# Standard Review Project Proposals Included in the SDG&E, SCE, and PG&E Transportation Electrification Applications Pursuant to SB 350

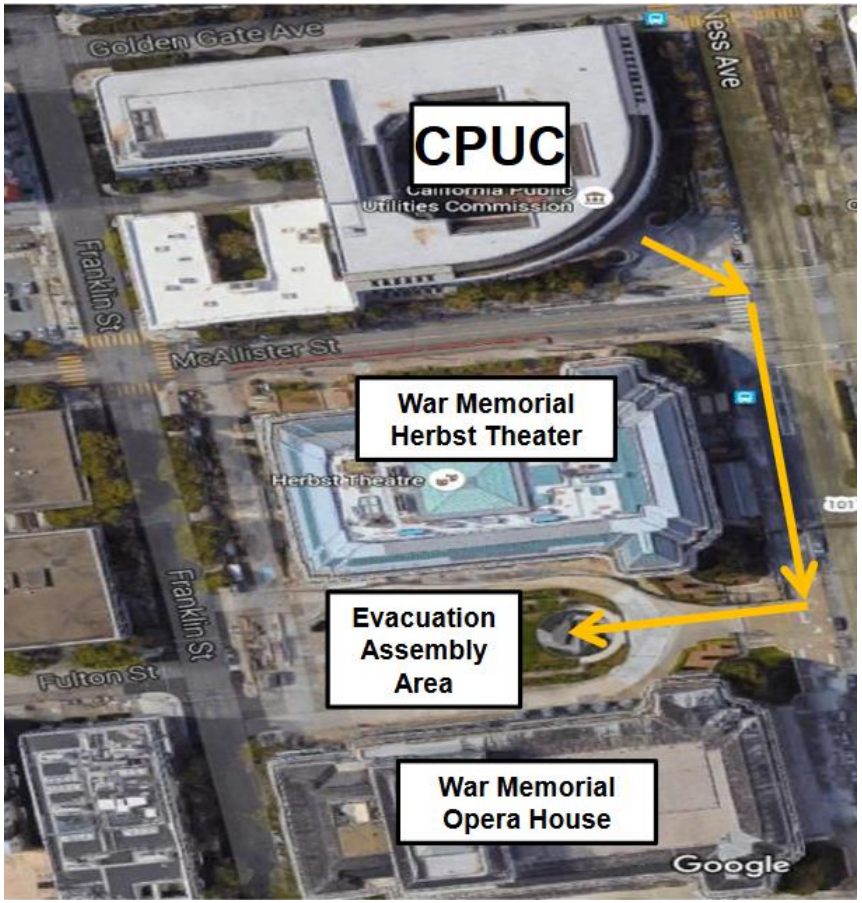
**July 11, 2017**



*This deliberative staff product does not represent the opinion of the Commission*

# Safety & Misc.

- In case of an Emergency
  - Staff will call 911
  - To evacuate, proceed out of 1 of 4 exits to Civic Center Plaza
    - Exit toward Van Ness / McAllister
    - Walk past City Hall
- Bathrooms & fountain across the Lobby



# Morning Agenda

| Topic | Time |
|---|---|
| **Ground Rules and Workshop Process**<br>Carrie Sisto, TE Analyst, Energy Division | 9:00am-9:10am |
| **Welcome and Introduction**<br>Commissioner Carla Peterman, CPUC | 9:10am-9:15am |
| **Residential and Public Charging Infrastructure Proposals**<br>• SDG&E Residential Charging<br>• PG&E Fast Charge | 9:15am-10:00am |
| **Break** | 10:00am-10:15am |
| **Medium- and Heavy-Duty Charging Infrastructure Proposals**<br>• PG&E Fleet Ready<br>• SCE Medium/Heavy-Duty Make-Ready | 10:15am-11:00am |
| **EV Rate Proposals**<br>• SDG&E Residential Grid-Integrated Rate<br>• SCE Commercial Rates | 11:00am-11:45pm |
| **Lunch** | 11:45pm-12:45pm |

# Afternoon Agenda

| Topic | Time |
|---|---|
| **CPUC Overview of Vehicle Adoption and Emissions Topics** | 12:45pm-1:00pm |
| **Electric Vehicle Adoption**<br>• CEC forecast of vehicle adoption (Aniss Bahreinian, CEC, 15 min)<br>• Vehicle Forecasts in Utility Applications (SDG&E, SCE, PG&E, 15 min)<br>• Data Needs for Integrated Resource Planning (Jason Ortego and Forest Kaser, CPUC, 10 min)<br>• Q&A and Discussion (25 min) | 1:00pm-2:05pm |
| **Break** | 2:05pm-2:15pm |
| **Measuring GHG and Criteria Pollutant Emissions Reductions**<br>• CEC present emissions calculator (Gary Yowell and Dave Vidaver, CEC, 15 min)<br>• Q&A and Discussion (45 min) | 2:15pm-3:15pm |
| **Wrap Up and Next Steps** | 3:15pm-3:30pm |

# Workshop Objectives

- Stakeholders can more fully develop the issues they will address in written testimony
  - Address “Discussion Questions”
  - Raise and address any other significant issues
  - Receive clarification from IOUs on proposal details

- NOT intended to review every issue that stakeholders will describe in testimony

# Ground Rules

- Identify yourself and your organization
- Limit each turn to 2 minutes
- Do not repeat what another person has already said
- Stay on topic: proposed standard review projects at level of detail in proposals
- Webex participants type questions/comments to ‘Chat Me!’ and they will be read aloud

# Scoping Memo Issues for Standard Review

1. What specific ratepayer benefits will result from the proposals, and are they commensurate with the costs ratepayers will have to bear from the proposals?
2. Are the programs designed to facilitate access to TE infrastructure for disadvantaged and low- and moderate-income communities?
3. Do the proposals allow for participation by customers of CCAs and energy service providers?
4. Are the programs designed to support and accelerate statewide TE?
5. Do the proposals quantify the expected GHG emissions reductions?
6. Are the programs appropriately scaled to address the GHG emissions reduction target with each utility's service territory?
7. Are the programs designed to not negatively affect competition?
8. Do the programs leverage non-ratepayer funding sources?
9. Do the programs minimize the risk of stranded infrastructure costs?
10. Do the proposals support grid integration of electric vehicles with appropriate rate designs?
11. Do the proposals include appropriate marketing, education, and outreach programs?
12. Are the proposed revenue requirements and cost recovery strategies appropriate?

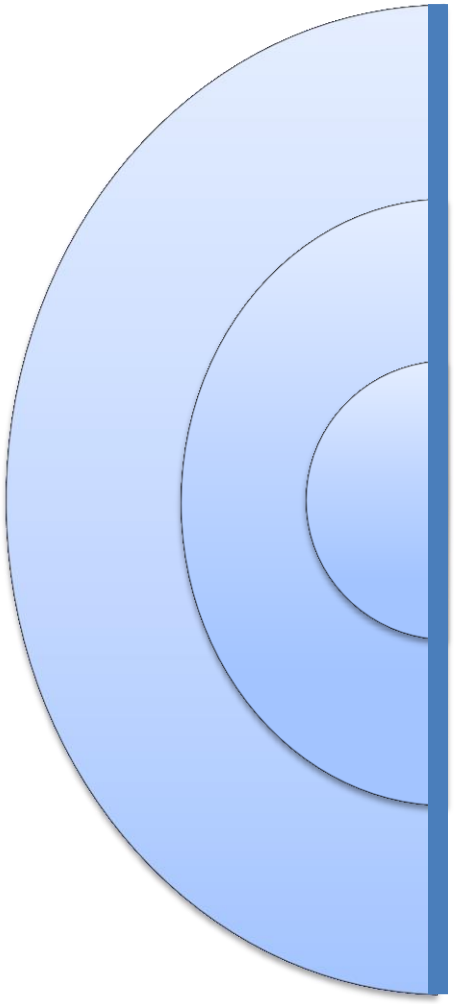
# Discussion

# Residential and Public Charging Infrastructure

- SDG&E Residential Charging
- PG&E Fast Charge

# Standard Review Workshop
# July 11, 2017

# Residential Charging Program Vision



**Maximize GHG Reductions:**

- The transportation sector accounts for over 50% of GHG emissions in San Diego
- Light-duty vehicles are responsible for approximately 80% of combined on-road and off-road GHG emissions.

