Evolution of Distribution Planning for Utilities

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Motivation for a planning shift

- The traditional planning process has met historic needs given relatively modest and predictable load growth
- California's ambitious decarbonization policies, particularly in Transportation Electrification (TE), increase both the pace and uncertainty of load growth
- Grid-readiness and availability of supportive grid infrastructure needed to power EVs are a primary concern for EV adopters, especially important for commercial fleets
- Some projects like substations require long lead times, and if not planning proactively (land purchases, management) utilities will have challenges accommodating customer EV adoption when the load materializes

- The scale and ubiquity of needs related to this load growth led SCE to identify the need for, and develop, an integrated planning approach that served several purposes:
  - Intake multiple forecasts and compare needs across them
  - Leverage advanced modeling tools to better understand impacts (i.e., time-series load flow)
  - Identify additional opportunities for DERs to solve needs
  - Explore opportunities to "optimize" solutions and solve multiple needs at the same time, particularly system capacity and asset needs

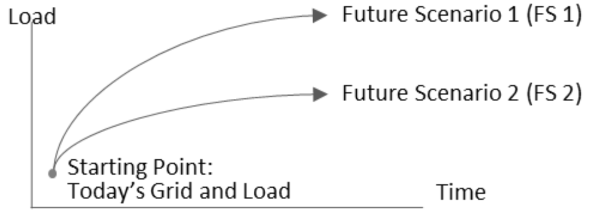
Integrated Planning Concept

1 Prepare load and generation forecasts

Identify drivers of load and DER growth

Driver Set 1	Driver Set 2 . . .
Customer Change 1	Customer Change 2
Supply Change 1	Supply Change 2
Climate Impact 1	Climate Impact 2
Electrification Change 1	Electrification Change 2

Select driver combinations that align with policy and strategies



2 Identify grid needs from multiple drivers

Identify largest needs/risks in a single geographical area for each scenario

Future Scenario	Year 1		Year 2		Year 10+	
	FS1	FS2	FS1	FS2	FS1	FS2 . .
Capacity		MW			MW	MW
Reliability	CMI				CMI	
Aging Equipment			Health %			
Climate					Future Hazard	

Engineers select from solution menu to develop alternative solution combinations to meet grid needs

	Potential Solution Options
Capacity	Upgrade Xfmr, DER, EV Control, New Lines
Reliability	OH to UG, Automation, Sectionalizing, DER, Sensors
Aging Equipment	Replace Equipment, Remove Equipment
Climate	UG, Fire Wrap, Covered Conductor, Waterproof

