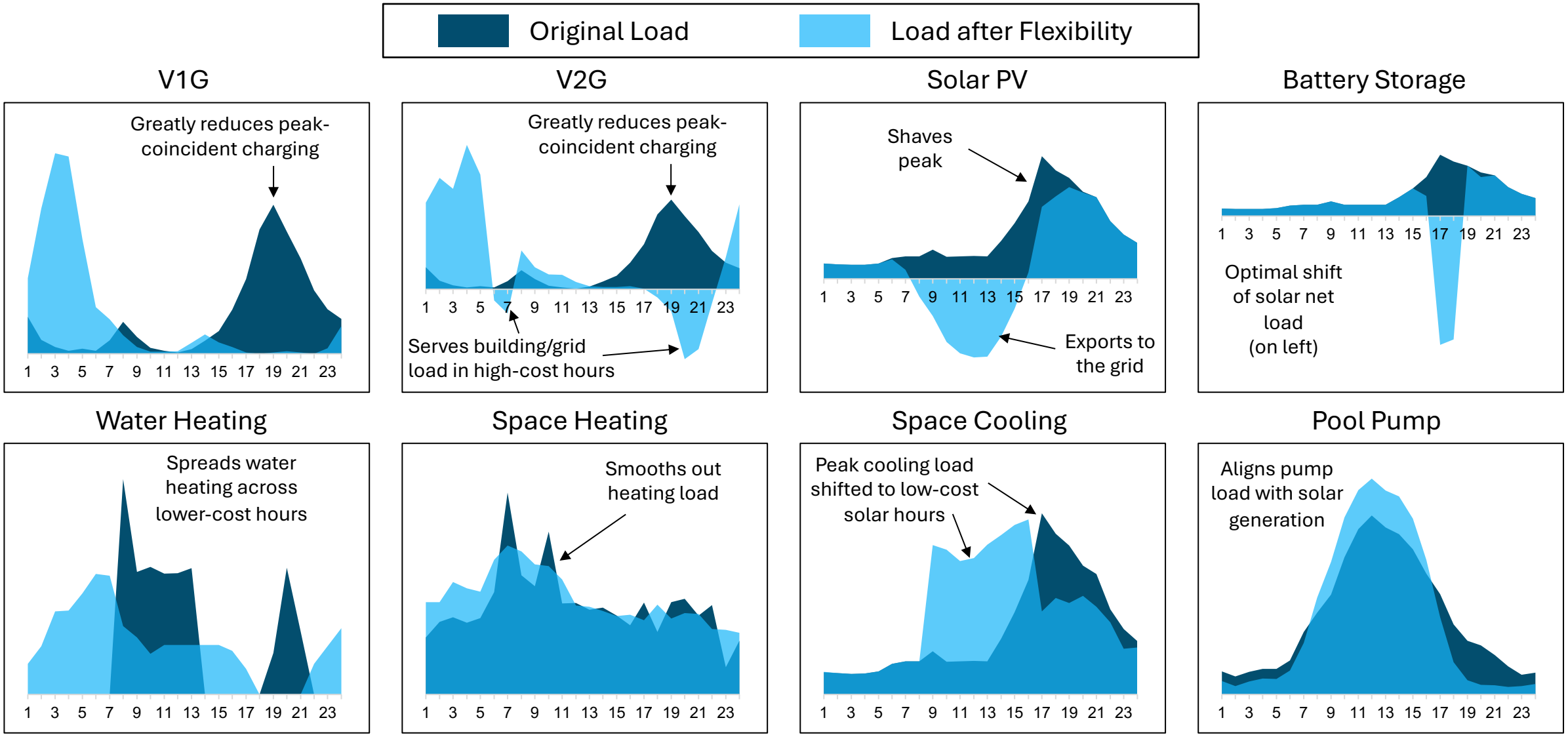
% Combined MF, Renter, and LMI Customers
(by Census Tract)



Rooftop Solar Technical Potential
(MW per km^2 Census Tract Area)



Load flexibility can come in many forms



- ***V1G:*** *One-directional smart charging that allows vehicles to charge from the grid at different times and speeds.*
- ***V2G:*** *Bi-directional capability that enables vehicles to both charge from and discharge to the grid.*

DERs may provide many benefits, but not all provide measurable benefits to ratepayers

Monetized Benefits (Ratepayer POV) **= Avoided Costs**	+ Procurement cost reduction + Transmissions capacity savings + Distribution capacity savings + Emissions savings + Operations and maintenance savings	+ Fuel cost savings + Reserve capacity costs reduction + Line loss reduction + Reduced methane leakage
Quantifiable Benefits	+ Environmental justice benefits + Voltage regulation/optimization + Financial risk reduction + Reliability + Resilience	+ Emissions savings + Land use impacts + Reduced water consumption + Bringing in federal incentive dollars + Reduced criteria pollutants
Qualitative Benefits	+ Data access + Equipment ratings and performance + Environmental justice benefits + Local workforce benefits	+ Economic development + Technology development + Improved public awareness