**Minimize Costs:**

- Shift flexible charging load from peak
- Improve net load factor
- Avoid generation and T&D upgrades for charging load

**EV Charging Should:**

- Be safe, widespread, affordable, reliable and easily accessible
- Be grid integrated
- Encourage use of renewable energy
- Benefit EV drivers, ratepayers, and the environment

**Tools Include:**

- Level 2 charging stations
- Grid-integrated rate (GIR)
- Education and outreach

# Residential Charging Program Overview

| | |
|---|---|
| Program Details | • 90,000 single family and small multi-unit customers<br>• 20% allocated to Disadvantaged Communities<br>• Program application process open for 5 years<br>• SDG&E would own, install, maintain, and operate Level 2 charging stations and move customers to a Residential Grid Integrated Rate |
| Ratepayer Interest, Public Utilities Code §740.8 | • Lower GHG emissions and increase air quality<br>• Increase access to Disadvantaged Communities<br>• Leverage EV load flexibility with managed charging to improve net load factor and avoid generation and T&D upgrades<br>• Project will increase the number of local high-quality "green" jobs for infrastructure and equipment installation |
| Ownership and Competition | • "End to end" utility ownership of this infrastructure ensures standards for safety and reliability are upheld, and the benefits of these *grid optimization assets* are realized for all ratepayers<br>• Utility-owned EV charging projects will produce benefits by growing the EV market, creating new opportunities for the private sector, help reduce overall ratepayer costs by using a competitive RFP process, and incent drivers with an innovative Grid Integrated Rate |

# Residential Charging Program Overview

## Level 1 vs. Level 2

| Charging Level | Power Supply | Charger Power | Miles/Hour of Charge |
|---|---|---|---|
| Level 1 | 120 VAC | 1.4 kW (onboard charger) | ~3–4 miles |
| Level 2 | 240 VAC | 3.3 kW (onboard charger) | ~8–10 miles |
| | | 6.6 kW (onboard charger) | ~17–20 miles |

*Source: California PEV Collaborative

**30 mile Charging Example:**

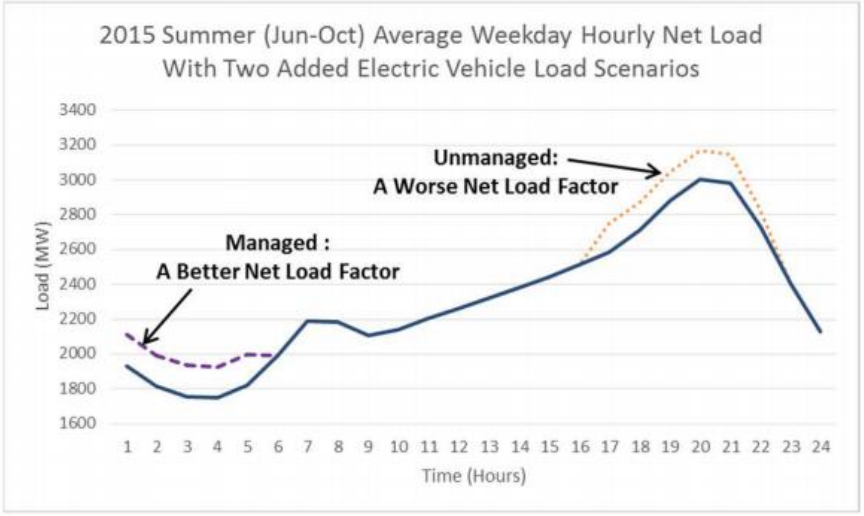
Level 1: 8-10 hours

Level 2 (3.3kW): 3 hours
Level 2 (6.6 kW): 1.5 hours

## Why Level 2?

Reduced charging time
+
Grid-Integrated Rate =

Flexible load (EV charging) after evening peak




*Source: Figures 8-9, in Chapter 8

# Fast Charge: Program Overview

Morgan Metcalf
Product Manager, Expert
July 11th, 2017

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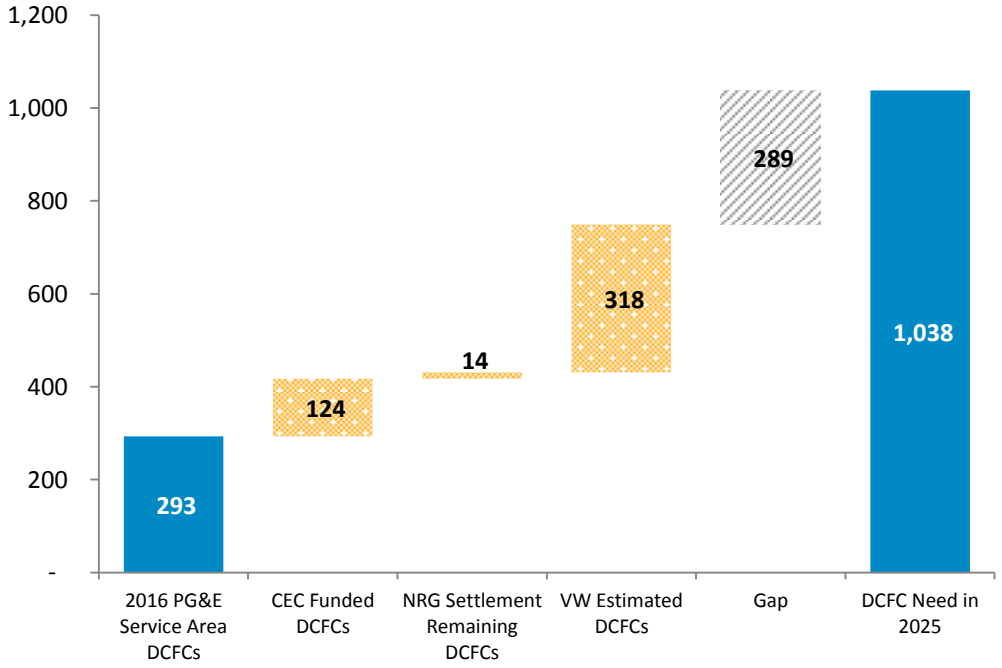
# Fast Charge: public DCFC make-ready program

- Program budget: $22M over 5 years
- Goal: Provide make-ready infrastructure for public DCFCs
  - Program sized to fill potential gap, both corridor and urban charging locations
  - Installations occur following customer acquisition of chargers; modeled with a variety of power levels (50 – 350 kW chargers)
  - Program will also provide a $25,000 rebate for installations in disadvantaged communities