3 Develop optimal solution and publish results

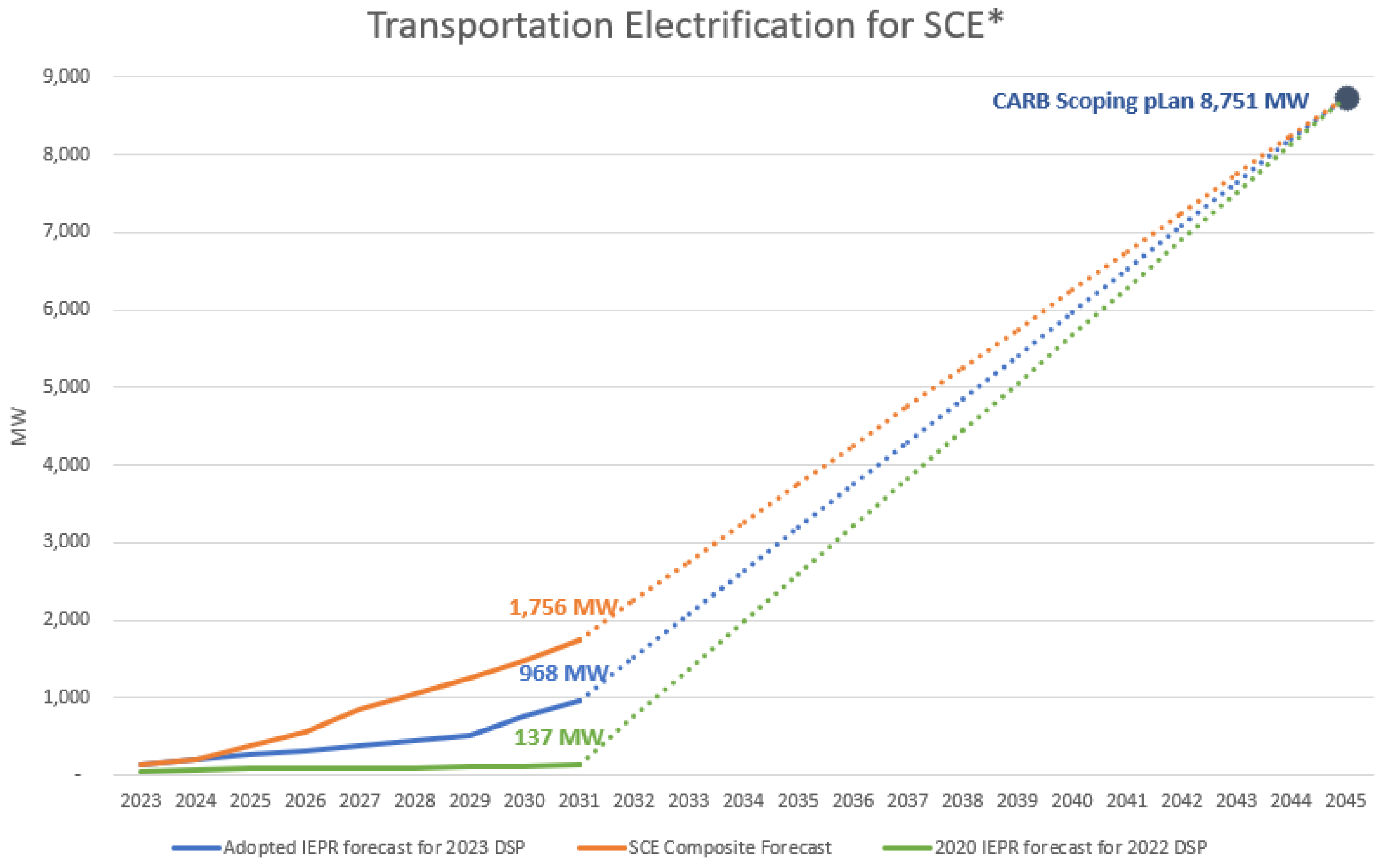
Develop alternative solution combinations that solve the largest needs/risks

Needs	Possible Solutions	Solution Combos
Capacity	New Line, DER	1. DER + UG + Replacement
Reliability	OH to UG, Sectionalize	2. New UG Line + Sectionalize
Aging Equipment	Replace Equipment	
Climate	UG, Fire Wrap, Covered Con.	

Develop scope and cost for each alternative and select optimized solution considering future scenarios impact on long lead time infrastructure needs

An alternative forecast helps to address when, not if, TE adoption will occur

- SCE developed an alternative supplemental forecast using
  - An internal forecast that achieves the economywide 2045 GHG target across all forecast components
  - Including a TE forecast using California Air Resources Board's (CARB) 2020 Mobile Source Strategy that reflects policy requirements and TE adoption required to meet GHG goals
- Using this forecast, relative to other approved forecasts help to lessen the amount of "catch up" that would be required in future years to support policy/TE adoption

