

SMUD's 2026 Integrated Distribution Resource Plan

Board Strategic Development Committee

October 6, 2026



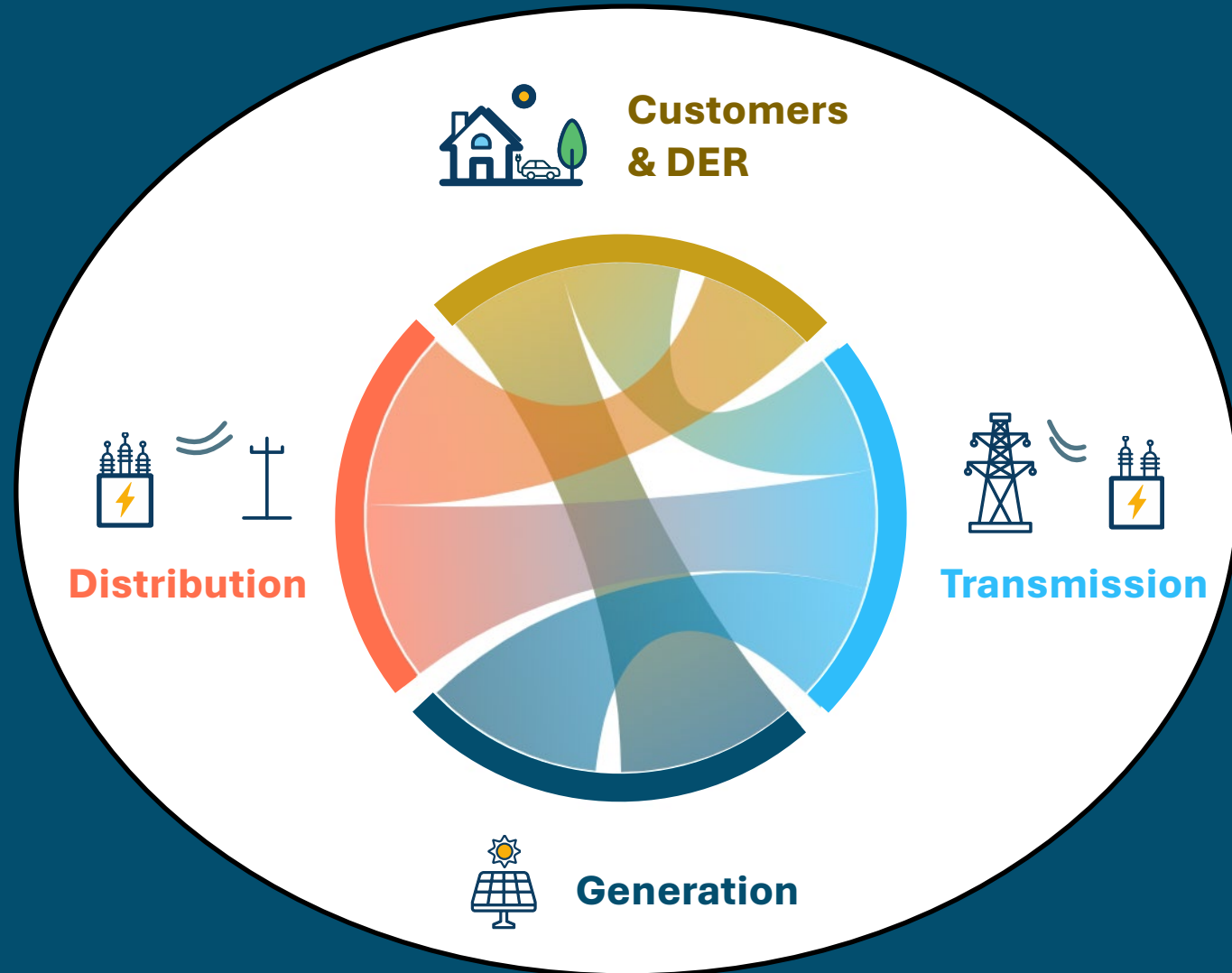
Energy+Environmental Economics

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Motivation: Integrated Planning

The IDRП increases the integration of SMUD's planning domains, driving the utility toward a planning framework that can better meet customer needs and decarbonization goals at lower cost.

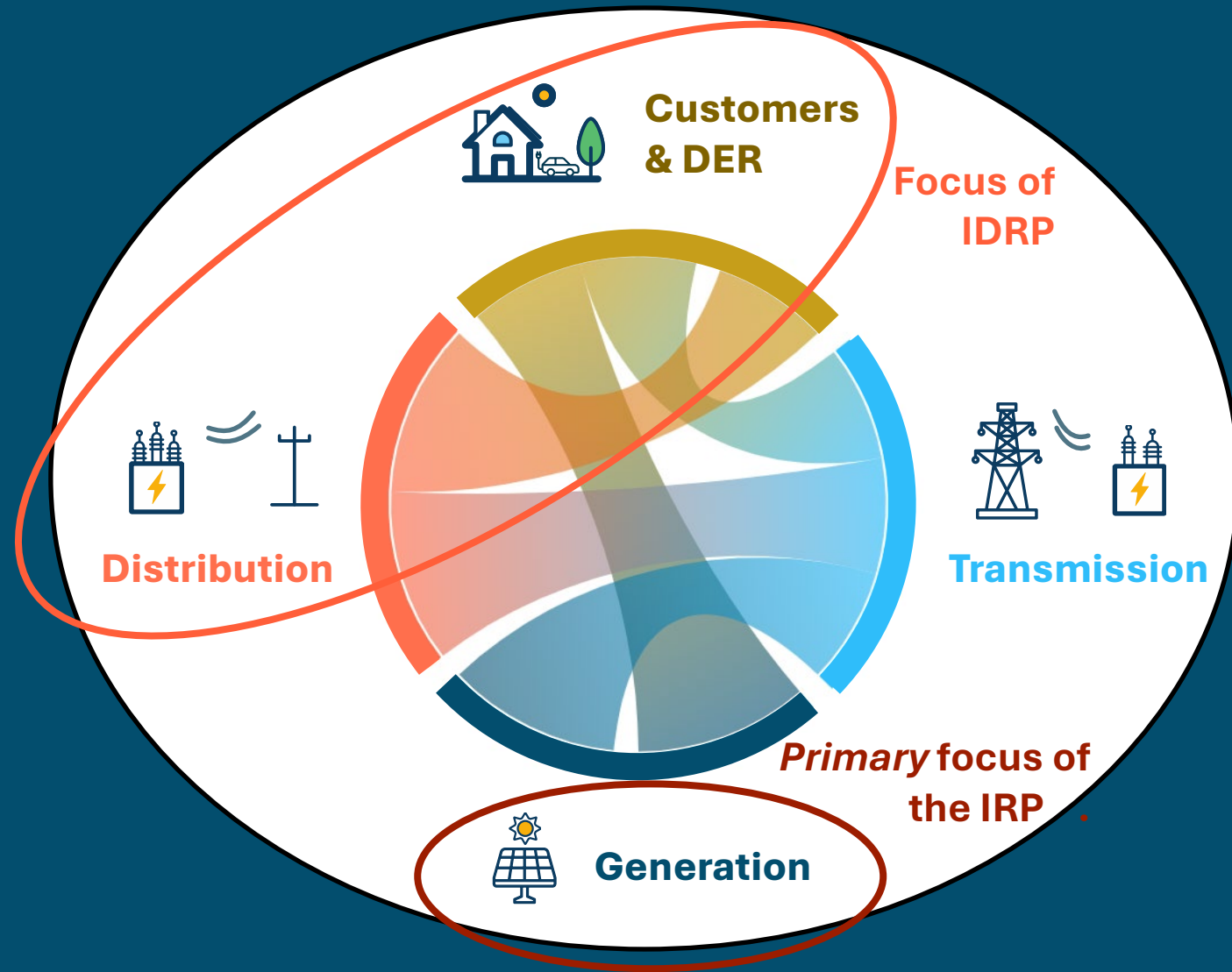
The IDRП's primary focus is on the intersection of **DER, customer programs, and distribution planning**. The analysis also explores the combined bulk and distribution system value of DER.



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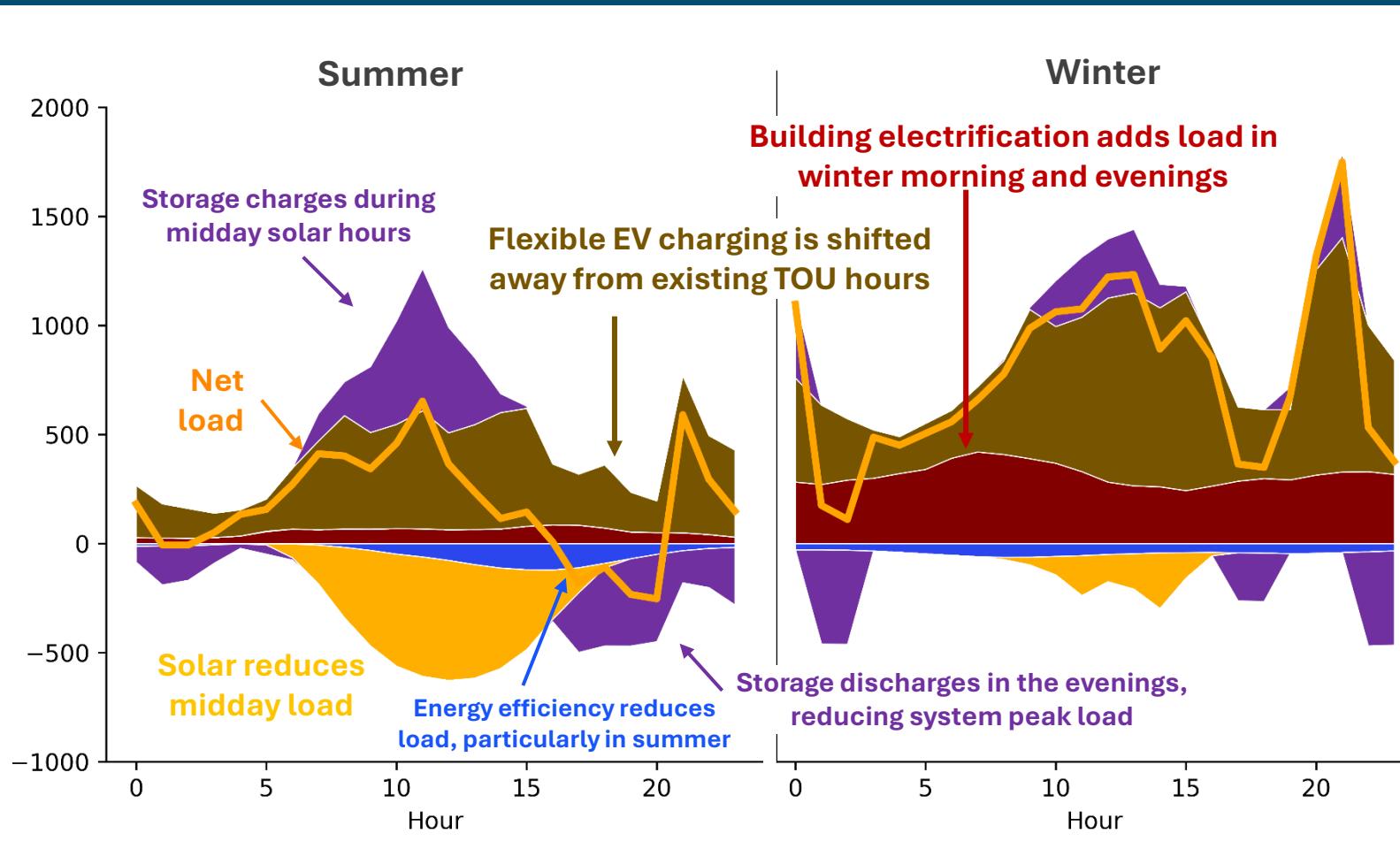
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Motivation for the 2026 Integrated Distribution Resource Plan

