The Public ADVOCATES OFFICE

Cal Advocates' Distribution Grid Electrification Model (DGEM) Preliminary Results

Distribution Planning and Policy

June 2, 2023

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Introduction

- Cal Advocates has developed a model of electrification load growth of similar purpose to the Electrification Impacts Study Part 1 (EIS) performed by the California Public Utilities Commission's consultant, Kevala.[1]
- **Cal Advocates' model preliminarily forecasts an electrification cost between $15 and $20 billion in distribution infrastructure through 2035**, one third of Kevala's estimate of $50 billion.
- Some of the assumptions of Kevala's EIS are not fully explained; Cal Advocates is analyzing further two key Kevala assumptions: Feeder unit cost and electric vehicle (EV) charging pattern (i.e., when EVs charge). These assumptions lead to uncertainty in Kevala's result.
- Cal Advocates will use its DGEM analysis as a basis for providing comments on the EIS, which Kevala may take into account in developing its Part 2 EIS.

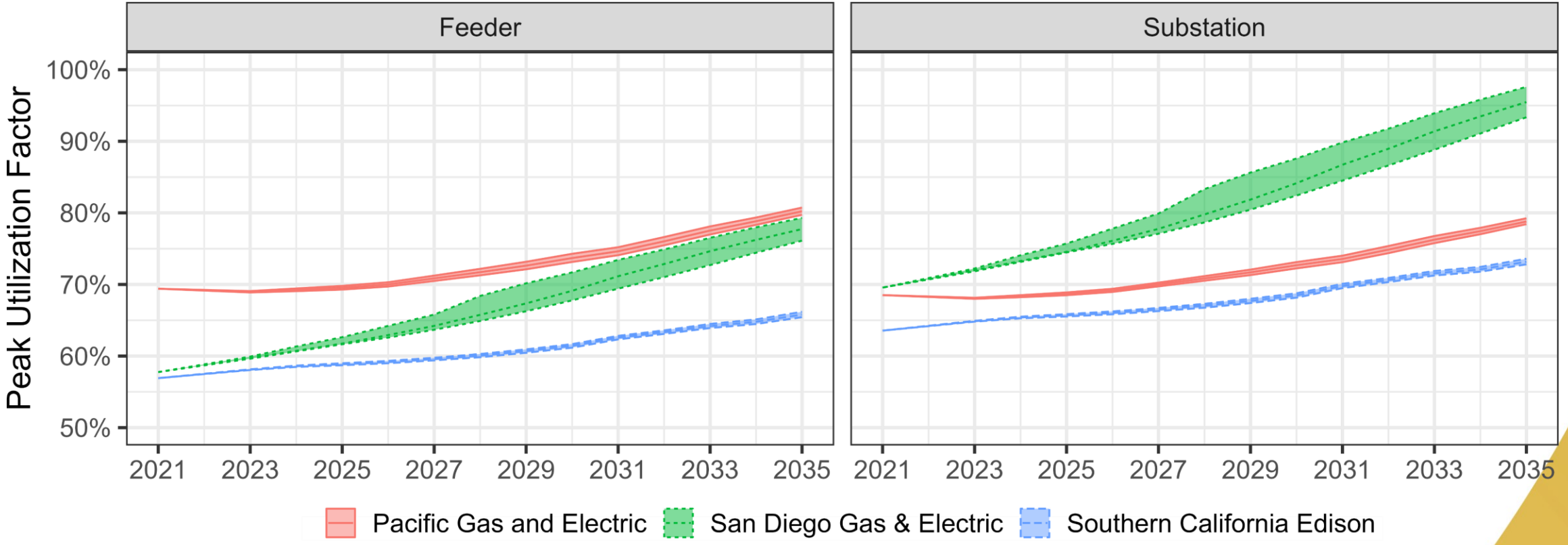
[1] Docketed at: https://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=509105421.

Cal Advocates' DGEM

- Cal Advocates' model disaggregates forecasted transportation and non-transportation load growth estimated through 2035 to feeders, adds this load growth to baseline feeder loads provided by Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E) (collectively, the Utilities), and then calculates where upgrades are needed and their cost.
- The following slides show how increasing infrastructure utilization due to load growth leads to overloads and ultimately drives the need for grid upgrades.
- Some of the data provided by the Utilities show that loads exceeded capacity in 2021. Some of these exceedances were caused by real events (e.g., planned temporary switching) in which the loading limit was exceeded; others are due to data issues.
- We later show costs with and without the calculated 2021 costs for comparison.
- All results herein are preliminary; Cal Advocates' DGEM is scheduled for completion in August 2023.

