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Distribution Planning In a High Electrification Future: SCE's Perspectives

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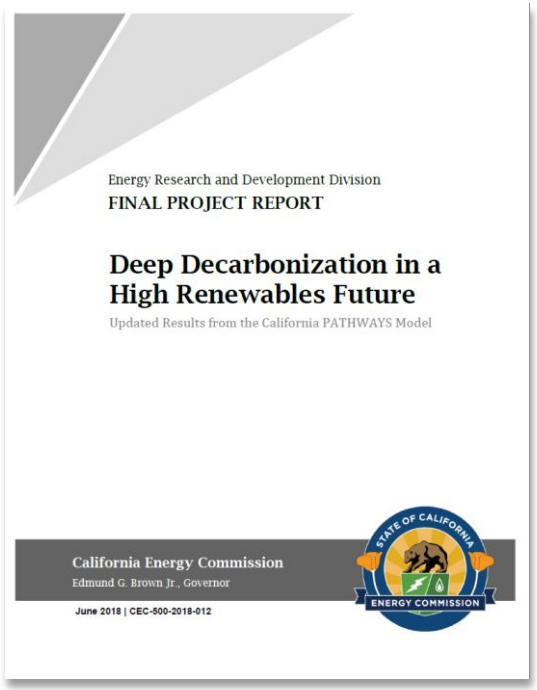
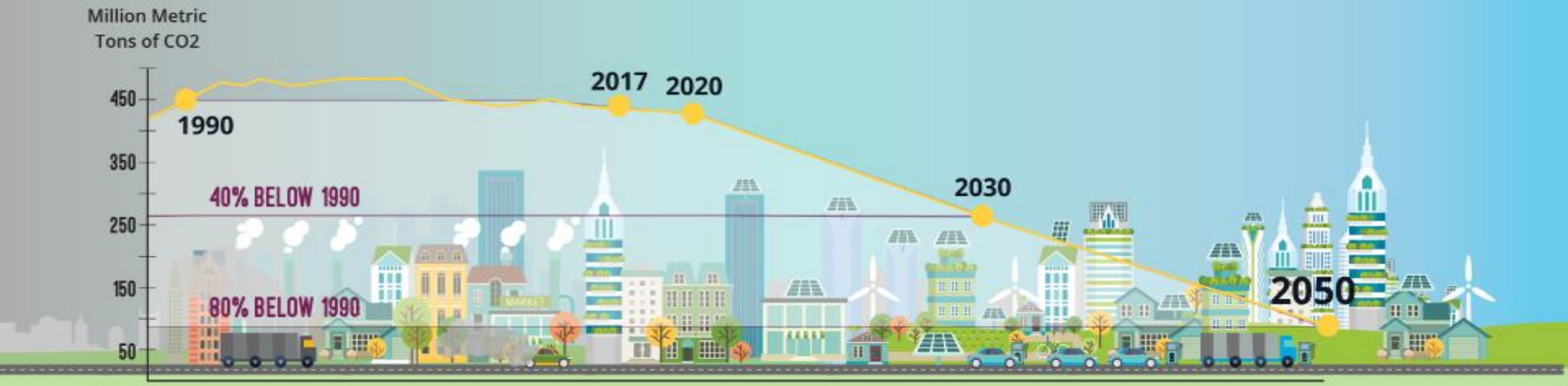
September 26, 2019