Forecasted SMUD System Wide Incremental Peak Day Load, 2040



Motivation

SMUD is anticipating rapid load growth and **accelerated infrastructure investment** needs over the next 15 years driven by electrification. Electrification presents an opportunity to **create downward rate pressure** if effectively managed to mitigate investment needs across the **bulk and distribution systems**.

Objectives of the 2026 IDR



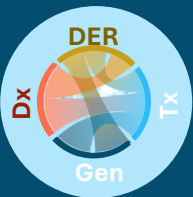
Inform **capital and staffing** strategies to meet a future accelerated pace of distribution upgrade needs



Evolve **distribution planning** practices to meet needs of high electrification future



Inform **DER strategy** to leverage DERs as both a bulk and distribution system asset



Identify opportunities to **coordinate planning** at SMUD to create **lower total system cost solutions**

Key Takeaways



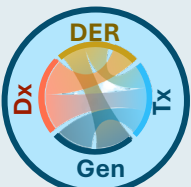
Significant load growth is coming, but we estimate that it will generate **downward rate pressure** for the distribution rate component



Enabling load growth will **require upfront investment in staffing and capital projects**: Electrification can increase the annual volume of distribution substation upgrades or replacements by 30-60%, depending on levels of load management

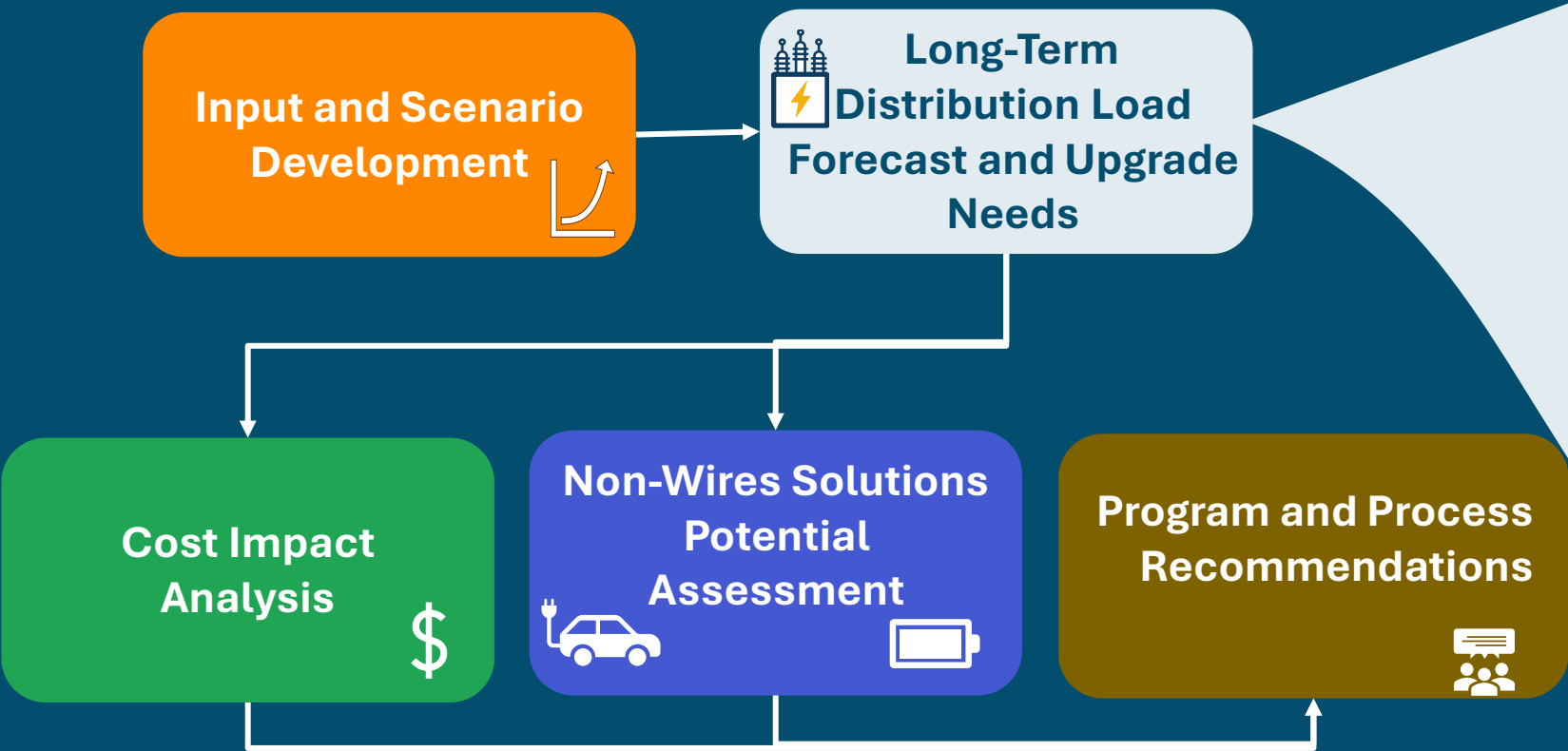


Managed charging strategies and Non-Wires Solutions **can reduce incremental distribution substation upgrade needs by up to 40% and incremental distribution system cost NPV by 50%** – yielding more downward rate pressure

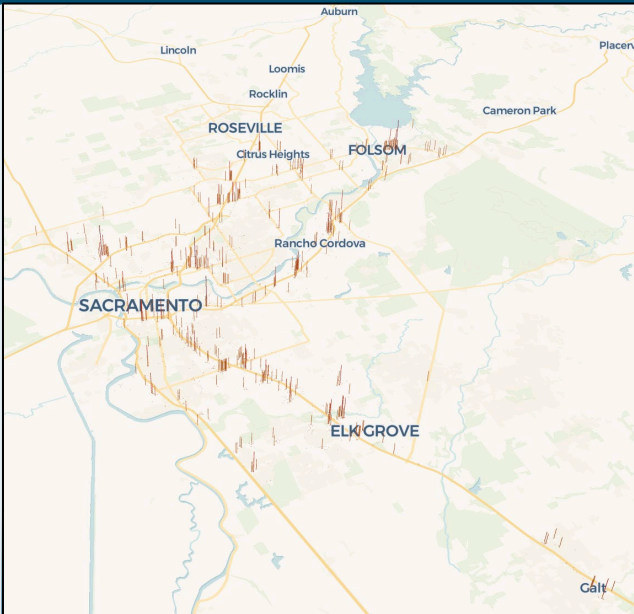


Enabling load management and NWS will require **new coordination pathways** between planning units on process, programs, and infrastructure