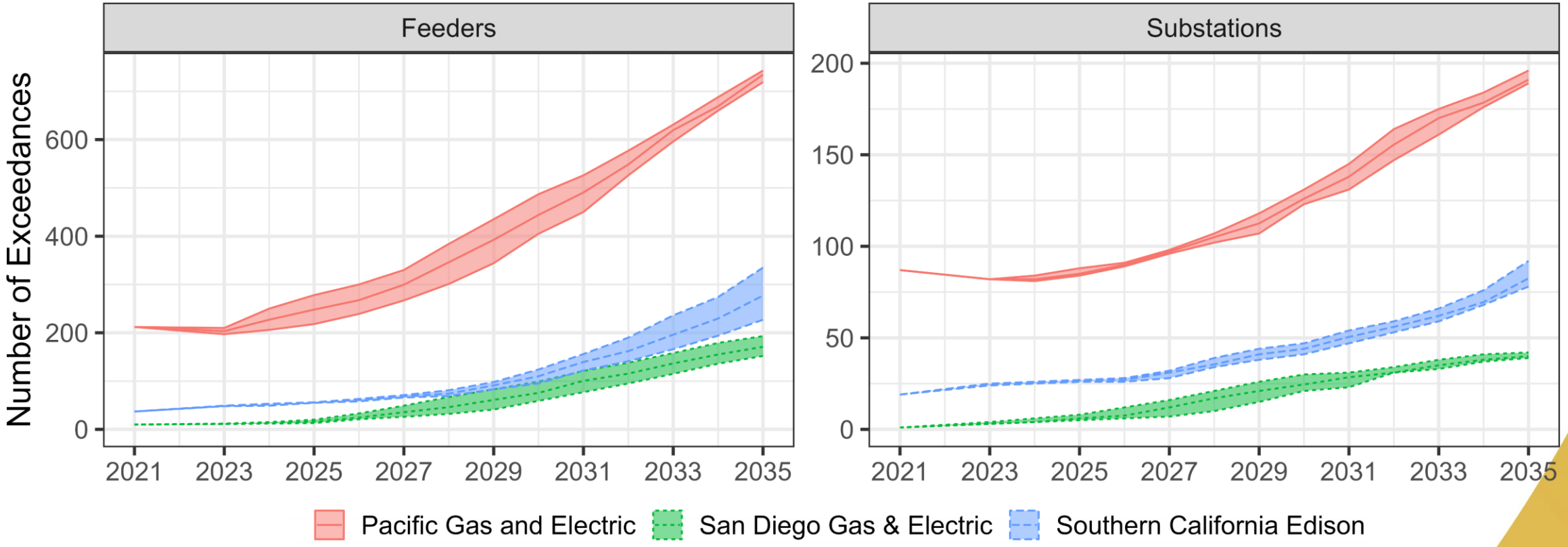
DGEM Preliminary Results

- Peak utilization factor is the sum of peak loads on each piece of infrastructure divided by the sum of the infrastructure capacities. The lower the utilization factor, the more coincident peak capacity is available on the circuit.
- Without upgrades, peak utilization grows by 10%-30% between 2021 and 2035.