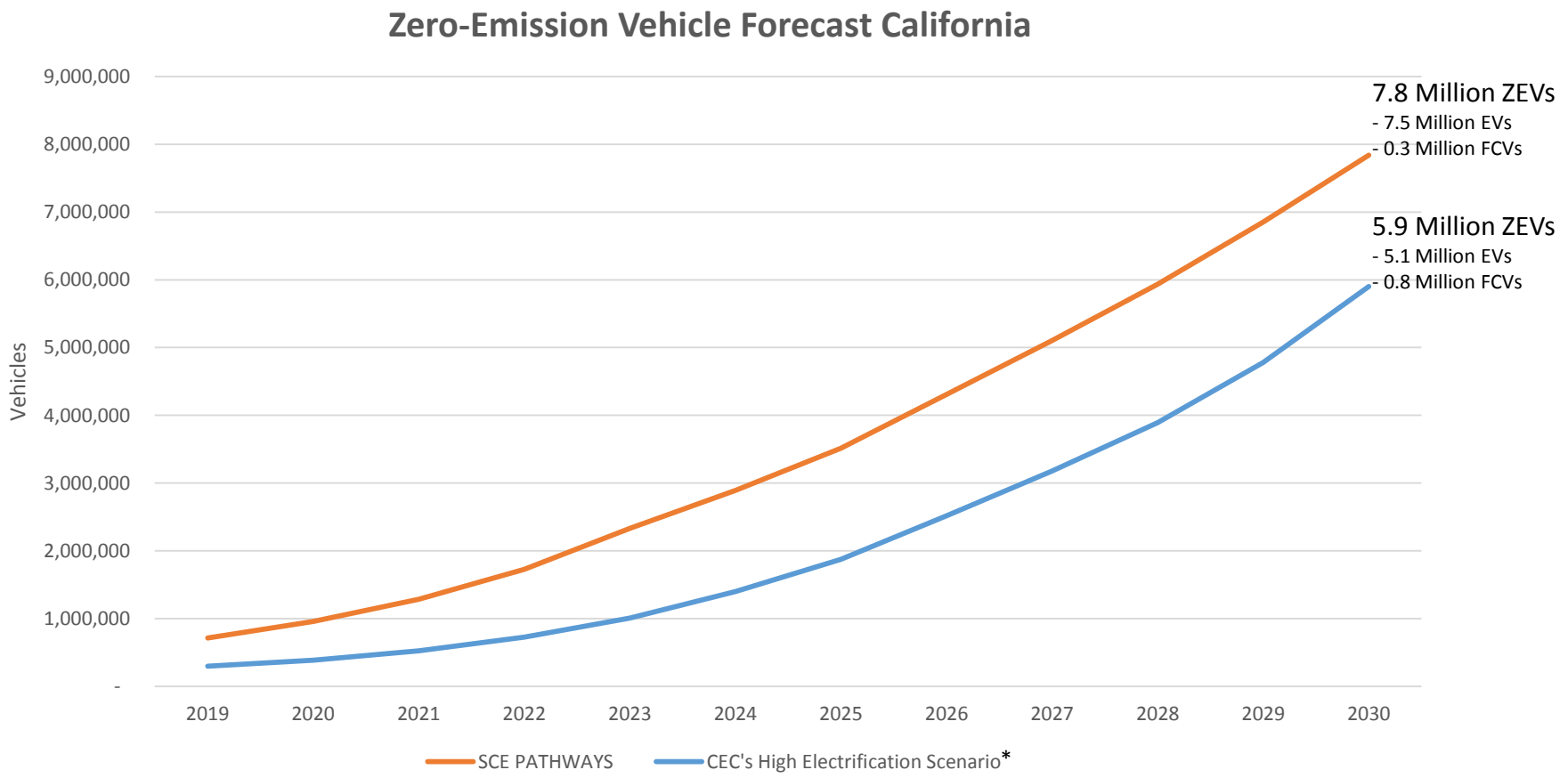
High Electrification is Required to Meet California's GHG Emissions Reductions Goals

- California targets **reduce GHG emissions 40%** below 1990 levels by 2030, and Carbon Neutrality by 2045.
- Affordably reaching the 2030 goals and beyond will require **significant electrification of the transportation and building sectors** among other measures.



Light Duty ZEV Forecast for California

SCE found that in the transportation sector, approximately 7.8 million light-duty ZEVs are needed statewide by 2030 to meet California's GHG emission targets.