2026 IDRP Scope of Work



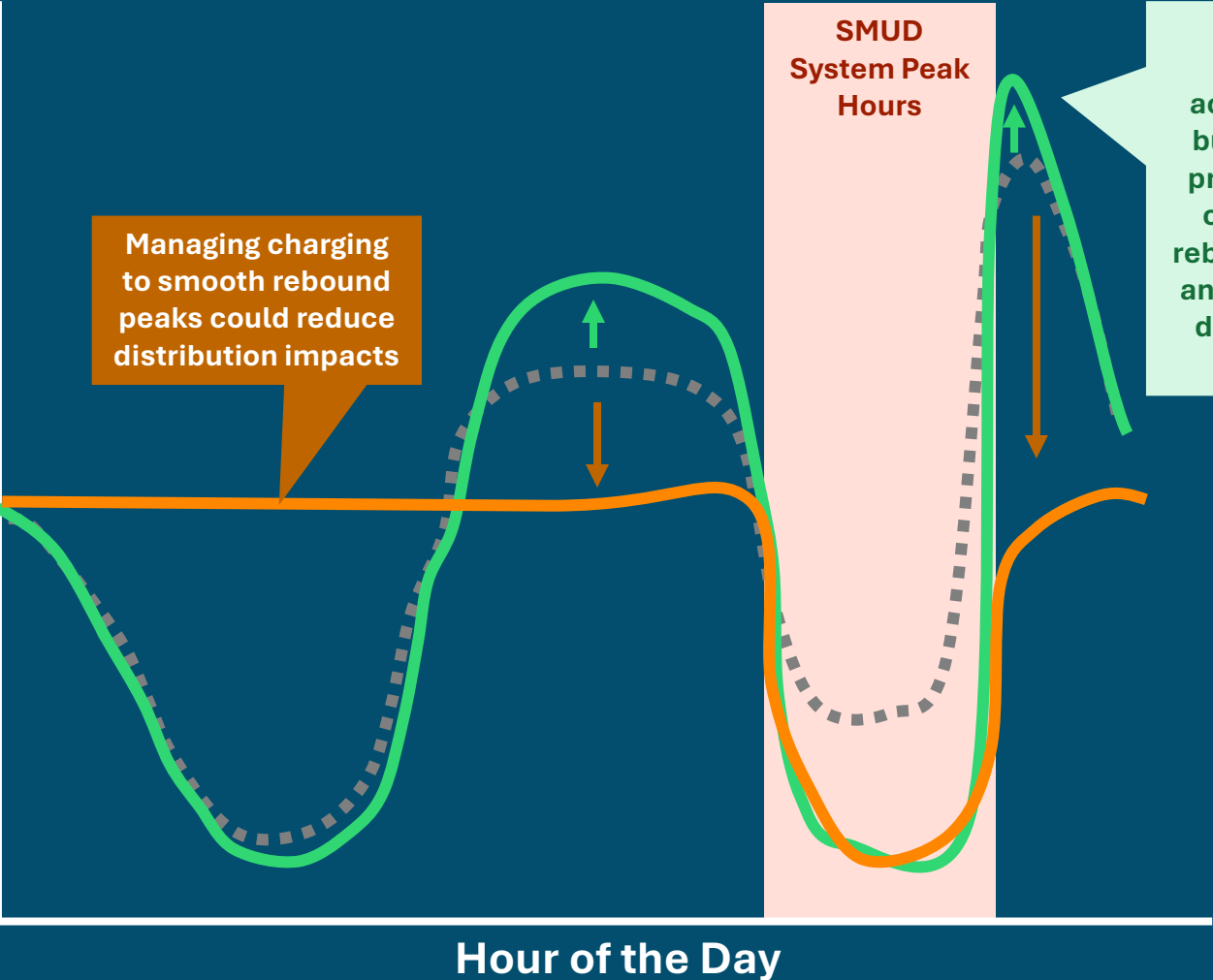
Public DCFC Charger Adoption



The level of detail and analytical rigor on the 2026 IDRP was enabled by SMUD’s investment in **LoadSEER** by Integral Analytics, a distribution load forecasting and planning software platform.

IDRP Scenarios

Illustrative Daily EV Charging Load Across Scenarios

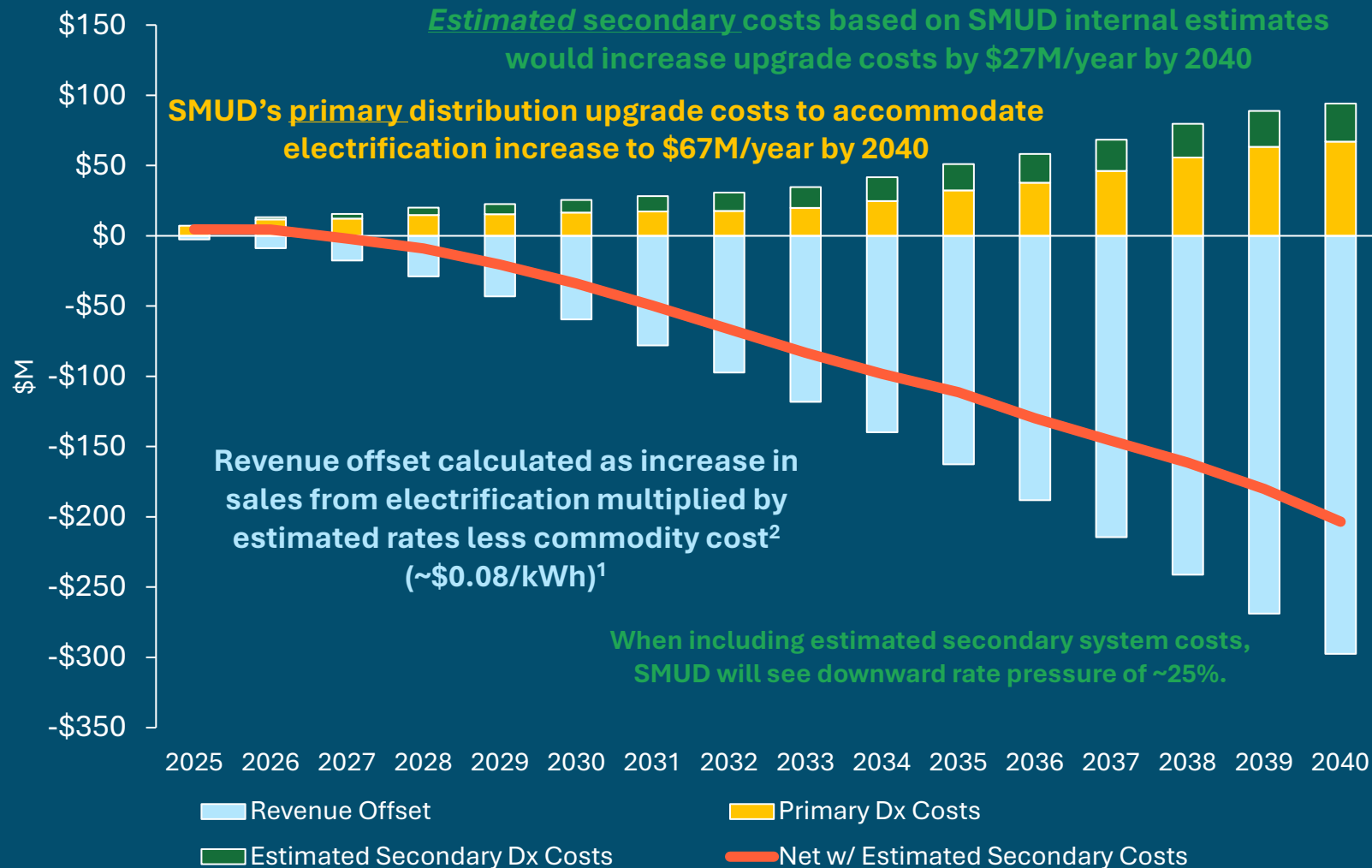


Scenario Descriptions

Reference Business-as - Usual	65% of customer passively manage charging on TOU rates 25% of customers participate in active managed charging program designed around bulk system price signals (i.e. generation capacity needs and energy arbitrage)
Managed for Bulk System Needs Bookend	50% of customers passively manage charging on TOU rates 50% of customer actively managed on programs designed around bulk system price signals.
Managed to Flatten Peaks Bookend	100% of customers actively manage their charging in a coordinated fashion that smooths rebound peaks.

Electrification presents an opportunity to increase system utilization and create downward rate pressure

Revenue Requirements Offset, Reference Scenario

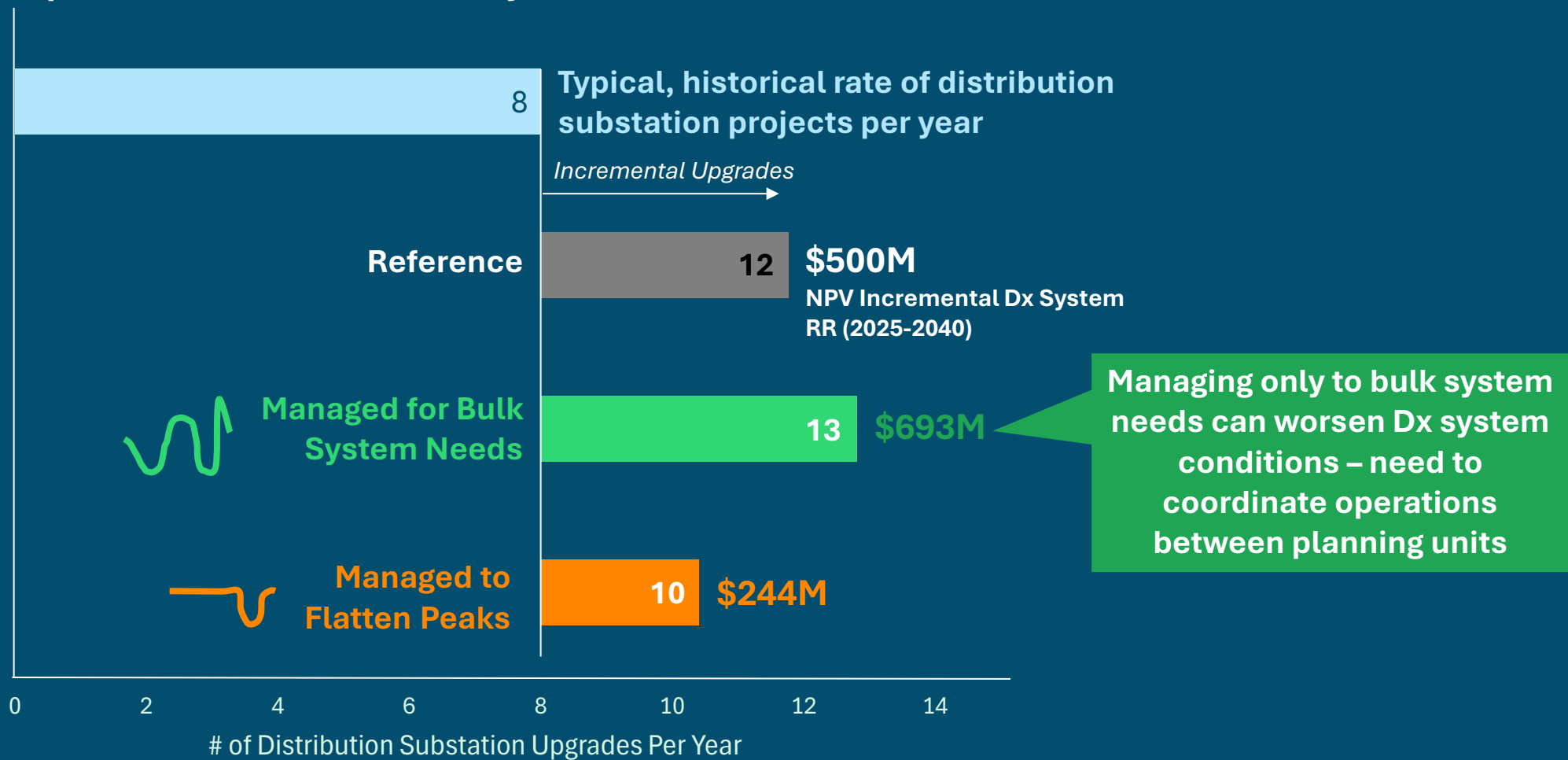


This is not a rate forecast. Costs only include capital costs for primary distribution upgrades and substation additions and estimated secondary system costs. It excludes distribution O&M, and customer program integration and incentive costs.