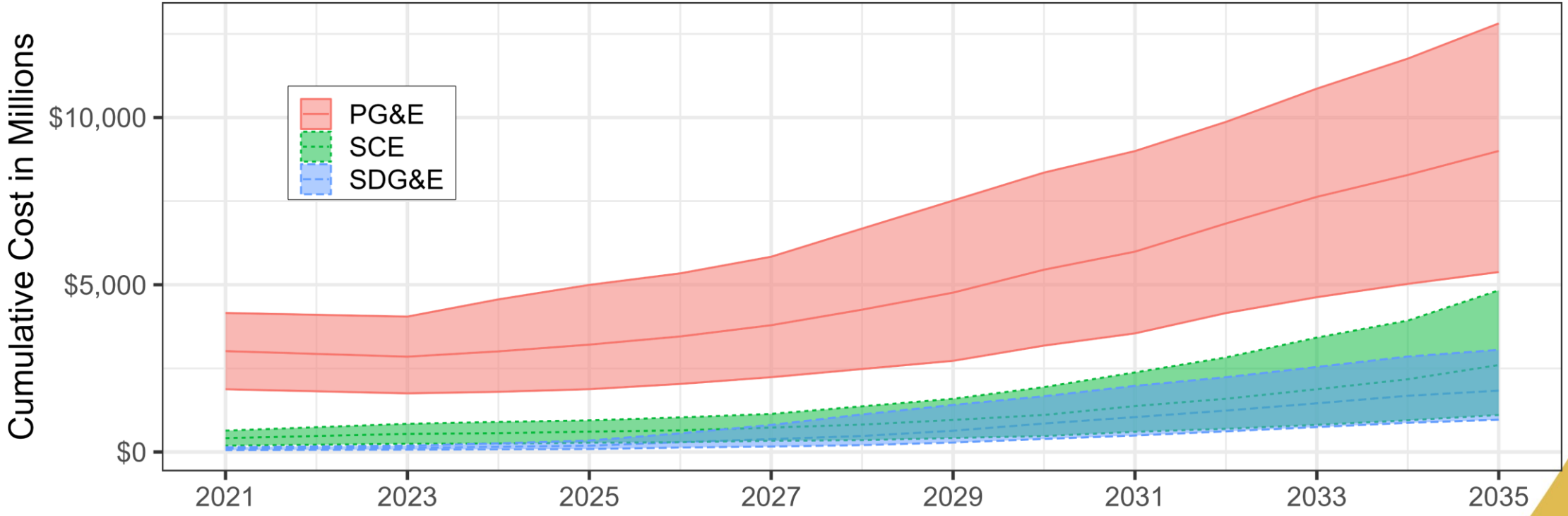
DGEM Preliminary Results

- Higher peak utilization drives exceedances, as shown below.
- Exceedances are cured by upgrading distribution feeders and substations.



DGEM Preliminary Results

- Total infrastructure upgrade cost, shown below, is highly uncertain. The range of estimates shown varies by a factor of two or more and does not account for all uncertainty.
- These costs below do not include secondary distribution infrastructure costs. (Secondary distribution equipment is low voltage and consists mainly of service transformers.) The following slide includes secondary distribution costs.



DGEM Preliminary Results

- Median cost estimates range from $10 billion to $20 billion depending upon whether secondary costs are considered and whether 2021 calculated “costs” are considered.

		Cost Less 2021 Cost (Millions)			Cost (Millions)		
		2025	**2030**	**2035**	**2025**	**2030**	**2035**
Without Secondary	**PG&E**	$202	$2,434	$5,984	$3,209	$5,449	$9,000
	SCE	$194	$708	$2,186	$608	$1,107	$2,600
	SDG&E	$83	$751	$1,733	$187	$852	$1,834
	Total	$479	$3,893	**$9,904**	$4,004	$7,408	**$13,434**
With Secondary	**PG&E**	$305	$3,675	$9,037	$4,846	$8,229	$13,590
	SCE	$293	$1,068	$3,301	$919	$1,671	$3,926
	SDG&E	$125	$1,134	$2,618	$282	$1,286	$2,769
	Total	$723	$5,878	**$14,955**	$6,047	$11,186	**$20,286**

Study Comparison

There are many differences between Cal Advocates' model and Kevala's.

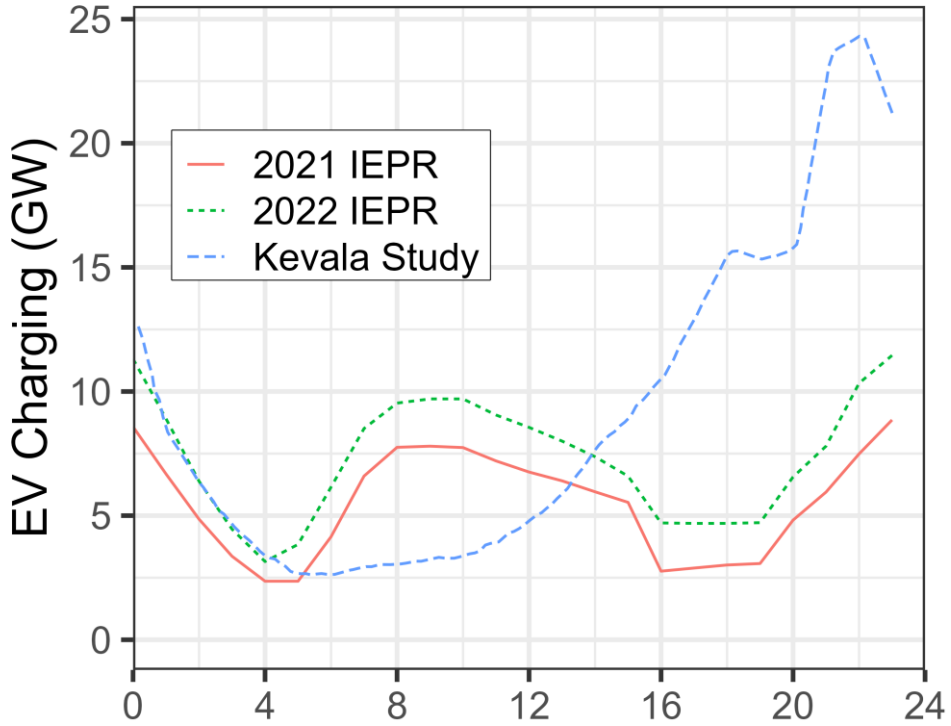
- Kevala's EIS show that non-EV assumptions have a low impact on upgrades and cost.
- Cal Advocates' analysis (see next slide) shows that charging load shape explains most of the difference between Cal Advocates' and Kevala's results.