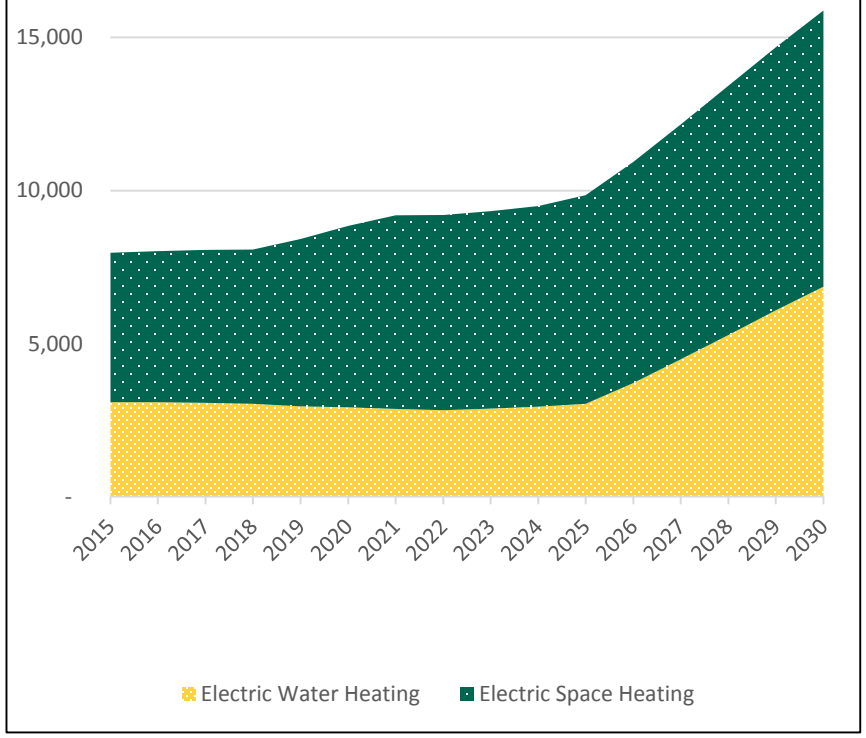


*E3/CEC High Electrification Scenario in "Deep Decarbonization in a High Renewables Future" study.

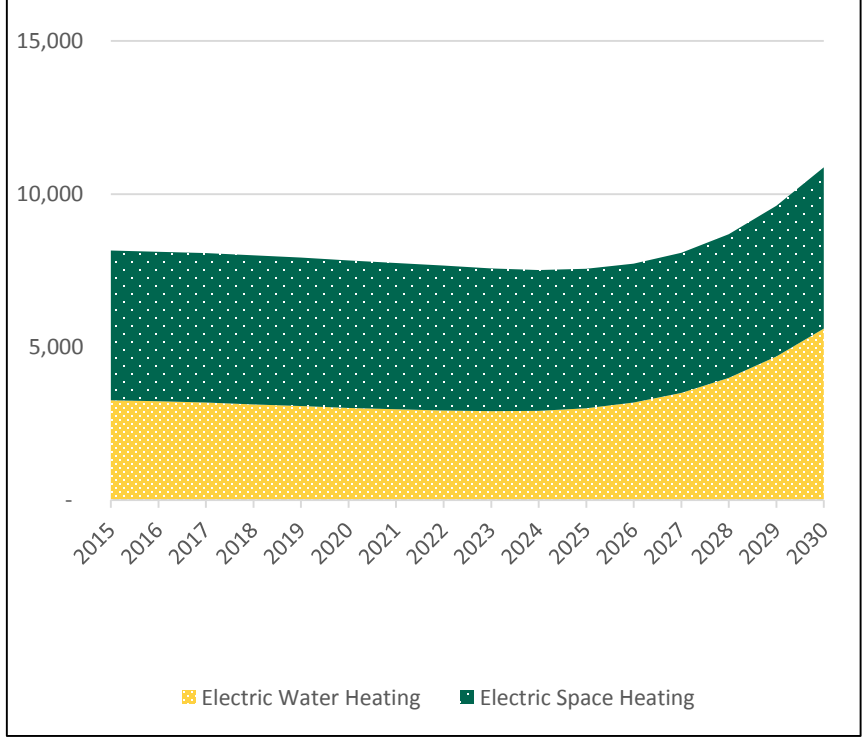
Building Electrification Forecast - Electric Water and Space Heating

SCE found that in the building electrification sector, approximately 30% electrification of water and space heating by 2030 represents cost-effective and feasible pathways for California to meet its 2030 GHG targets.