- + Costs of capital expenditures to upgrade distribution infrastructure are offset by sustained revenue growth from electrification
- + In the near term, upward rate pressure may be seen as distribution upgrades are needed before load materializes fully

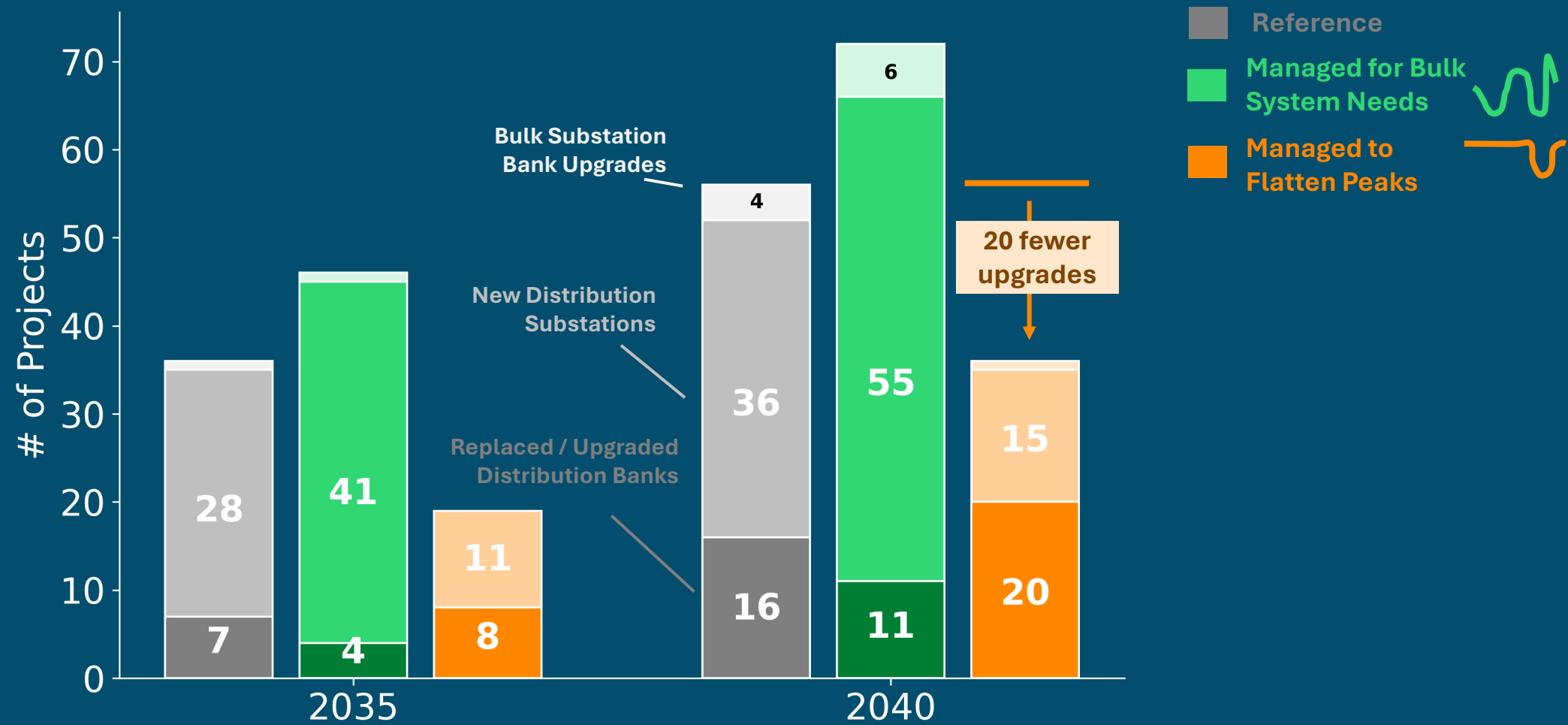
Without other interventions, electrification can increase the annual volume of distribution substations upgrades or additions by 30-60%

Annual Number of Distribution Substation Upgrades, Replacements, or Additions by Scenario



SMUD has a limited number of years to develop the programs, processes, and infrastructure needed to enable dynamic load management

Distribution System Upgrades, Cumulative # of Incremental Projects through 2040



Evolutions in Customer Programs for Locational Benefits

Program performance carries more risk at the locational level, requires more coordination

Conventional DER Programs

- All resources can be dispatched on a **systemwide dispatch signal**
- Program performance carries some **financial risk**
- Systemwide benefits will evolve with decarbonized system, but can be forecasted over **program lifetime**

Locationally Targeted Programs

- **Diversity of dispatch signals** is critical
- Performance carries **physical and financial risk**: Limited backup options to avoid capacity exceedance
- **High locational value is transient**, only lasting until deferred upgrade is made

Coordination is key:

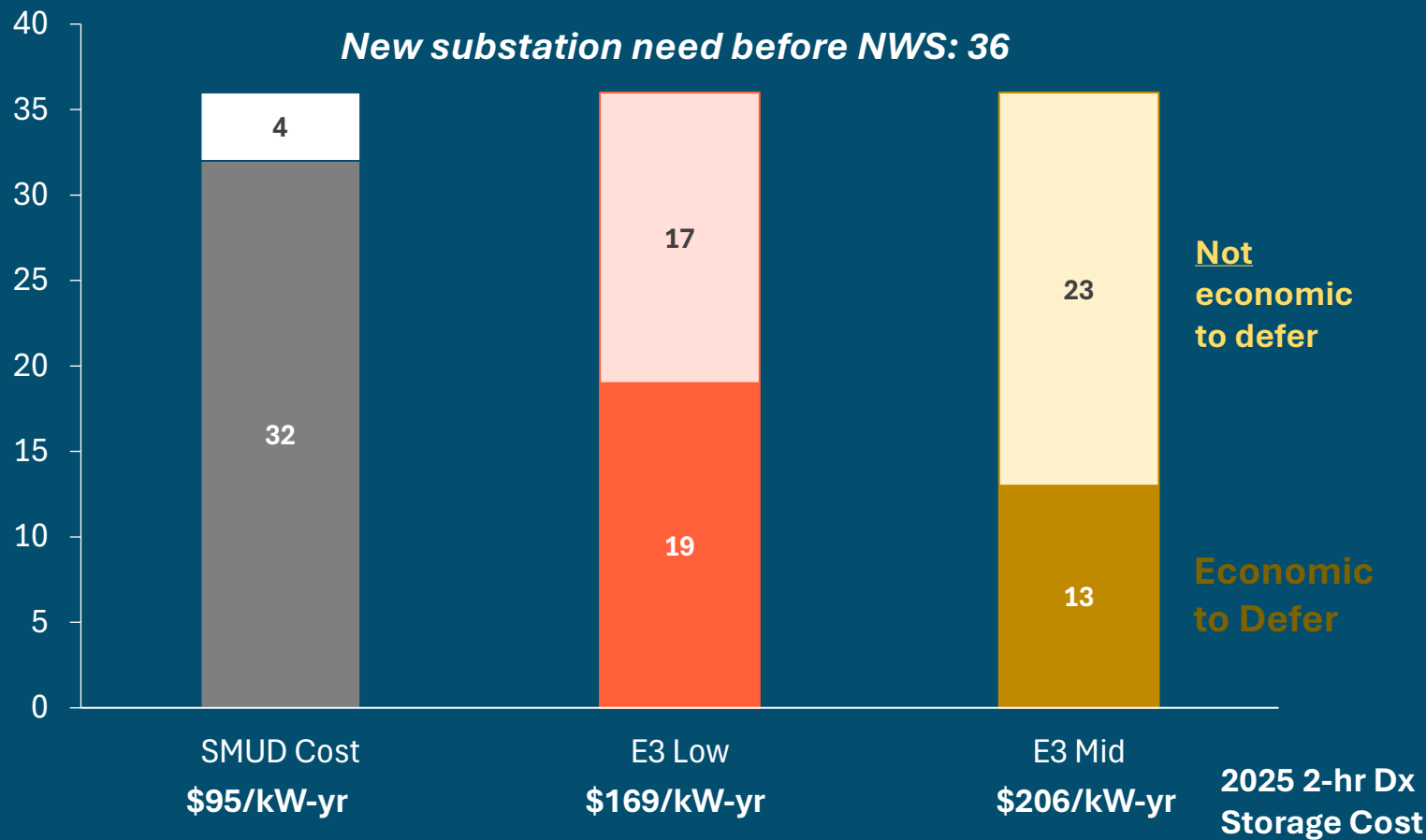
Customer Program team needs to know where/when distribution constraints are.

Distribution Planning team needs to know where/how much potential DER capacity is available.

Resource Planning team needs to know when locational dispatch will lock out bulk system dispatch

There is **significant *economic* potential** to defer traditional distribution infrastructure upgrades with **non-wires solutions (NWS)**