**Known significant DCFC deployments expected in PG&E service area**
Compared to expected 2025 need



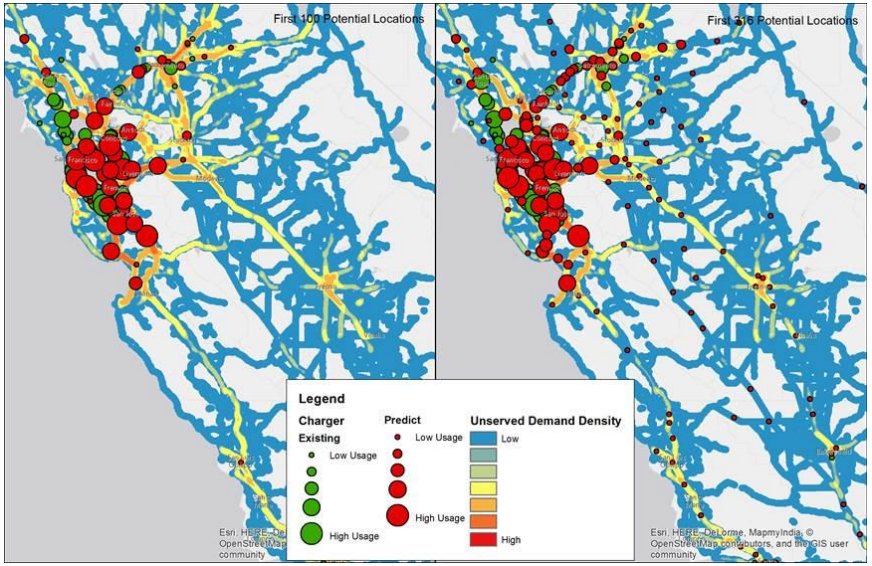
# PG&E research optimizes siting of Direct Current Fast Chargers (DCFCs)

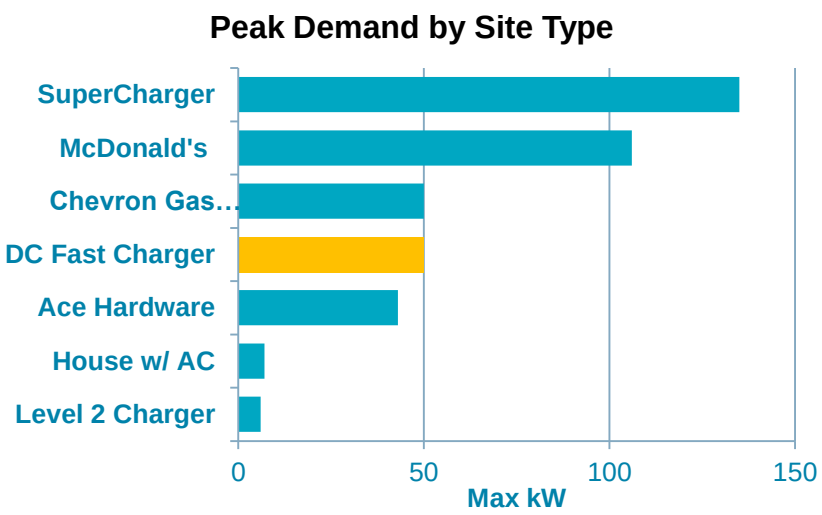
## Project Goal

- Determine optimal location for up to 300 DCFCs in PG&E's territory

## Project Overview

- Develop prioritization criteria (e.g. safety, travel behavior, distribution system design)
- Create a ranking algorithm to prioritize locations
- Provide the list of locations to third parties
- Guide PG&E's potential infrastructure deployment




## What is a Direct Current Fast Charger?

- 50 kW instant peak, power demand comparable to a gas station, but cycles on and off for 20 minutes at a time
- Ability to fill a Nissan LEAF battery to 80% in 20-30 minutes
- $150-250k to install
- Strategic siting is key to reducing costs

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# Residential/Public Infrastructure Qs

1. Do projects increase access for DACs/low income?
2. Are there opportunities to incentivize used vehicles?
3. Do projects enable customer choice & private investment?
4. Is SDG&E's proposal for ownership at residence appropriate?
5. What lessons has SDG&E learned from Power Your Drive?
6. Do proposals minimize risk of stranded assets?
7. Are projects in interest of ratepayers?
8. Do utilities leverage pilots, resources?
9. Is the scale appropriate?
10. Do proposals address load impacts & grid integration?
11. Have utilities consulted with union/labor groups?

# Medium- and Heavy-Duty Charging Infrastructure

- PG&E FleetReady
- SCE MD/HD Infrastructure

# FleetReady: Program Overview

David Sawaya
Strategy and Policy Design
July 11th, 2017

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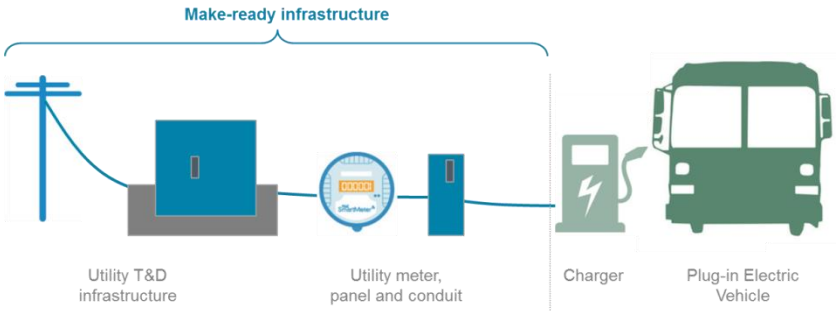
# FleetReady: Overview

- Accelerates adoption of non-light-duty EVs by reducing upfront customer infrastructure costs by providing make-ready infrastructure following customer acquisition of EVs and chargers
  - Covers all sectors (e.g. transit, last-mile delivery, forklifts, idle-reduction technologies, etc.)
  - Includes targeted incentives for disadvantaged communities and “beach head” sectors (school and transit buses) to propagate technology developments