SCE Clean Power Electrification Pathway (GWh)



CEC High Electrification Scenario (GWh)



California's Likely High Electrification Future – Transportation Electrification

- SCE TE programs overcome barriers (availability, affordability, and awareness) to help CA move into a high electrified future
  - SCE Charge Ready Pilot/Bridge and Charge Ready 2 (approval pending) with roughly $800 million investment for more than 50,000 ports
  - SCE Charge Transport and Transit Bus programs with more than $350 million investment for roughly 9,000 ports

- Approved MD/HD policies and anticipated CARB regulations bring additional electrification through non-LDV sectors
  - Approved MD/HD Policies**:**
    - SB 350 Utility Infrastructure Programs (2018-2019)
    - ~18,000-21,000 MDHD EVs over the next 5 years
    - CARB Innovative Clean Transit Rule (2018)
    - ~12,000 Zero-Emission (ZE) buses by 2040
    - CARB ZE Airport Shuttle Rule (2019)
    - ~1,000 ZE shuttles by 2035
    - San Pedro Bay Ports Clean Air Action Plan (2017)

  - In Process or Forthcoming (from CARB):
    - ZE Truck Regulations:
      - Advanced Clean Trucks (2019-2020), ~80,000 ZE Trucks on the road by 2030, ZE Truck Fleets (2022), ZE Drayage Trucks (2022), ZE TRUS (2020)
    - ZE Off-road Equipment Regulations:
      - Airport GSE (2020), ZE Forklifts (2021), ZE Cargo Equipment (2022)

California's Likely High Electrification Future – Building Electrification

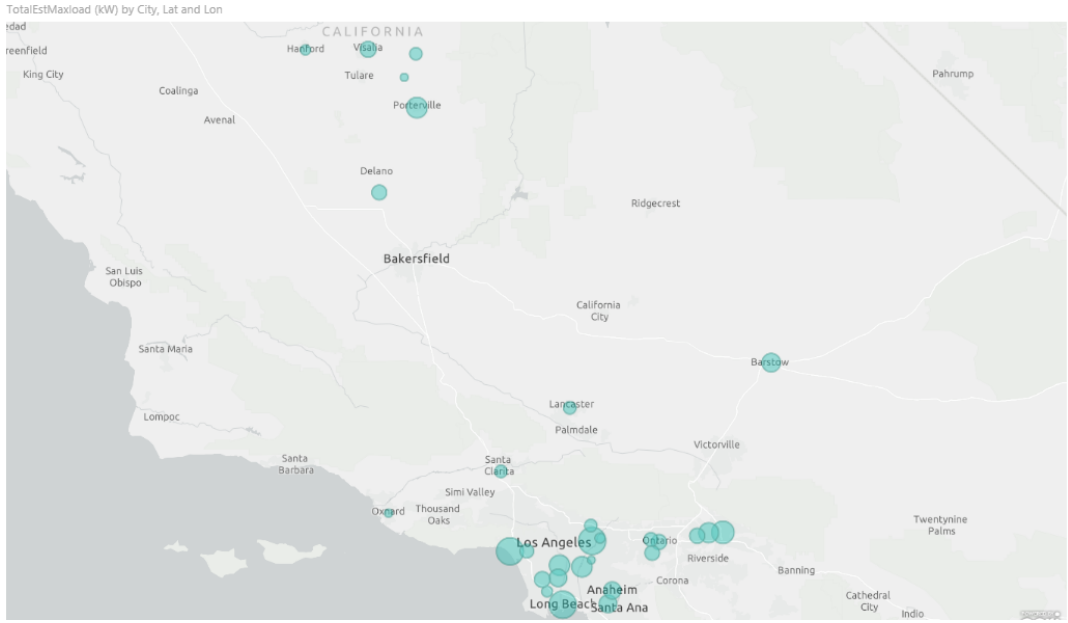
More BE programs and building codes development overcome barriers to adoption of building electrification.