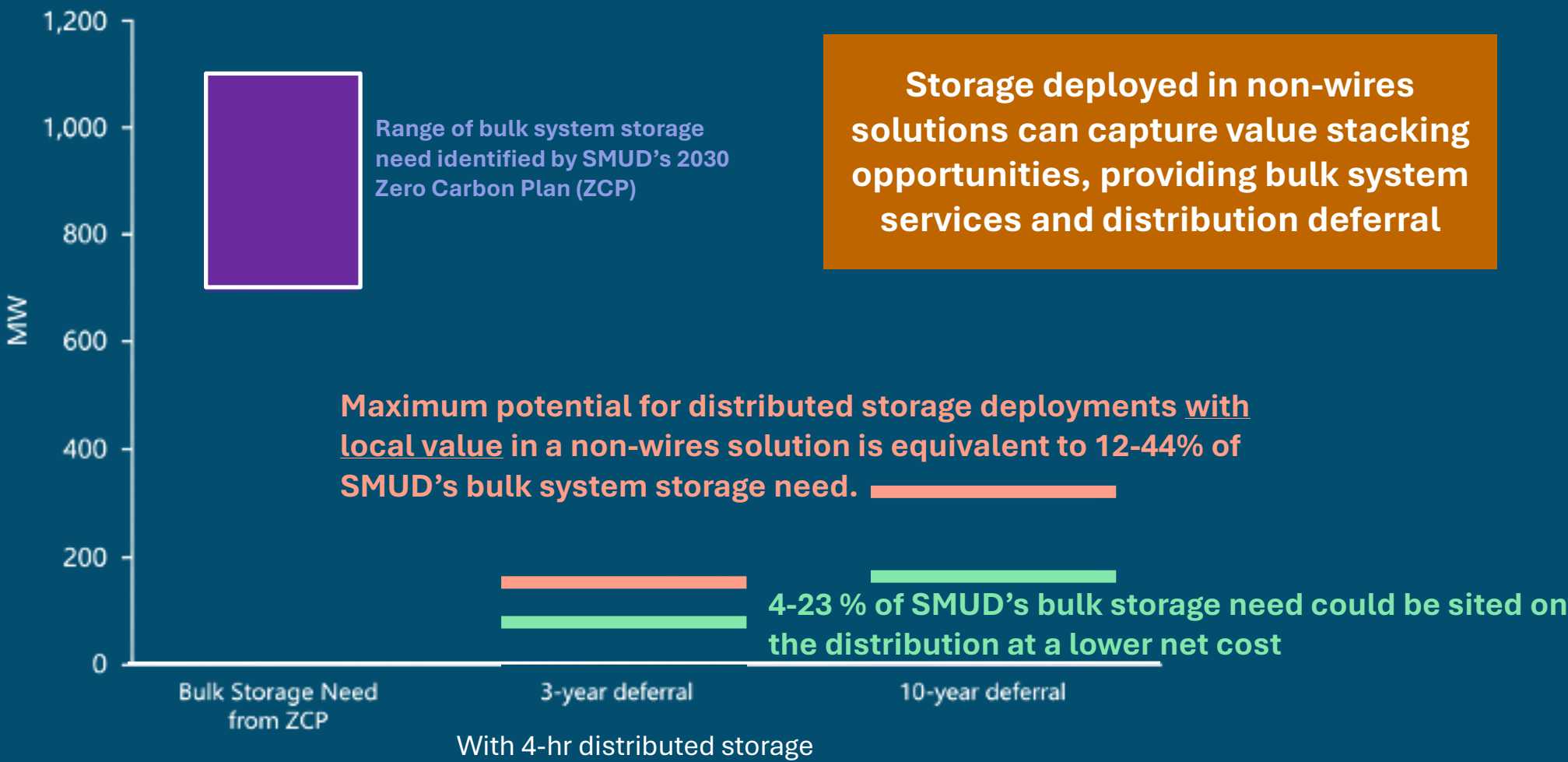
New Substations that are Economic to Defer with Storage for 7 Years, #



Factors that will constrain the amount of economic deferral potential SMUD can actually achieve include timelines for DER procurement, uncertainty in load forecast and DER performance, customer willingness to participate, and technology readiness

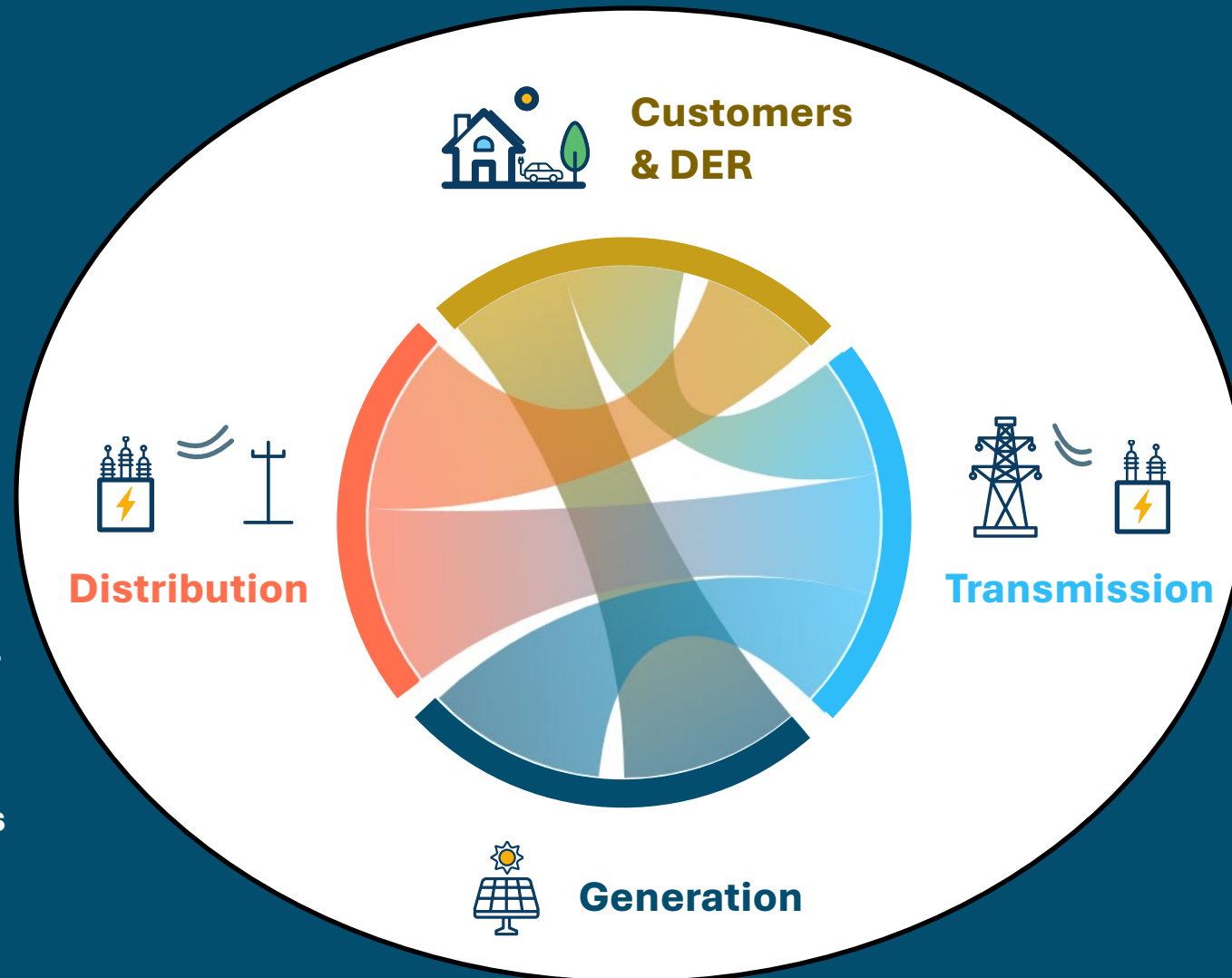
Distribution-sited storage could displace some of SMUD's new bulk system battery storage needs at lower net total system cost

Bulk system storage capacity that could be displaced by distribution storage at lower cost net of locational value



Final Takeaways

- + Significant load growth is coming, but we estimate that it will generate **downward rate pressure** for the distribution rate component
- + Enabling load growth will **require some upfront investment in staffing and capital projects**: Electrification can increase the annual volume of distribution substation upgrades or replacements by 30-60%, depending on levels of load management
- + Managed charging strategies and Non-Wires Solutions **can reduce incremental distribution substation upgrade needs by up to 40% and incremental distribution system cost NPV by 50%** – yielding more downward rate pressure
- + Enabling load management and NWS will require **new coordination pathways** between planning units on process, programs, and infrastructure



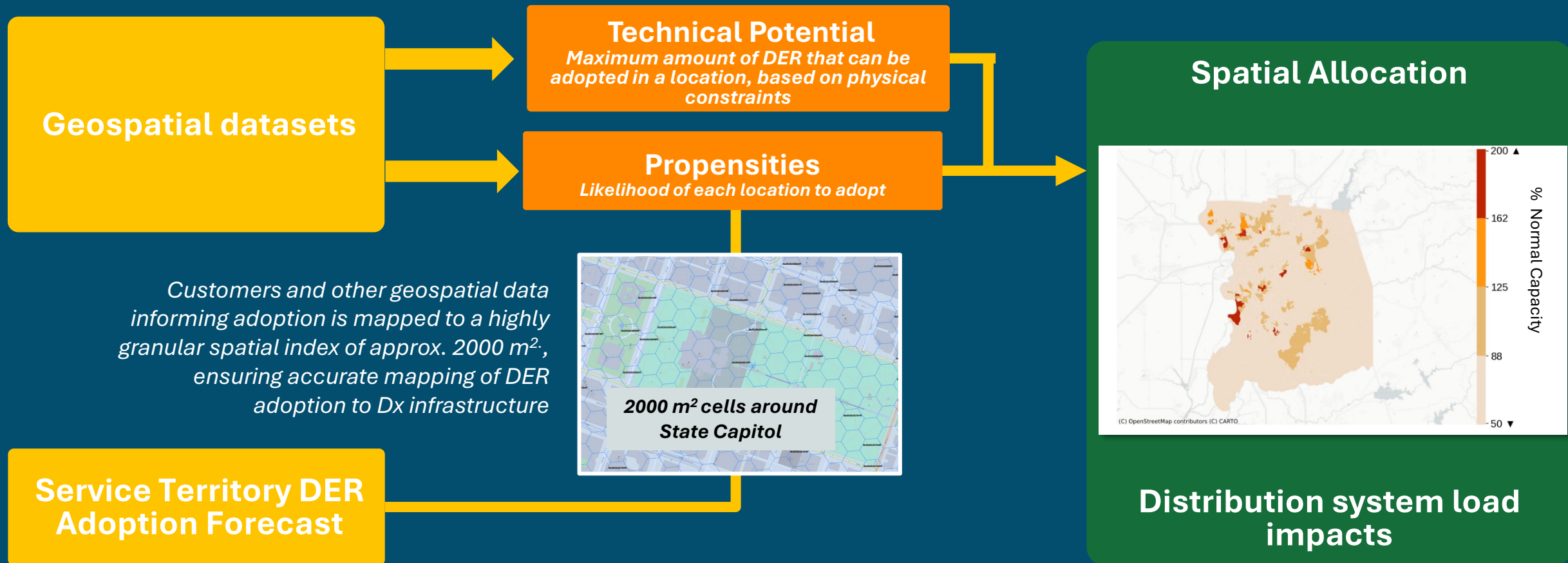
Appendix

Summary of Key Findings

1. Electrification presents an opportunity to increase system utilization and **create downward rate pressure**
2. Without investment in other interventions, electrification can **increase the annual volume of distribution substation upgrades or replacements** by 30-60%, depending on levels of load management.
3. Distribution system impacts are forecasted to accelerate in the mid 2030s, giving SMUD a **limited number of years to develop the programs, process, and infrastructure** needed to enable dynamic load management to mitigate upgrade needs.
4. **Charging management strategies** can reduce incremental distribution substation upgrade needs by 40% and reduce the NPV of incremental distribution system costs by 50%. Charging management strategies that consider **both bulk and distribution system needs** yield overall **lower total system costs**
5. There is **significant economic potential** for distribution deferrals with **non-wires solutions**. The **achievable deferral potential will be limited** by timeline feasibility, risk tolerance, technology readiness, vendor readiness, and customer willingness to participate.
6. Some of SMUD's **bulk system storage need could be sited on the distribution system** at lower cost when considering the local value of distributed storage
7. SMUD's **Sustainable Communities** have higher forecasted distribution system upgrades needs to support electrification.