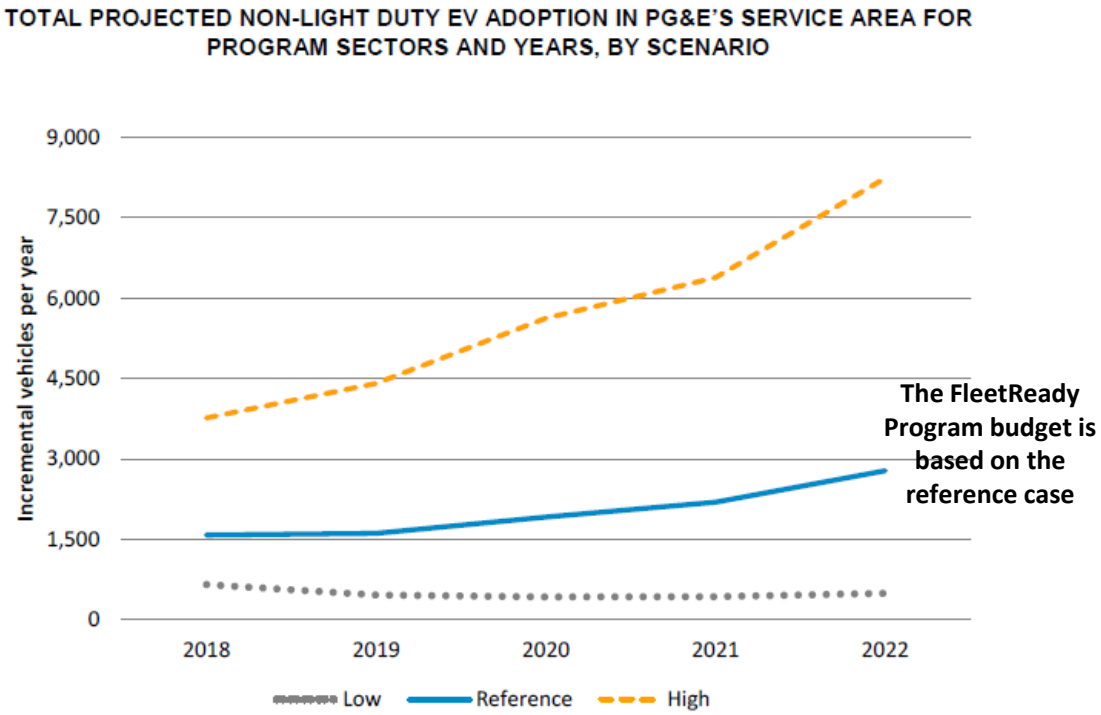

- Program costs estimated using the following steps:

CA vehicle adoption forecast, by sector → PG&E-specific forecast → Estimate # of sites and site characteristics → PG&E estimators determine cost per site → Calculate program cost

- Program designed to minimize costs and maximize benefits
  - Ensures co-funding for all projects (through make-ready approach)
  - Limits incentives to sectors which have highest impact
  - Ensures infrastructure installations follow customer decisions to procure EVs; avoids risk of stranded assets (budget request is a cap, not a goal)

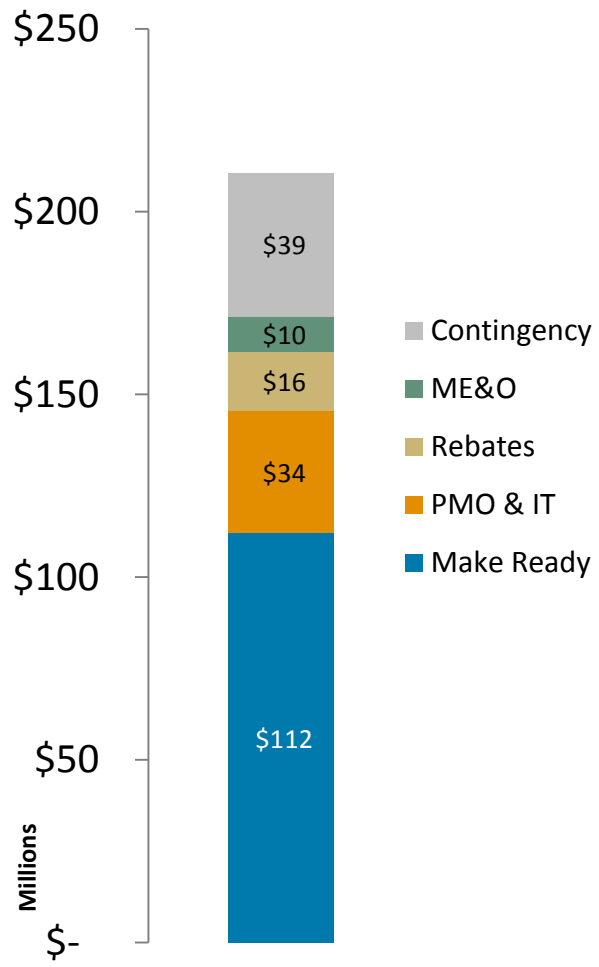
# FleetReady: site cost estimates and program budget

- Site costs estimated, by sector, based on the following variables:
  - Site power requirements
  - Transformer characteristics (new vs. upgrade & overhead vs pad-mount)
  - Trenching distance and material
  - Indoor vs outdoor
  - ADA requirements




**FleetReady Program Budget**

By cost type



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# SCE Standard Review Project Workshop

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# Medium- and Heavy-Duty Charging Infrastructure Proposal

**Trucks, Buses, Forklifts**

**Objective** - Support the acceleration of widespread transportation electrification for goods movement and mass transit by mitigating the costs and complexity of deploying charging equipment.

- **Build make readies and charging station rebates** for electric trucks, buses, shuttles, port and material handling equipment.
- Follows model developed for the **Charge Ready** pilot program, where SCE deploys, owns, and maintains the electric infrastructure needed to serve charging equipment for in-scope vehicles.
- Participating customers will be **responsible for procuring charging station equipment and installation** (and paying any costs in excess of the rebate amount) and for maintaining the equipment in working order for the duration of the program.
- Targets **non-residential customers** and solicit for participation through SCE's Business Customer Division.
- Feedback from **advisory board with customers and industry stakeholders**.
- Provide **quarterly status reports** to the Commission's Energy Division and other stakeholders.

**Program Benefits** - Improved Safety, Benefits DACs, Innovative, Environmental and Other Air Quality Benefits

# MD/HD Infrastructure Questions

1. Is make ready infrastructure the most cost-effective way to increase MD/HD TE adoption?
2. Do proposals minimize risk of stranded assets?
3. Are proposals in interest of ratepayers?
4. Do projects benefit DACs?
5. Do utilities leverage pilots, resources?
6. Is the scale of the programs appropriate?
7. Have utilities consulted with union/labor groups?
8. Do proposals address load impacts & grid integration?
9. Are their specific MD/HD sectors to focus on?

# Electric Vehicle Rates

- SDG&E Residential Grid Integration Rate
- SCE Commercial Rates

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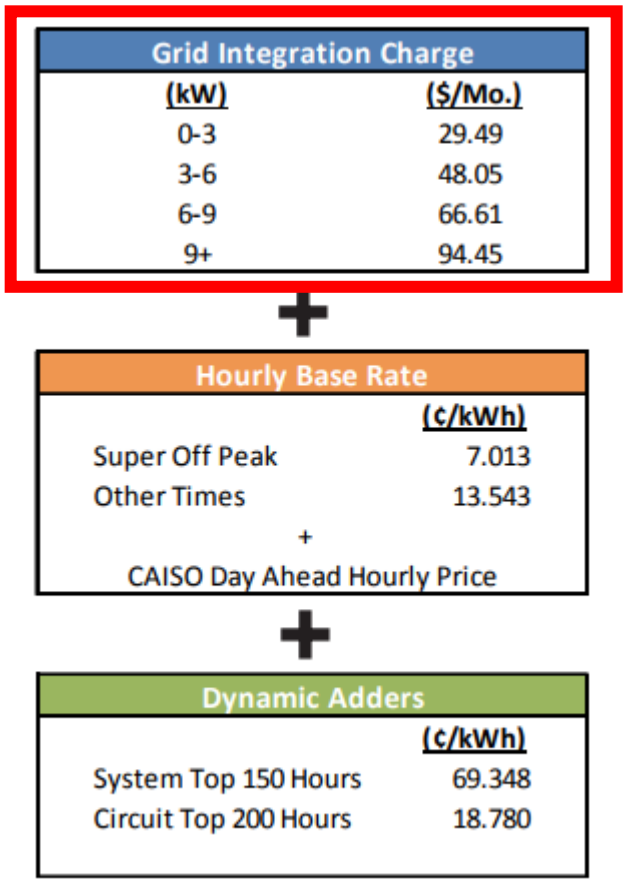
# July 11, 2017