	2019 - 2021	2022 - 2030
New Construction	• 2022 Title 24 carbon metric • Local reach code support • Launch "BUILD" pilot (statewide $20M/year for 4 years) • Launch Income Qualified Program (IQP) new construction program ($21M for 4 years)	• 2025 T24 electric-ready mandate • Other Incentives and programs (TBD)
Cross Cutting	• Customer cost analysis • Customer segmentation • Customer survey • Manufacturer engagement • Customer & supply chain awareness & education	• Robust marketing/outreach • Train/support workforce • Rate design for bill impacts (2021 GRC Ph II)
Retrofit	• Pilots (e.g. SJV, CEOP, others) • Launch TECH pilot (statewide $30M/year for 4 years) • Leverage existing energy efficiency programs ($XM TBD) • Launch IQP BE pilot and include BE measures in ESA program ($50M+ for 5 years)	• Other Incentives and programs (TBD) • Launch financing program (TBD)

Grid Impact from Future Medium/Heavy Duty Electric Vehicles

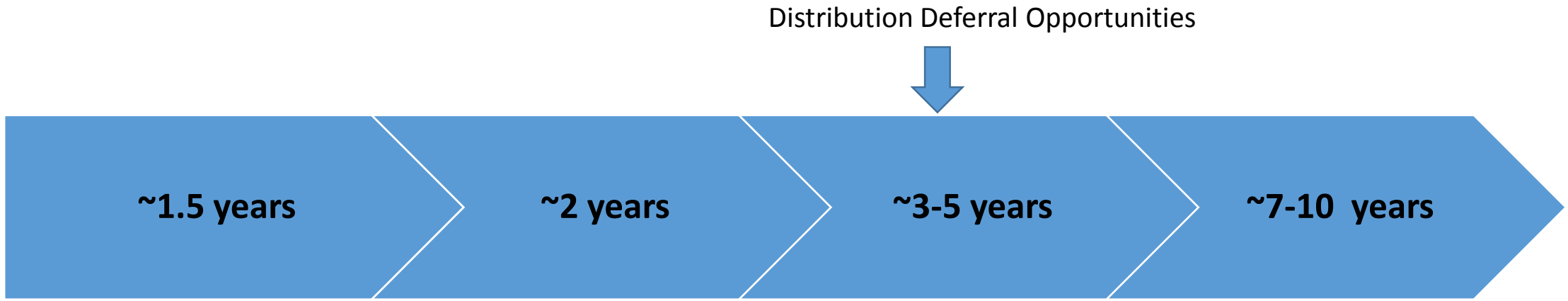
- **MD / HD is expected to have significant demand impact on SCE's distribution and subtransmission systems**
  - SCE's initial Charge Transport Applications range from <.25MW – 9MW anticipated demand
  - These sites may have significant impacts on SCE's distribution grid

- **Preliminary data from SCE Charge Transport Applications indicates potential high concentration of demand growth in local areas**



Significant Lead Time is Required to Support High Electrification

Distribution planning needs to be able to incorporate the significant electrification impact on local demand growth well in advance (e.g. typically 4 to 5 years ahead for seeking distribution deferral opportunities) to ensure grid's safety and reliability.



A New Process Development for Incorporating Incremental Local Load Growth Driven by High Electrification is Critically Needed

- Currently, distribution planning is required to apply existing IEPR forecast for the 10-year planning analysis
- Rapid development from programs, C&S, policy making, and regulations to support state's high electrification future requires utility planners to adequately forecast future incremental demand growth across the planning horizon in a timely fashion
- Development of a new process between CEC and utilities is critically needed in the short term to determine the incremental local load growth driven by high electrification
- Aligning the IEPR forecast with utility local knowledge and development of a high electrification IEPR policy scenario forecast would be ideal for future planning

Back Up

Charge Ready 2: Speed, Scope, Scale

Proposal to deploy **32,000 level 2 ports at 3,200 workplaces, apartments, destination centers** and fleets; Install an additional **200 DC Fast Chargers.**

Provide **rebate for above-code installations at new apartments**; Up to $3,500 rebate per port to exceed CalGREEN building code and install a minimum of 16,000 ports at new construction multi-unit dwellings.