Distribution Load Forecasting with LoadSEER

Geospatial adoption and distribution load impacts were modeled using Integral Analytics' LoadSEER software, which spatially allocates service territory wide DER adoption forecasts to specific places in the system.

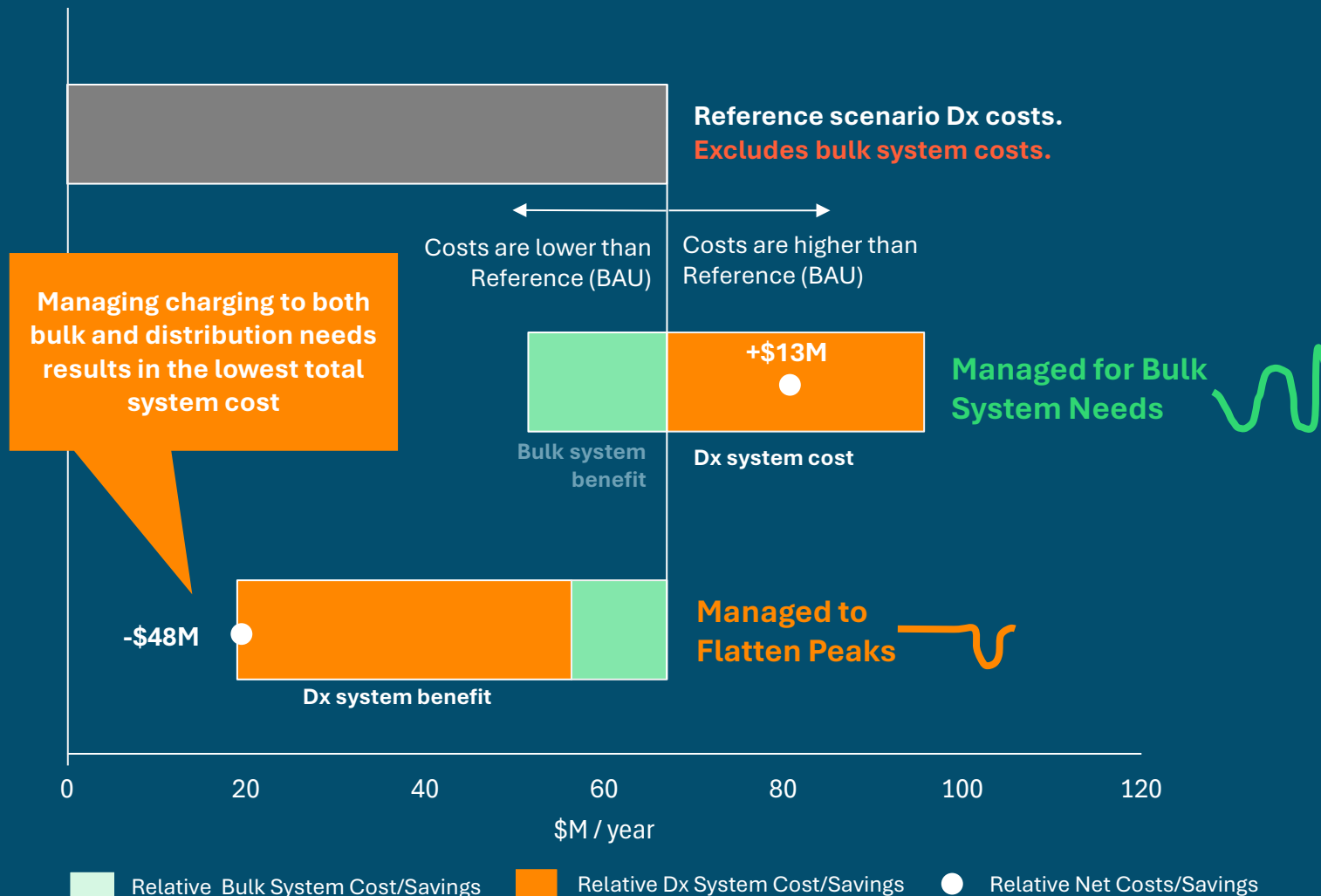


Study Recommendations

	Near-term (1-2 years)	Mid-term (3-5 years)	Long-term (>5 years)
Distribution Planning <i>Distribution load impacts are forecasted to accelerate in the mid 2030s, giving SMUD approximately 3 distribution planning cycles to develop the programs and infrastructure needed to enable dynamic load management to mitigate upgrade needs.</i>	Determine data needs and requirements from NWS pilots to be able to incorporate load management solutions in future planning cycles Explore capability of other interventions , such as circuit switching, to mitigate constraints	Incorporate LoadSEER forecasts into ongoing distribution planning projects to identify potential opportunities to optimally size near-term upgrades to accommodate future load growth	Leverage learnings from pilot programs to accommodate forecasted acceleration in distribution system projects in mid-2030s
Customer Programs <i>The IDRP demonstrated that designing customer programs purely for bulk system needs, without awareness of local distribution constraints, may increase distribution system costs by ~\$30M/year by 2040.</i>	Pilot coordinated load management strategies . Key activities include: • Test different program structures, rules, and compensation mechanisms • Identify potential vendors to support new programs • Study customer willingness to participate	Conclude pilots and scale up load management programs . Develop mechanisms to ensure diversity of charging patterns and ability to co-optimize bulk and local system benefits to produce lower cost total system plans.	Where local distribution constraints are projected, dispatch load management with sharper focus on local level . Areas without active local constraints can continue to maximize bulk system benefits
Staffing and Capital Planning <i>The IDRP found that SMUD will need to accelerate the pace at which it builds new distribution infrastructure by 30-60%. Incremental costs to upgrade the primary system could range from \$30-95M/year in 2040.</i>	SMUD should review staffing and long-term capital plans to prepare for an escalation in new substation construction Define SMUD's framework for characterizing what makes a good NWS investment from a capital planning perspective	Confirm that load growth trajectories are consistent with IDRP, to validate need for increased staffing/capital	
Integrated System Planning and Operations	Adapt planning frameworks to better integrate bulk and local system planning , with consistent load forecasts, resource costs, and load management assumptions Establish commitment to coordinating program design and dispatch of resources across bulk and local system needs		
Community Engagement	SMUD should engage fleet operators, especially in disadvantaged communities , to eliminate distribution bottlenecks to fleet electrification in those communities. Promote broad participation in load management programs		Continue to emphasize benefits from new participants, and sustained participation from existing participants

Charging management strategies that consider both bulk and distribution system needs yield overall lower total system costs

Incremental Revenue Requirement Relative to Reference, \$M/year, 2040



Study Recommendations:

Near-Term (1-3 years):

- Pilot the coordination of load management activities across bulk and local system needs
- Test program rules, compensation structures, and customer willingness to participate

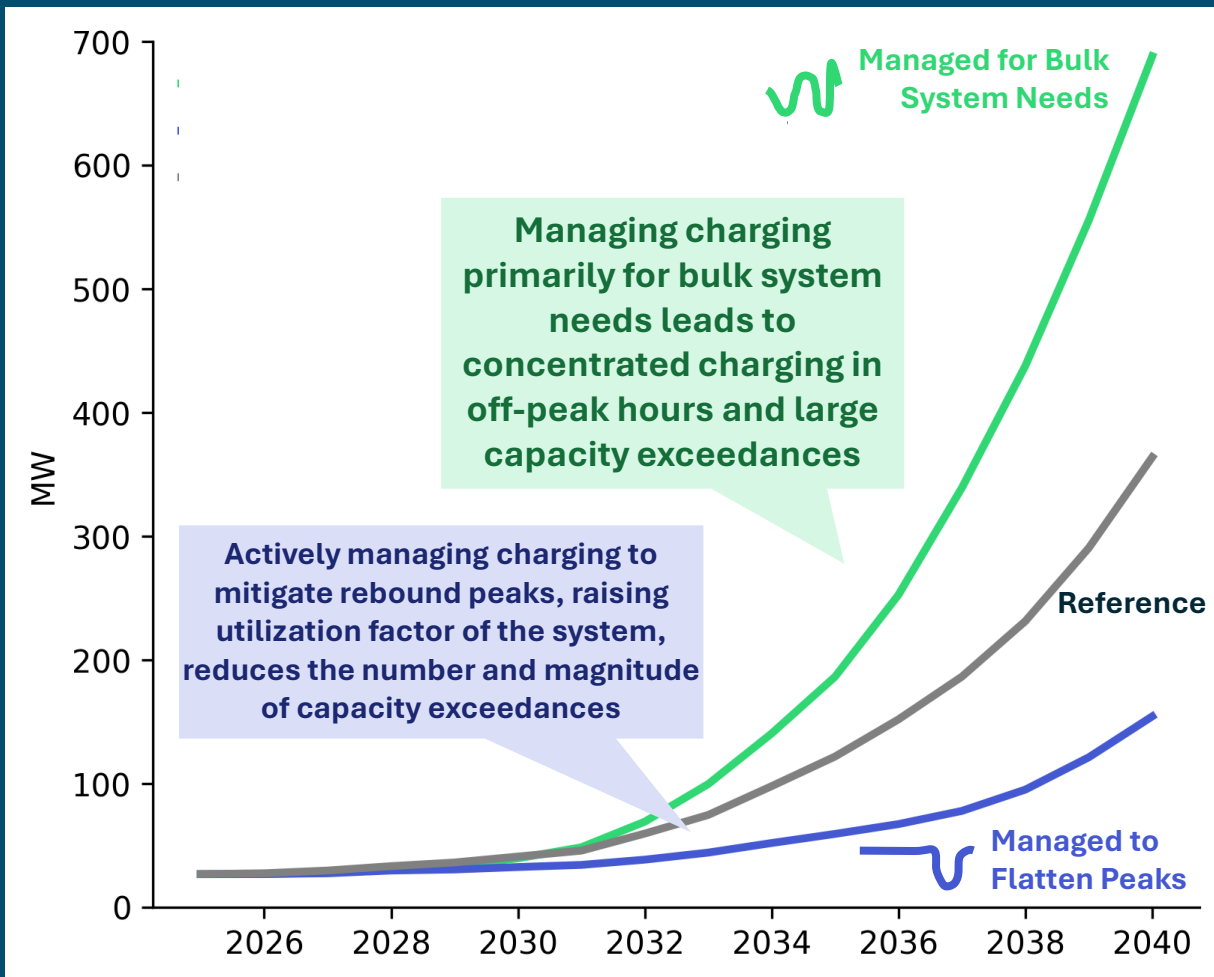
Mid-Term (1-5 years):