# Residential Grid Integration Rate

Super off-peak demand is exempt



**Grid Integration Charge**

| (kW) | ($/Mo.) |
|---|---|
| 0-3 | 29.49 |
| 3-6 | 48.05 |
| 6-9 | 66.61 |
| 9+ | 94.45 |

**Hourly Base Rate**

| | (¢/kWh) |
|---|---|
| Super Off Peak | 7.013 |
| Other Times | 13.543 |

\+

CAISO Day Ahead Hourly Price

**Dynamic Adders**

| | (¢/kWh) |
|---|---|
| System Top 150 Hours | 69.348 |
| Circuit Top 200 Hours | 18.780 |

- Consists of a Grid Integration Charge, Hourly Base Rate, CAISO Day-Ahead Hourly Price, and Dynamic Adders (System and Circuit)
- Based on Residential class rates (Schedule DR)
- GIC based maximum annual demand (average hourly)
  - Super off-peak exemption
- Fixed monthly incentive to partially offset GIC for a 5-year transition period

# Residential GIC Transition

| Residential Grid Integration Charge | | | | | | |
|---|---|---|---|---|---|---|
| Demand | w/o Incentive | Year 1 w/ Incentive | Year 2 w/ Incentive | Year 3 w/ Incentive | Year 4 w/ Incentive | Year 5 w/ Incentive |
| (kW) | ($/Mo.) | ($/Mo.) | ($/Mo.) | ($/Mo.) | ($/Mo.) | ($/Mo.) |
| 0-3 | 29.49 | 10.00 | 14.87 | 19.74 | 24.62 | 29.49 |
| 3-6 | 48.05 | 16.29 | 24.23 | 32.17 | 40.11 | 48.05 |
| 6-9 | 66.61 | 22.59 | 33.59 | 44.60 | 55.60 | 66.61 |
| 9+ | 94.45 | 32.03 | 47.63 | 63.24 | 78.84 | 94.45 |

# Comparison to Existing EV Rates

Super off-peak demand is exempt

| | Residential GIR (Whole House GIR) | EV-TOU (01/01/2017 Rates) | EV-TOU-2 (01/01/2017 Rates) |
|---|---|---|---|
| **Grid Integration Charge (GIC)** | ($/Mon.)[1] | ($/Mon.) | ($/Mon.) |
| 0-3 kW | 29.49 | N/A | N/A |
| 3-6 kW | 48.05 | | |
| 6-9 kW | 66.61 | | |
| 9+ kW | 94.45 | | |
| **Hourly Base Rate** | (¢/kWh) | (¢/kWh) | (¢/kWh) |
| Super Off Peak | 7.013 | N/A | N/A |
| Other Times | 13.543 | | |
| CAISO Day Ahead Hourly Price | 3.018[2] | | |
| **TOU Rates** | (¢/kWh) | (¢/kWh) | (¢/kWh) |
| Summer | N/A | | |
| On-Peak | | 48.673 | 48.761 |
| Off-Peak | | 23.539 | 23.843 |
| Super Off-Peak | | 19.032 | 19.029 |
| Winter | | | |
| On-Peak | | 23.383 | 23.028 |
| Off-Peak | | 22.319 | 22.619 |
| Super Off-Peak | | 20.199 | 20.197 |
| **Dynamic Adders** | (¢/kWh) | (¢/kWh) | (¢/kWh) |
| System Top 150 Hours | 69.348 | N/A | N/A |
| Circuit Top 200 Hours | 18.780 | | |

[1] GIC in Year 5 at cost-based level

[2] Average CAISO Day Ahead Hourly Price for 2016

**Annual High Cost Hours**: Residential GIR = 4%, EV-TOU = 33%, EV-TOU-2 = 24%

# SCE Standard Review Project Workshop

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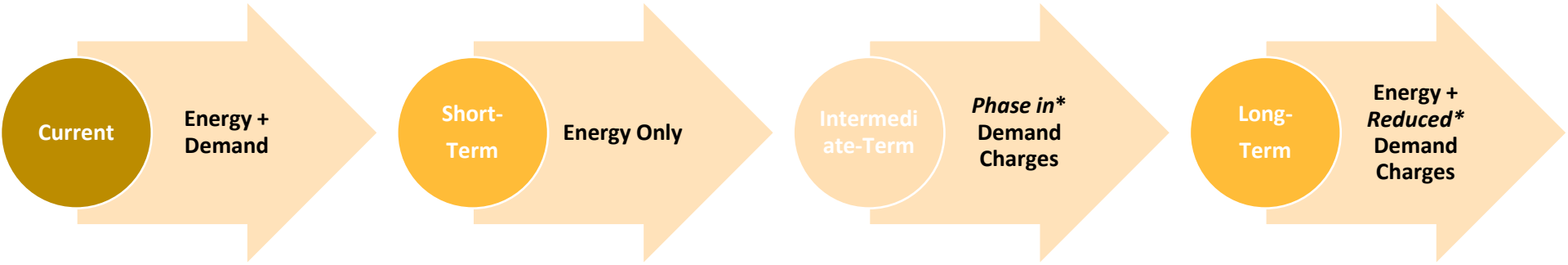
# SCE's Proposed EV Rates