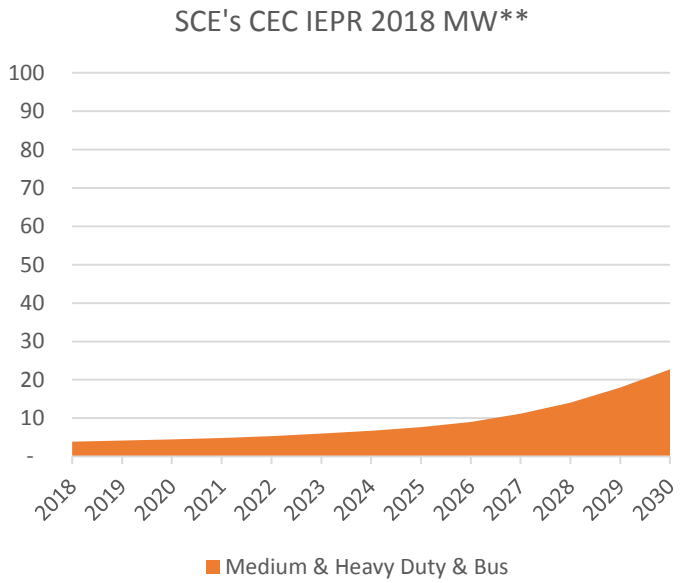
Offer apartments and government customers a **turnkey solution**: SCE can install, own, and maintain up to 4,230 new charging ports.

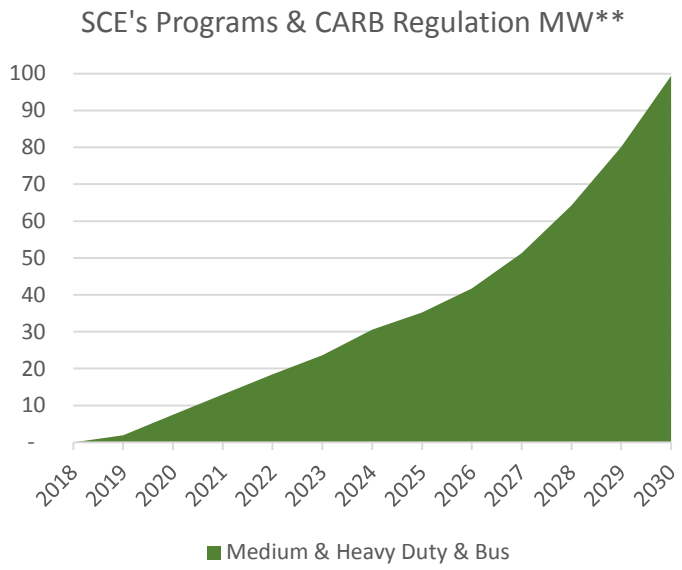
Multi-prong marketing strategy:

- Mass media advertising of EVs and benefits;
- Targeted marketing on EV experience;
- Support businesses to convert fleets to electric;
- Program-specific marketing.