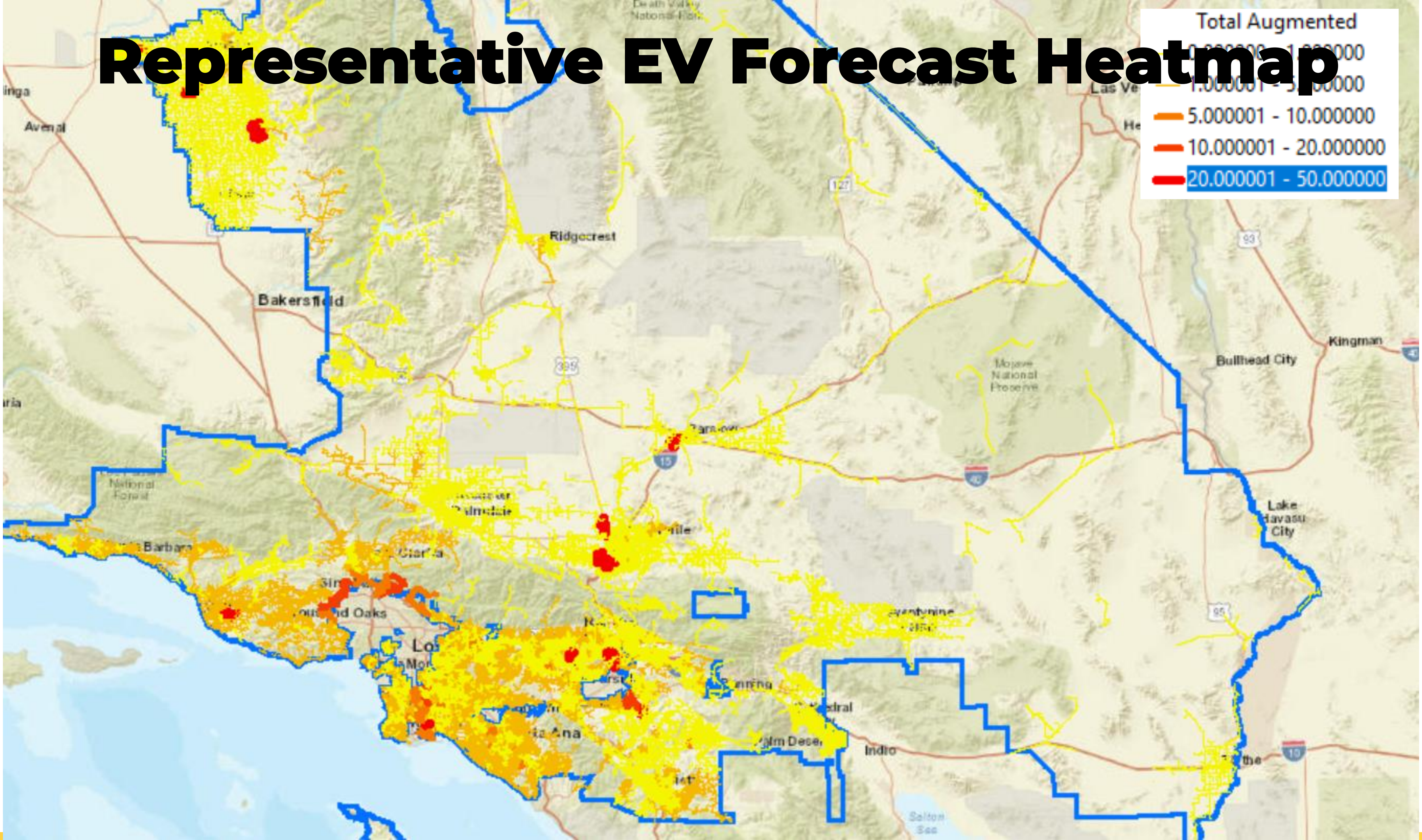


*To estimate the coincident peak impact, SCE used the annual circuit peak hour from the underlying hourly forecast from either SCE's DSP forecast or CEC IEPR forecast.

Understanding where TE load will materialize is critical, especially for MD/HD

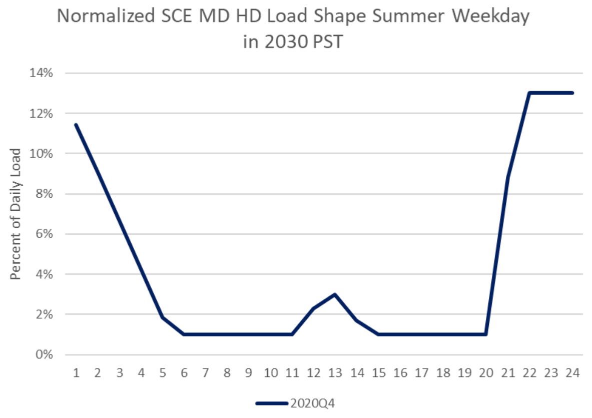
- Traditional disaggregation process for load allocation is a system-wide top-down process that can miss the local specifics of customer adoption of electric vehicles, particularly those of fleet operators
  - Which is compounded by a lack of empirical adoption information to inform understanding
- SCE first worked to better understand the customers likely to adopt; identifying large fleet operators, mapping TE adoption by customer type, and incorporating published studies (e.g., Port of Long Beach electrification plan) that reflect identified adoption
- Then, to better understand where this would occur, SCE built a bottom-up view by carefully looking at large fleet operators of MD/HD vehicles and other commercial fleets in SCE service territory and mapped their propensity for TE adoption to circuits
- Additionally, SCE considered other data points that reflect potential for TE adoption/load, including:
  - the identification of truck stop locations,
  - large warehouses,
  - drayage truck companies
  - deployment of DC fast chargers