- Establish commitment to coordinating DER planning, program design, and dispatch across bulk and local system needs

Charging management strategies that smooth rebound peaks and raise the utilization of the system result in lower peak load growth

Distribution Bank Capacity Exceedances, MW

Non-Coincident Peak Load less 85% Normal Capacity



Study Recommendations:

Near-Term (1-2 years):

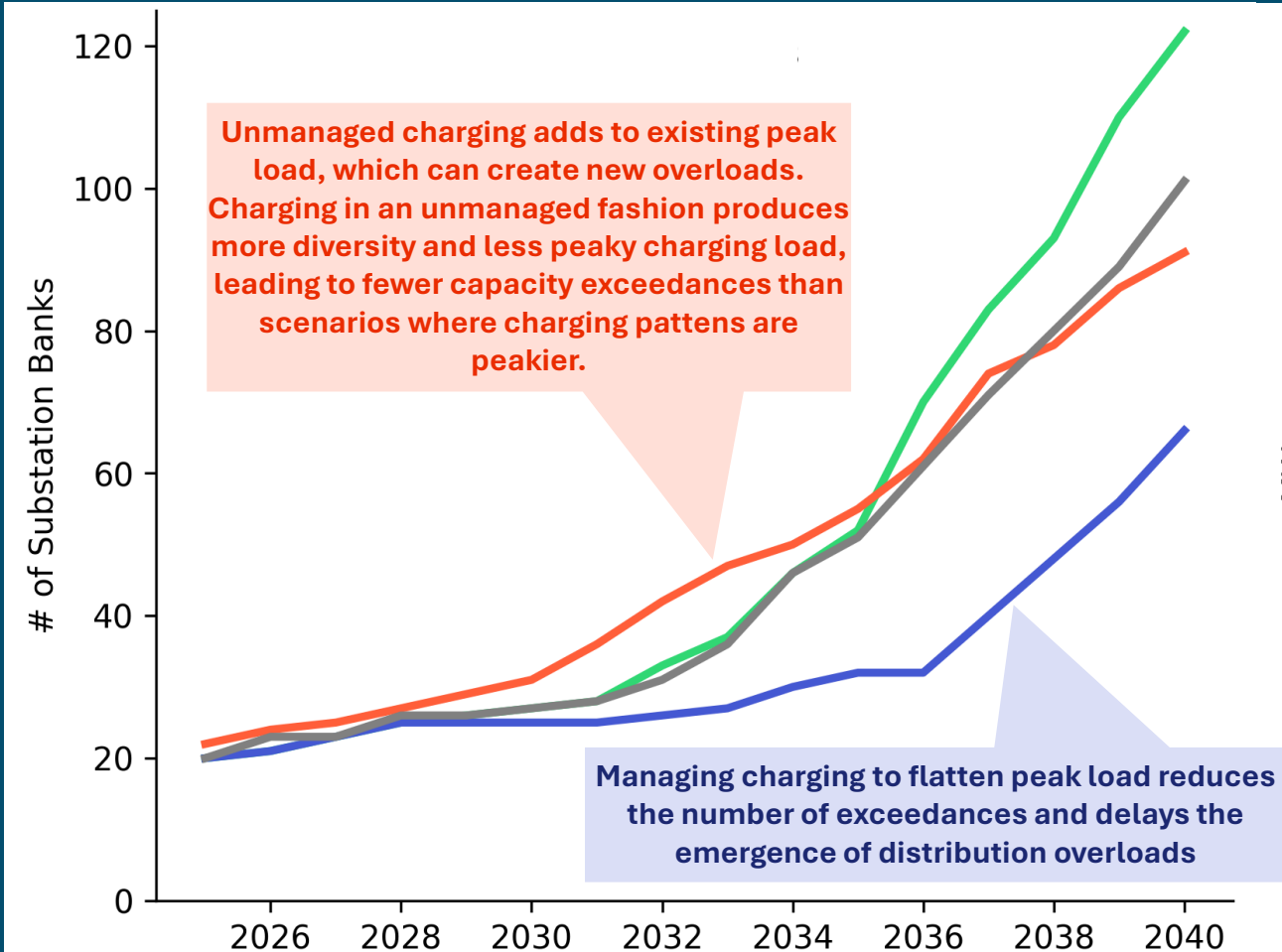
- Pilot the coordination of load management activities across bulk and local system needs
- Test program rules, compensation structures, and customer willingness to participate

Near to Mid-Term (1-5 years):

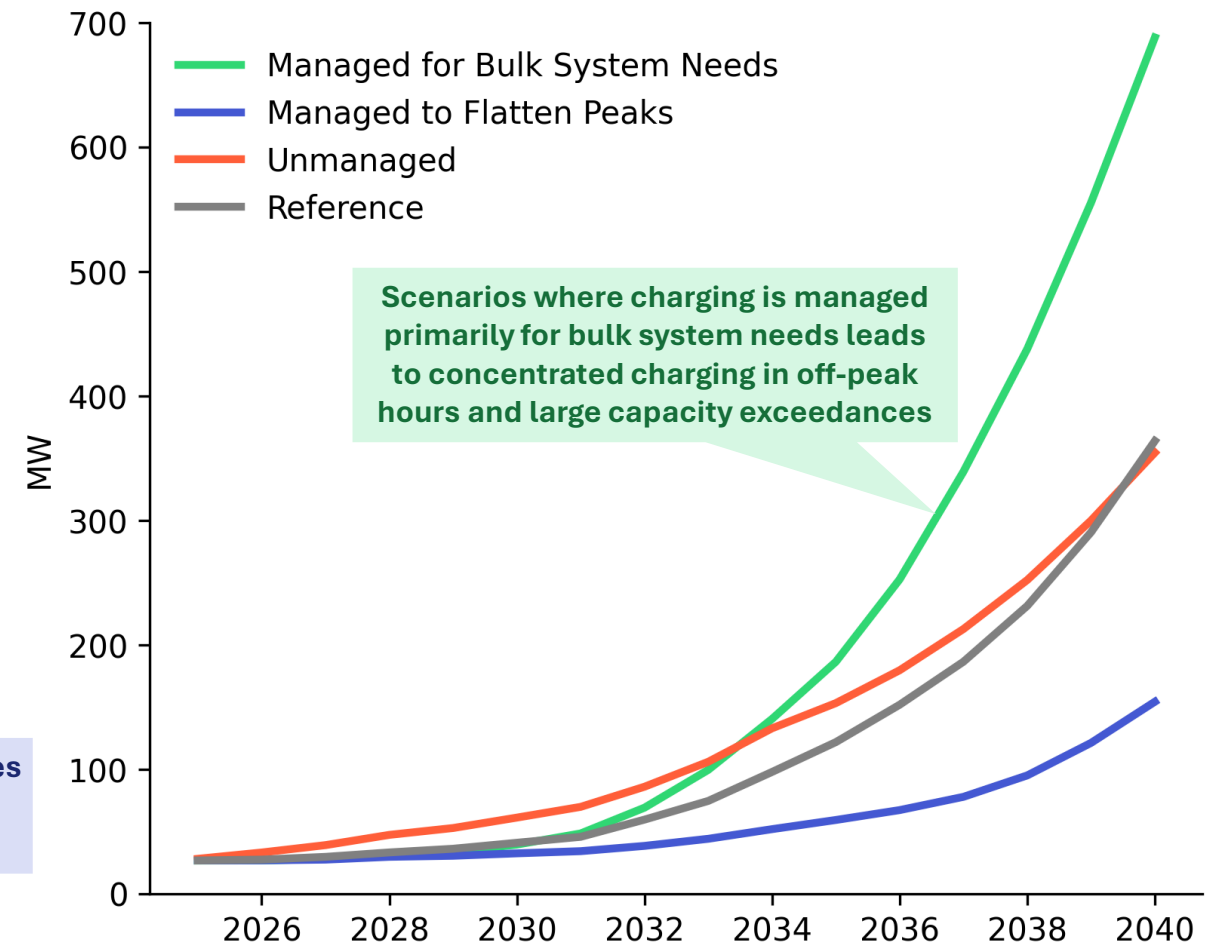
- Establish process to coordinate DER planning, program design, and dispatch across bulk and local system needs

Distribution Bank Capacity Exceedance Forecast

Distribution Bank Capacity Exceedances, #
Peak load exceeds 85% of Normal Capacity