An Illustration of Medium and Heavy Duty Vehicles Program & Policy Impact

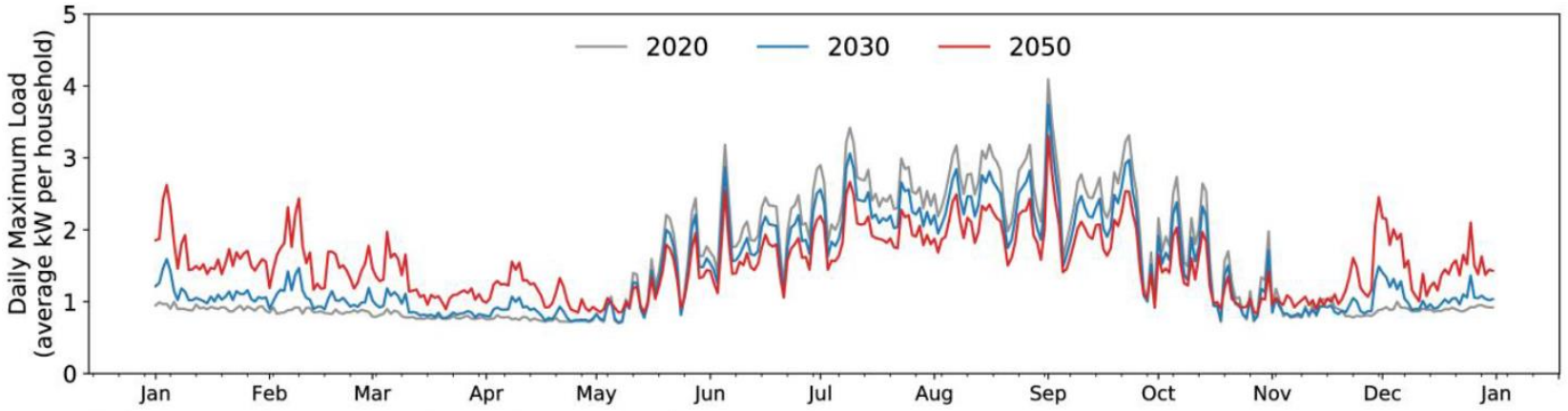
SCE's Programs & CARB Regulation reflects SCE's charge ready transport program (8,490 vehicles by 2024) and CARB's Advanced Clean Trucks (ACT) Regulation starting 2024.*





* By 2030, zero-emission truck/chassis sales would need to be 50% of class 4 – 8 straight trucks sales and 15% of all other truck sales.
** Maximum Charging capacity to grid and it's based on rough estimation.

High electrification of residential buildings is expected to improve the grid load factor without exacerbating the peak*



	2020 Penetration (% of stock)	2030 Penetration (% of stock)	2050 Penetration (% of stock)
Share of all-electric low-rise residential homes	0%	26%	86%