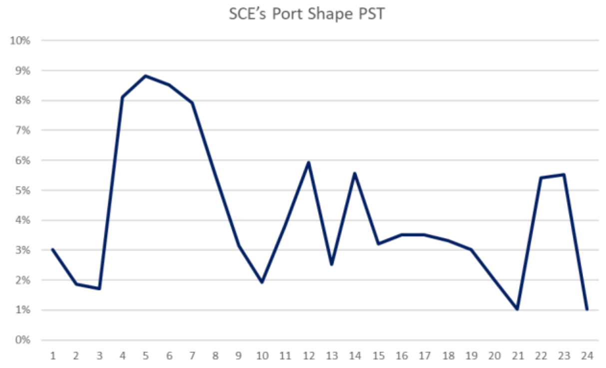
Representative EV Forecast Heatmap



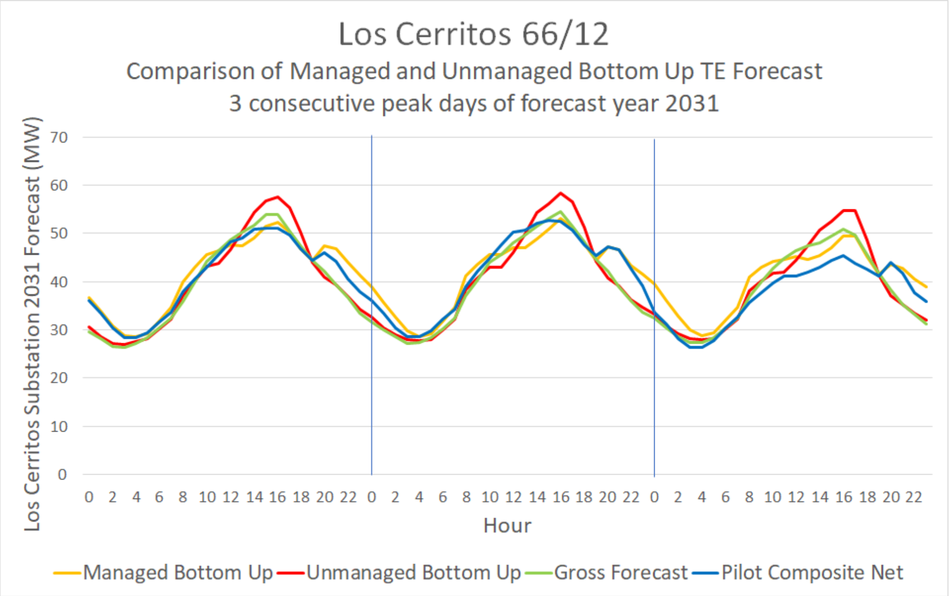
A key consideration in understand grid impacts from TE is their load shapes

Sample of Load Shapes





- SCE is using various load shapes across the different vehicle classes and charging locations
- These shapes have been developed using best available information, but are lacking empirical data
- Generally, the load profiles are placing charging outside of mid-day bulk system peaks, but depending on the circuit may or may not contribute to circuit overloads



- As part of the work, SCE explored the impact of the load shape assumptions on system overloads
- In this example, the assumed load profile (managed) places the additional load at non-coincident peak times, not triggering an overload
- However, as shown with "unmanaged" case, if charging occurs on peak, it would have significant impact and overload the circuit

Despite an aggressive forecast, the planning time horizon can mask areas near their tipping point