Distribution Bank Capacity Exceedances, MW
Peak load less 85% of Normal Capacity



Despite load growth, many distribution banks will continue to have headroom

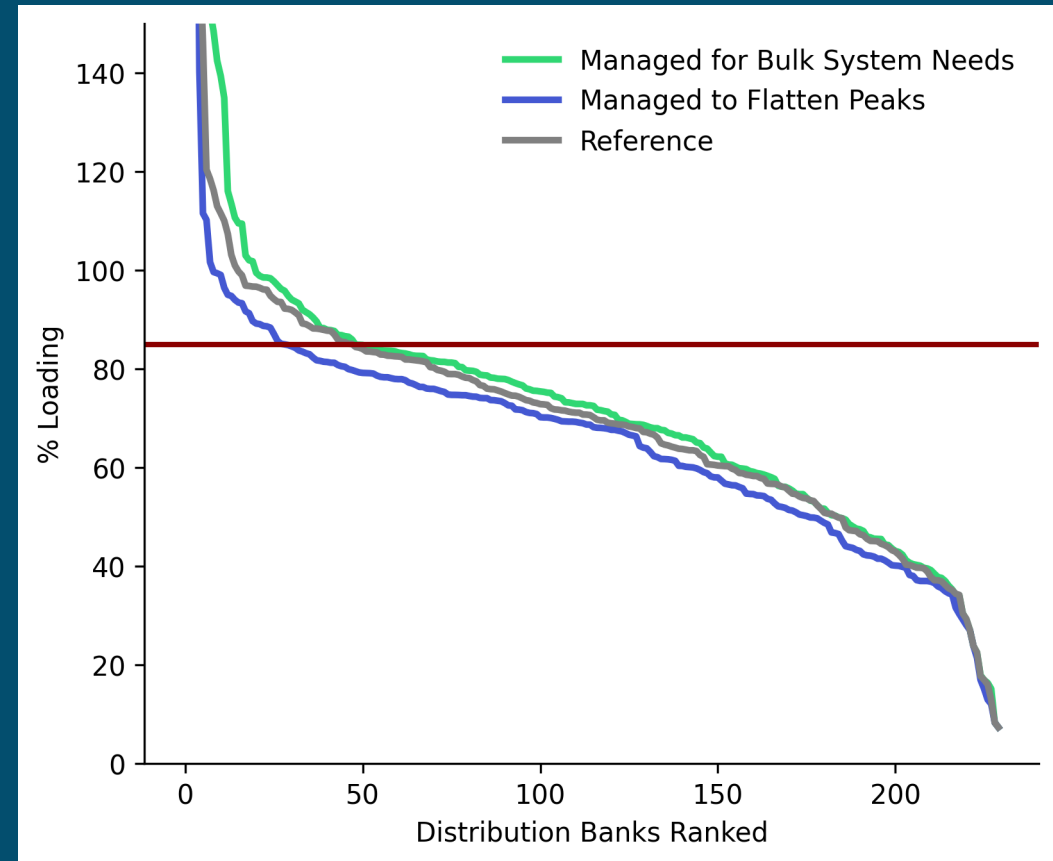
+ In any given study year, there are three categories of distribution bank loading

- Loading so high that even optimal load management cannot relieve capacity exceedance
- Loading that can be mitigated by load management
 - This is the delta between the lower bound (Managed to Flatten and Peaks) and the upper bound (Managed for Bulk System Needs)
- Loading that is so low that no upgrades are needed regardless of management

+ This shows that costs are driven by a relatively small number of locations amid the broader system

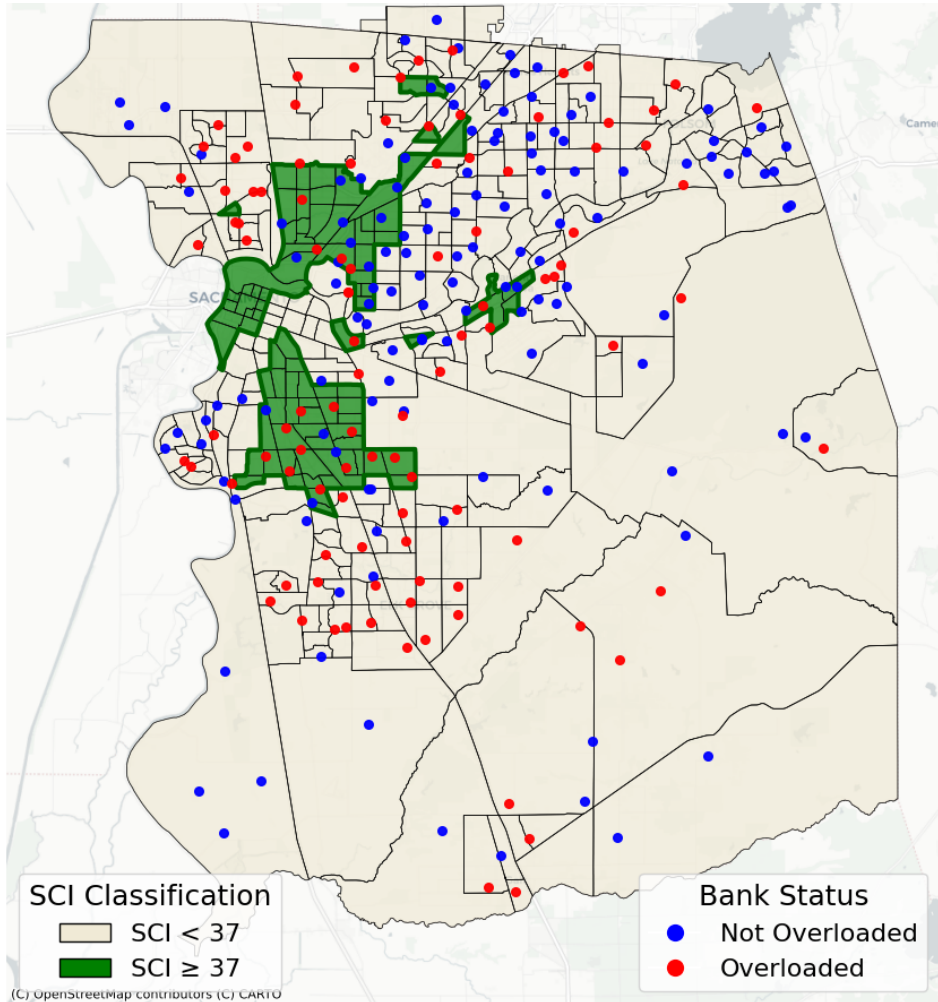
- Most distributed resources should therefore be able to dispatch to bulk system needs, but SMUD should be very cautious to manage load in sensitive regions

Distribution Bank Loading - 2035

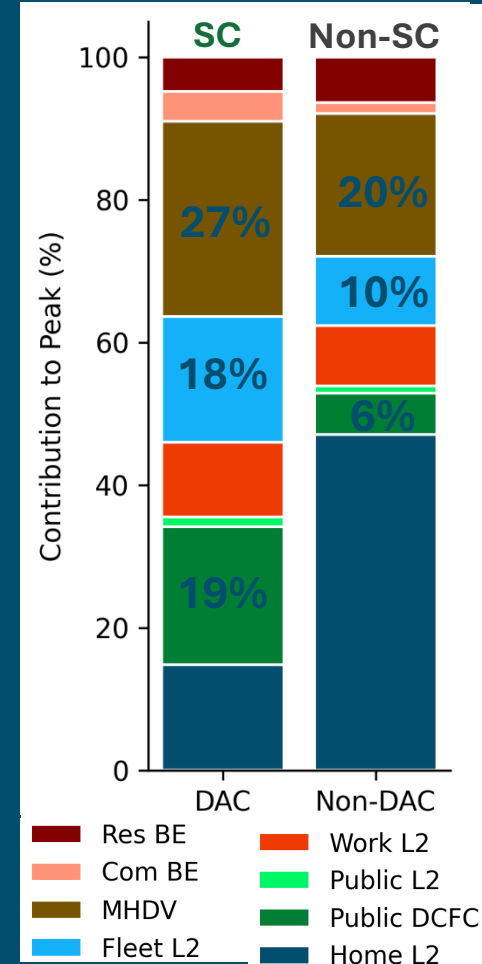


Sustainable Communities have more forecasted distribution bank overloads compared to other communities, due to proximity to transportation corridors

Distribution Bank Capacity Exceedances
Reference Scenario, 2040



Contribution to Peak of Load
Increasing DER for All Overload
Banks, 2040



Investing grid upgrades in these communities can help reduce local emissions and criteria pollutants.

Modeled constraints/upgrades in Sustainable Community Zones are primarily due to MHDEV, Fleet LDV or public DCFC charging, caused by proximity to transportation corridors.

Study Recommendations:

- Engage fleet operators, especially in disadvantaged communities, to eliminate distribution bottlenecks to fleet electrification
- Encourage broad participation in load management

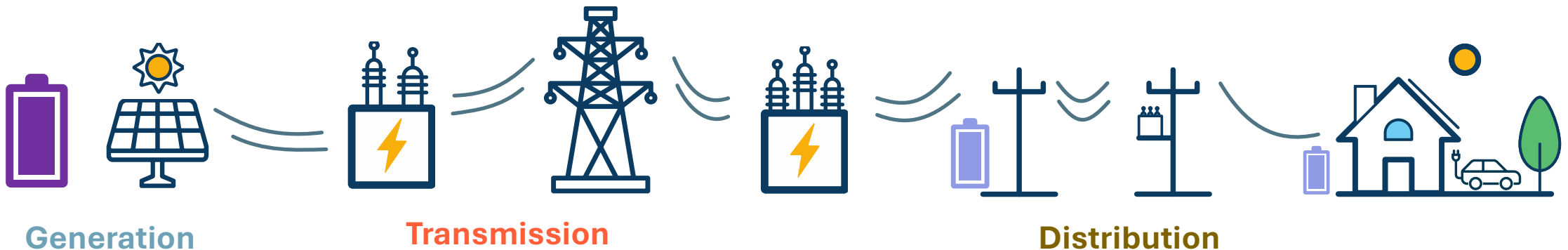
Integrated System Planning Analysis Questions

1. Non-Wires Solutions (NWS) Screening: Where and at what scale is the net cost (considering its bulk system value) of a distributed storage deployment to relieve an overload less than the cost of a distribution upgrade?

$$\text{Distributed Storage Cost} - \text{Avoided Energy} + \text{Capacity} < \text{Distribution Upgrade Cost}$$

2. Bulk vs Local Siting: How much distributed storage has a net cost (considering its locational value) less than utility-scale storage?

$$\text{Distributed Storage Cost} - \text{Avoided Distribution Upgrade Cost} < \text{Bulk System Storage Cost}$$



Scope of Distribution Impact Analysis

- + The IDRП focused on identifying capacity overloads at **bulk** and **distribution** substation banks.
- + Cost to mitigate those capacity overloads with traditional infrastructure investments considered the need for other associated primary distribution system infrastructure (e.g. construction of new feeders with new substations)
- + Costs for the **secondary distribution system** upgrades needed to support electrification were not evaluated in this study