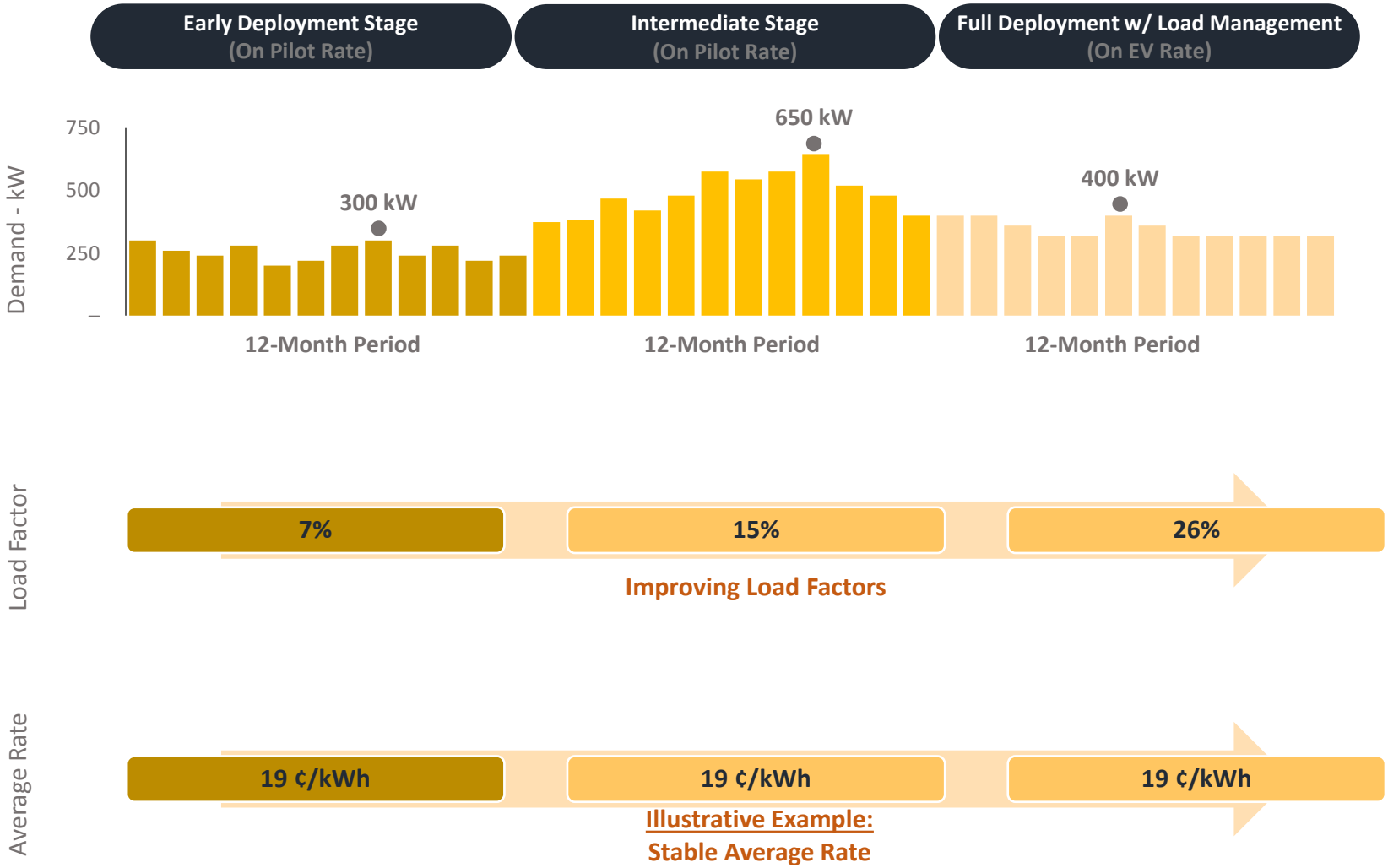

* Five-year introductory period; intermediate period phased monthly demand charges

* Demand charge to collect 60% of all distribution capacity costs; the remaining 40% will be collected through TOU energy charges

- **Benefits** – Reduced distribution-related demand charges relative to the current EV and non-EV rates; attractive volumetric rates during daytime super-off-peak periods and overnight; and lower summer season charges to mitigate seasonal bill volatility.

- **Revenue Neutral** - Optional rates are designed to recover the same amount of total revenues as the "base" or "default" rates would collect.

# Lessons Learned – Pilot



# SCE's Current and Proposed Commercial EV Rates

| Rate | Status | Demand | TOU Periods | Features |
|---|---|---|---|---|
| TOU-EV-3 | Approved | ≤ 20kW | On-Peak: noon – 6 pm, weekdays except holidays<br>Mid-Peak: 8 am –noon; 6 pm – 11 pm, weekdays except holidays<br>Off-Peak: 11 pm – 8 am | Option B of this rate includes demand charges where the TOU-EV-3 account is only charged incremental Facilities-Related Demand (FRD) charges when the account registers a demand greater than the primary account |
| TOU-EV-4 | Approved | > 20 kW and ≤ 500kW | On-Peak: noon – 6 pm, weekdays except holidays<br>Mid-Peak: 8 am –noon; 6 pm – 11 pm, weekdays except holidays<br>Off-Peak: 11 pm – 8 am | This rate includes demand charges where the TOU-EV-4 account is only charged incremental FRD charges when the account registers a demand greater than the primary account |
| TOU-EV-6 | Approved | > 500kW | On-Peak: 2 pm – 8 pm, weekdays except holidays<br>Super Off-Peak: 10 pm – 8 am<br>Off-Peak: All other hours | This rate includes demand charges where the TOU-EV-6 account is only charged incremental FRD charges when the account registers a demand greater than the primary account |
| TOU-EV-7 | Proposed in A.17-01-021 | ≤ 20kW | Winter (Oct-May)<br>Off-Peak: 9pm – 8am<br>Super-Off-Peak: 8am – 4pm<br>Mid-Peak: 4pm – 9pm<br><br>Summer (June-Sept)<br>Off-Peak:9pm– 4pm, weekdays & weekends<br>On-Peak: 4pm– 9pm, weekdays<br>Mid-peak: 4pm – 9pm, weekends | The rate will phase in demand charges over a 10-year period. Five year introductory period with no demand charge, only volumetric TOU energy charge and customer charges. In years 6-10, SCE will phase in demand charges by initiating and increasing the facilities-related demand charge by 10% each year. In year 11, the schedule will reflect stable demand charges that collect 60% of all distribution capacity costs; the remaining 40% will be collected through TOU energy charges. |
| TOU-EV-8 | Proposed in A.17-01-021 | > 20 kW and ≤ 500kW | Same as TOU-EV-7 | Same as TOU-EV-7 |
| TOU-EV-9 | Proposed in A.17-01-021 | > 500kW | Same as TOU-EV-7 | Same as TOU-EV-7 |

# Rate Questions

1. Are proposals in interest of ratepayers?
2. Do utilities leverage pilots?
3. Will the rates increase EV adoption & provide lower costs than diesel?
4. Do rates facilitate integration of renewables?
5. Do rates reflect cost causation & revenue neutrality?
6. Do rates provide understandable price signals?
7. How will SCE facilitate understanding of demand charges during 5 year introductory period?

# Lunch Break

# CPUC Staff Overview of Vehicle Adoption and Emissions Topics

# Statutory & Regulatory Requirements

Excerpts related to vehicle adoption and emissions

- Senate Bill 350 requirements:
  - …reduce dependence on petroleum, meet air quality standards… and reduce emissions of greenhouse gases to 40 percent below 1990 levels by 2030 and to 80 percent below 1990 levels by 2050.

- CPUC guidance on application contents:
  - Describe and provide measurable indicators, where possible, on how TE proposals will contribute towards meeting the goals of supporting the ZEV Executive Order and GHG emissions reduction targets pursuant to SB 32 and SB 350. Consider proportional share of these statewide goals.
  - Consider several ongoing initiatives, including: Integrated Resource Planning, ARB Scoping Plan and Mobile Source Strategy, and demand forecasting.
  - Include vehicle goals, grid impacts, and emissions benefits and accounting methodology.

- Scoping memo asks if utilities have:
  - Quantified expected GHG emissions reductions from proposals.
  - Explained how scale of proposals relates to GHG emissions reduction targets for their territory.
  - Ensured programs reduce emissions and comply with state and federal health regulations.

# Utility Applications

- SDG&E, SCE, and PG&E applications addressed guidance differently
  - SDG&E provided a consultant study that quantifies total vehicles supported by program; incremental vehicle adoption due to program; reductions of $CO_2$, $NO_x$, VOC; load impacts; and cost-effectiveness
  - SCE and PG&E didn't forecast incremental vehicle adoption due to programs, but attempt to quantify GHG reductions based on total EV adoption in territory

# Approach to Vehicle Adoption & Emissions

Energy Division Staff recommended approach for current TE proposals

Approve TE proposals that use a well-defined ex ante methodology to quantitatively show benefits (incremental EV adoption and emissions reductions) attributable to the proposal

Approve TE proposals that provide reasonable justification of developing the TE market and leading to increased vehicle adoption and emissions reductions. Track project outcomes quantitatively & qualitatively and attempt to quantify benefits upon project completion.

Approve TE proposals that relate to transportation electrification, but do not have any specific benefits associated with them nor any proposals to collect data or assess project outcomes.