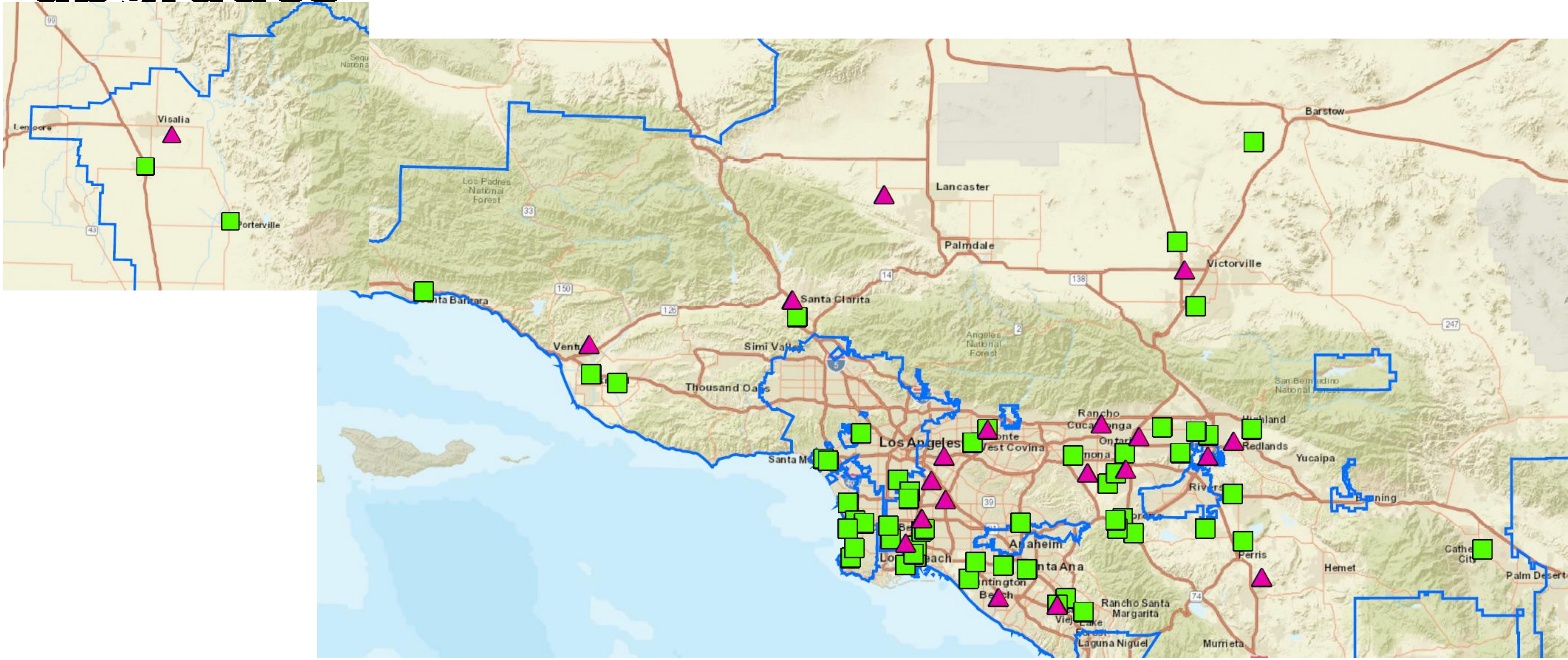
- Given the lead-time of some project types, there is a need to start contemplating a future-back approach, where the full potential for electrification load growth is considered

- To reasonably do this, it's important to understand the limits of capacity availability alongside increasing levels of TE load (i.e., how much load *ultimately* may come relative to how much load a system *ultimately* could support)

- As part of this effort, SCE stress tested the electric system to further assess its readiness to accommodate higher levels of TE load, which effectively reflects adoption occurring past the 10-year planning window
  - This included expanding adoption to "full" customer potential rather than what could be expected by 2032
  - This also included a review of ability to expand/build out existing substations

- SCE identified 20 potential substations that after accounting for the full physical build out of existing B-substations are still likely to be constrained when faced with additional increasing TE load.

Geographic representation of proposed upgrades



Distribution projects
Sub-transmission projects

Lessons learned and path ahead

- Fundamentals are key!
  - Tool performance and data congruence are crucial
  - Understanding DER performance (and cost) is necessary
  - Customer benefits need to be identified early on and quantifiable throughout the process

- Ample room for continued work, with a few key activities identified
  - Developing tools that can accelerate planning timeline and handle multiple scenarios
  - Ability to assess impact of load shape/behavioral permutations to be increasingly needed
  - Aligning drivers and being able to assess their impacts across various planning areas
  - Understanding the interactive effect of DERs and/or operational solutions across various needs will help unlock additional optimization and new solution opportunities