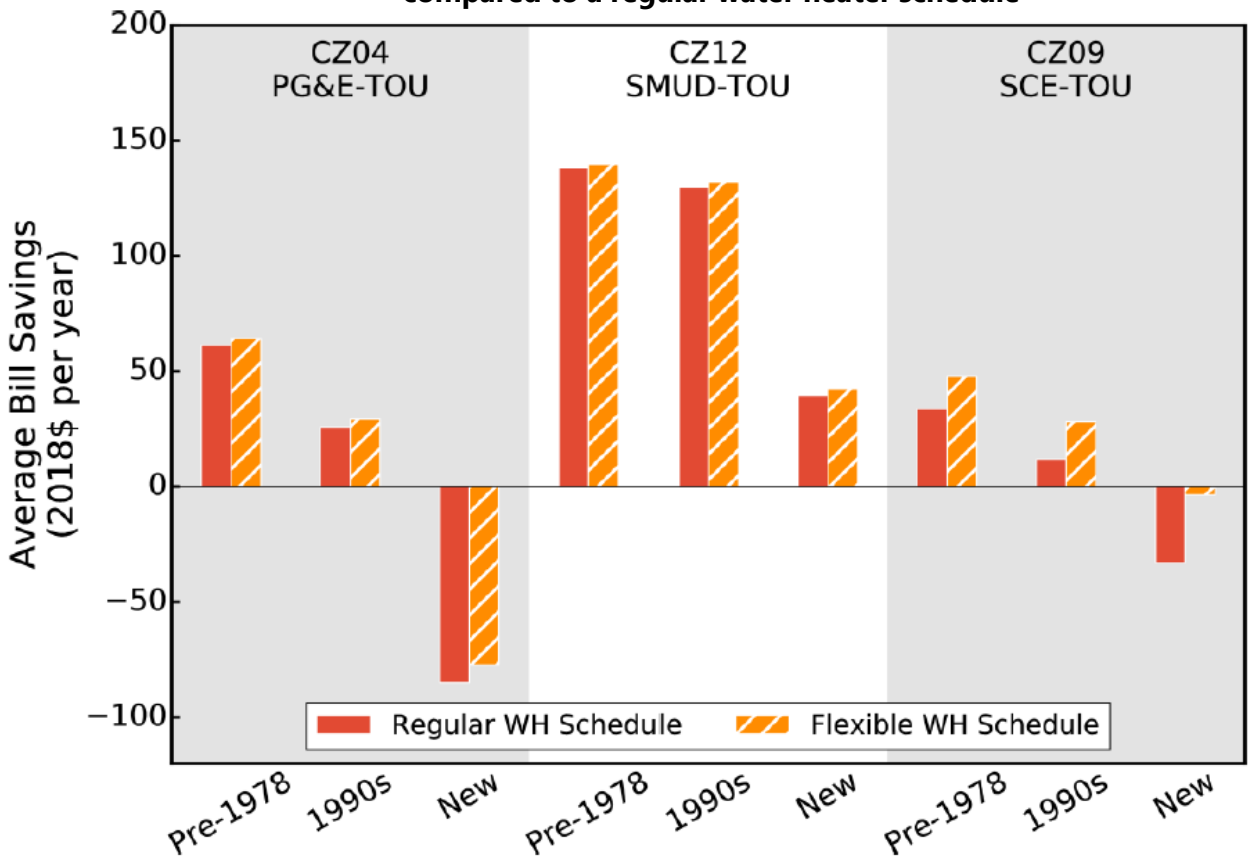
Penetration represents the share of all-electric equipment among the entire stock of all fuel types.

- Slightly lower summer peak due to greater cooling efficiency with HVAC heat pump vs. A/C compressor
- Increased winter demand remains below summer peak demand levels under Typical Meteorological Year (TMY) weather conditions modeled
- Electrification contributes to a better utilization of the bulk power grid, as residential building load factor increases from 19% in 2018 to 26% in 2050
- Localized impacts at regional and distribution-level need to be further studied

*"Residential Building Electrification in California - Consumer economics, greenhouse gases and grid impacts", E3, April 2019

Appropriate TOU rates can encourage customers to use flexible water heating schedules

Average consumer bill savings from a flexible water heater schedule compared to a regular water heater schedule*



*Assumes water heater runs at minimal power during the peak TOU hours and shifts the water heating to off-peak TOU hours

- Customer bill savings of flexible water heating are highest under the SCE TOU-4-9 rate structure due to the large TOU differentiation ($0.12/kWh) in winter.
- Flexible water heating schedules generate little bill savings under PG&E and SMUD TOU rates, given the small difference (<$0.04/kWh) between on-peak and off-peak
- New rate designs that encourage the use of flexible water heating would have larger differences in TOU periods, particularly in winter when water heating demands are higher.

SCE Distribution System Planning Overview

The Objective of the Distribution System Planning Process is to evaluate peak loading conditions on the grid over the next 10 years to ensure the grid is designed to safely and reliably serve forecasted load

- The System Planning Process is split up into 3 major components throughout the planning year:

1. Develop load, and DER ***Forecast***
   - Cleanse historical demand data **(August – September)**
   - Identify local growth projects **(September – October)**
   - Disaggregate IEPR Forecast **(November – December)**

2. Perform ***System Analysis*** *studies to identify system risks including thermal overloads*
   - Utilize disaggregated forecast to evaluate overload, voltage, and VAR needs **(January – April)**

3. Facilitate **Project Development** *in order to effectively and efficiently address system risks.*
   - Identify required transfers and system upgrades required to address risks and criteria violations **(April)**
   - Evaluate project alternatives (**May)**