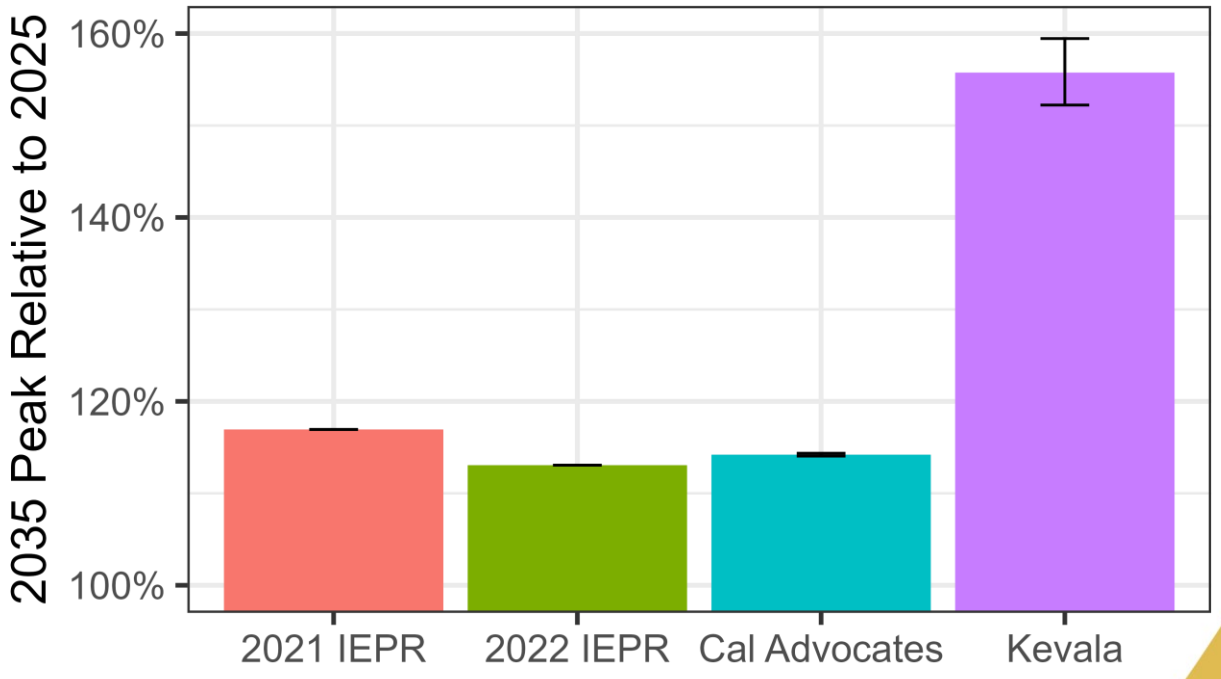
Model parameter	Cal Advocates	Kevala	Impact
PV/BE/EE/BESS Forecasts	From 2022 IEPR (planning) hourly load growth profiles	From 2021 IEPR (mid-mid) deployment forecasts	Low
EV forecasts (2035, IOU area)	11,700,000 LD 300,000 MD+HD	10,000,000 / 9,500,000 LD 220,000 / 230,000 MD+HD	Medium
EV forecast source	2022 IEPR (planning)	CARB / 2021 IEPR (high/bookend)	Medium
Charging pattern	2022 IEPR (planning)	Modeled from non-EV TOU rates	High
Public charging	Not included	Included	Low
Baseline load data	Feeder level	Premises level	Low