Rigorous methodology for well-understood project types

No clear objective or quantification of benefits necessary

# Approach to Vehicle Adoption & Emissions

## Short-Term

- Implement projects across a variety of sectors
- Collect and report data and lessons learned
- Forecast total electric vehicle adoption in IOU service territory
- Coordinate across state agency & other investments

## Medium-Term

- Assess results from initial IOU investments & other relevant pilots/research
- Estimate emissions reductions associated with completed IOU pilots

## Long-Term

- Understand full suite of utility interventions that can promote widespread TE
- Develop methodology to attribute increased vehicle adoption & associated emissions reductions to different types of IOU TE programs
- Compare to other GHG-reduction programs in Integrated Resource Planning

# Electric Vehicle Adoption

# PEV Adoption: Preliminary Forecast

Aniss Bahreinian

July 11, 2017

CPUC Workshop

Aniss.Bahreinian@energy.ca.gov

# Transportation Electrification (TE)

TE included in CEC forecast:

- Light Duty Plug-in Electric Vehicles (PEVs)
- Neighborhood Electric Vehicles (NEVs)
- Urban Transit Vehicles; rail and bus
- Electrified Heavy (commuter) Rail (starting in 2020)
- High Speed Rail (starting in 2025)
- Electric Medium Duty vehicles
- Off-Road Electrification
  - Air & Sea Port Electrification
  - Truck Stop Electrification
  - Forklift

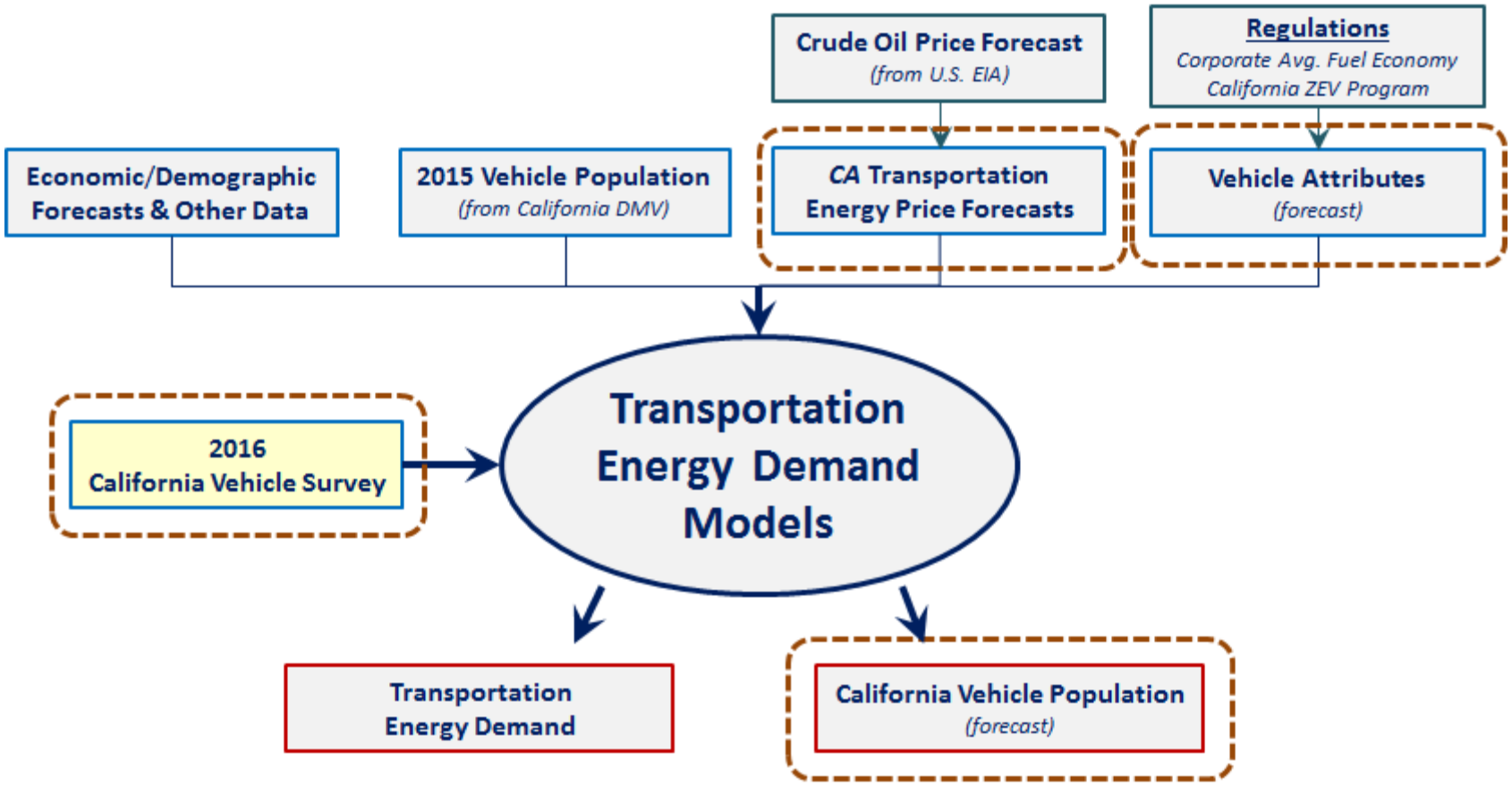
# Transportation Demand Cases

*Cases represent different levels of transportation electricity demand*

| Demand Case | Population | Income | Fuel Prices | |
|---|---|---|---|---|
| | | | Petroleum Fuels | Electricity / Natural Gas / Hydrogen |
| **High Demand** | High | High | High | Low |
| **Mid** | Mid | Mid | Mid | Mid |
| **Low Demand** | Low | Low | Low | High |

# Transportation Models

Key Inputs & Outputs



# Trends in Fuel Cost per Mile

- Light Duty Vehicles
  - Electricity is projected to have the lowest cost per mile among fuel types
  - Hydrogen fuel costs are projected to decrease over the forecast period
- Medium Duty Trucks
  - Electricity fuel cost per mile remains relatively flat and offers the lowest cost per mile among fuel types
- Medium Heavy Duty Trucks
  - Diesel-Electric Hybrid is the fuel type with the lowest cost per mile
  - Natural gas has marginal fuel cost advantage over diesel