BE = building electrification
BESS = battery energy storage system
CARB = California Air Resources Board
DER = distributed energy resource
EE = energy efficiency
IEPR = Integrated Energy Policy Report
LD = light-duty
MD+HD = medium duty + heavy duty
PV = photovoltaic
TOU = time-of-use

Charging Profile Comparison

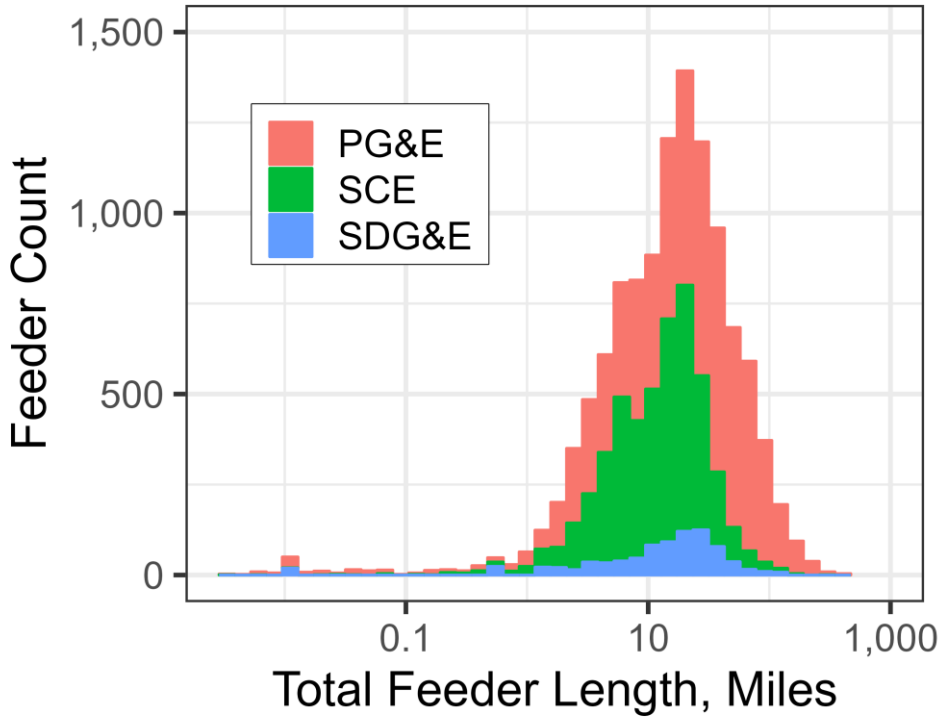
- Kevala's model forecasts much more afternoon and evening (4 pm to 11 pm) EV charging than the load forecasts presented in the California Energy Commission's 2021 or 2022 IEPRs.
- Furthermore, Kevala predicts 40% more peak day charging energy than the 2022 IEPR.
- Greater evening charging predicted by the EIS (from different time of charging and more total charging energy) drives significantly higher peak load growth estimates than both IEPRs predict.
- Cal Advocates' load growth forecast aligns more closely with the IEPR than does Kevala's study.





Total Cost Estimation

- Because peak load growth is the main driver of upgrades, Kevala's nearly four-times higher load growth leads to a cost estimate three times as high: Cal Advocates estimates the cost of distribution grid upgrades to be $15-$20 billion in 2035 compared to Kevala's estimate of $50 billion.
- Conversely, feeder unit costs are highly uncertain and could be more costly than Kevala accounts for.
- Kevala uses costs consistent with two miles of mitigation per feeder upgrade, but feeder lengths can be far longer.
- Upgrades are unlikely to generally cover entire feeders but may be more or less than two miles.
- If feeder upgrades tend to span distances longer or shorter than two miles, Kevala's estimate of unit cost, and resulting bottom line cost may be too high or too low. This adds uncertainty to Kevala's results.



Key Questions

- Are Kevala's assumptions of EV charging time, peak daily EV charging energy, and the resulting peak load growth, appropriate?
- Should Kevala's peak load growth estimates align with the IEPR's peak load growth estimates?
- Are Kevala's peak load growth estimates causing overestimation of distribution grid cost impact?
- Are Kevala's unit costs for feeders underestimating or overestimating the cost of distribution upgrades?