# Light Duty Vehicle Forecast

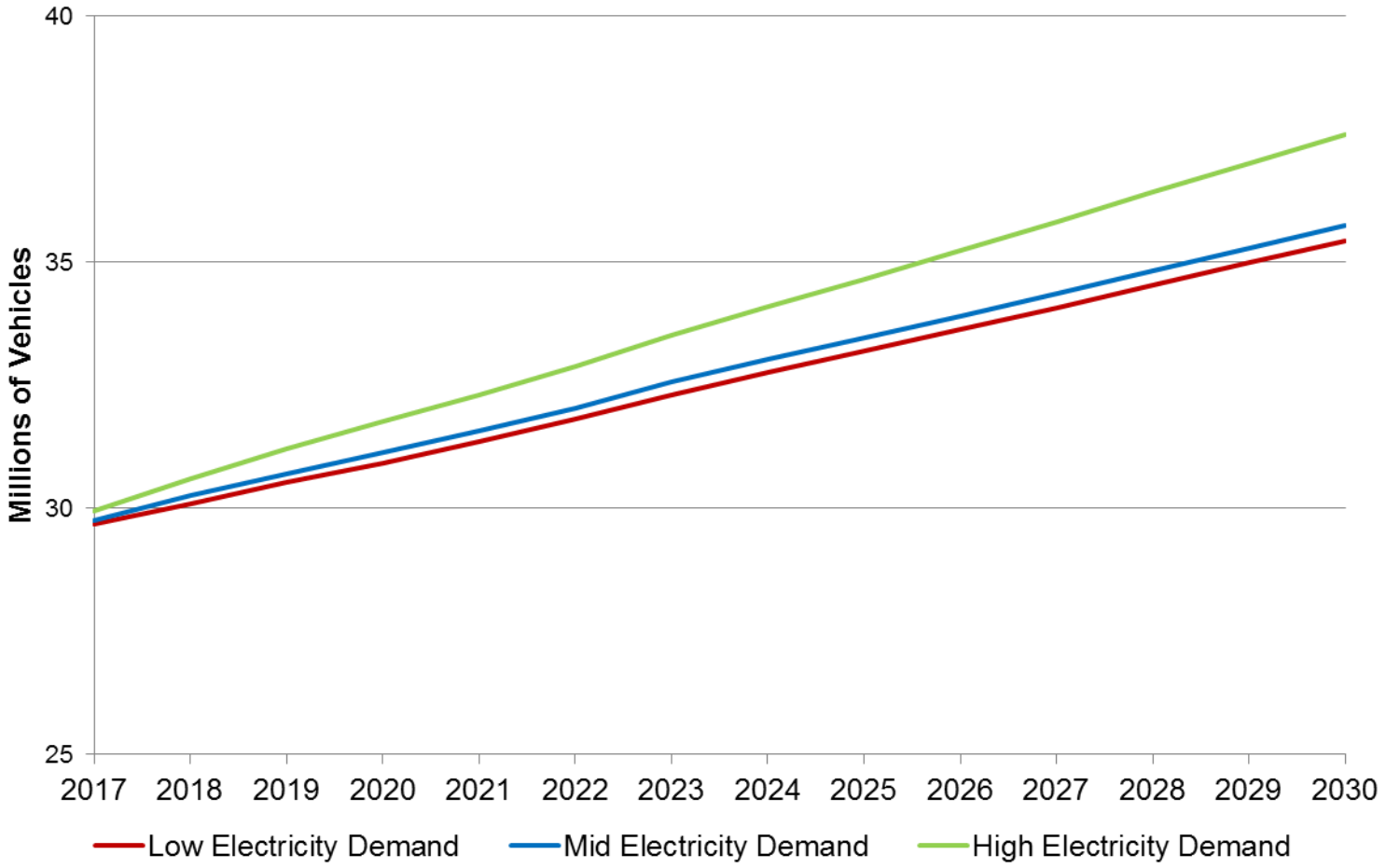
Light duty vehicle demand forecast is based on:

- The CEC's 2016-2017 residential and commercial surveys of consumer preferences.
- Updated LDV models based on survey results.
- Latest projections of vehicle attributes, accounting for announced/projected technology developments in 2017 and beyond.

# Consumer Preferences Change: 2016 Survey Compared with 2013

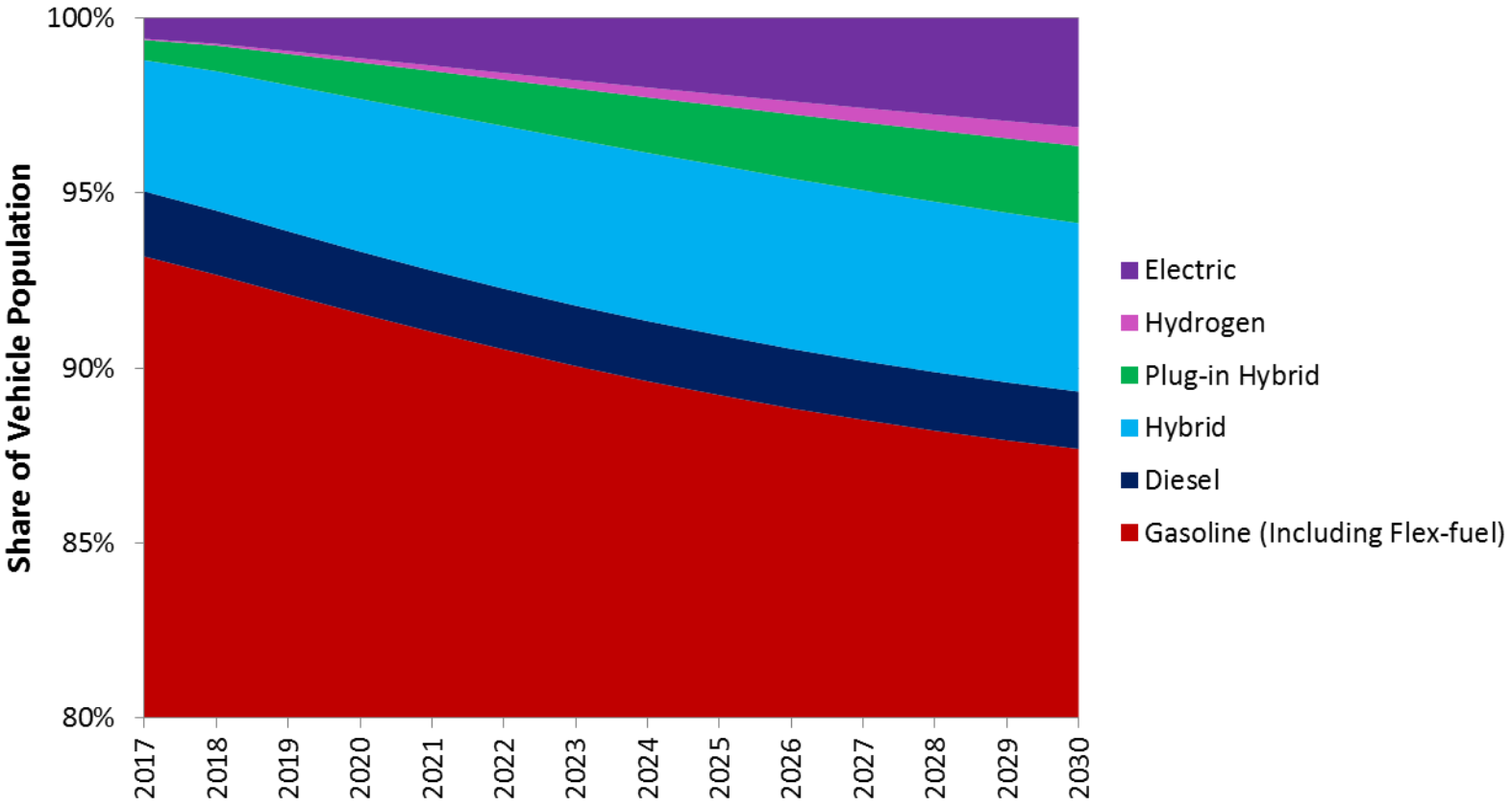
| Residential | Commercial |
|---|---|
| Higher preferences for ZEVs, with BEVs being the most favored among ZEVs | Higher preferences for ZEVs, with BEVs being the most favored among ZEVs |
| Vehicle price is less important | Vehicle price continues to be the most significant attribute |
| Vehicle range is more important | Vehicle range is more important |
| Tax credit and rebate more important; HOV lane access less important | HOV lane access and Tax credits are both important |
| Fuel economy is less important | Fuel economy is less important |
| | Acceleration is more important |

# Light-Duty Vehicle Stock Grows with Population and Economy

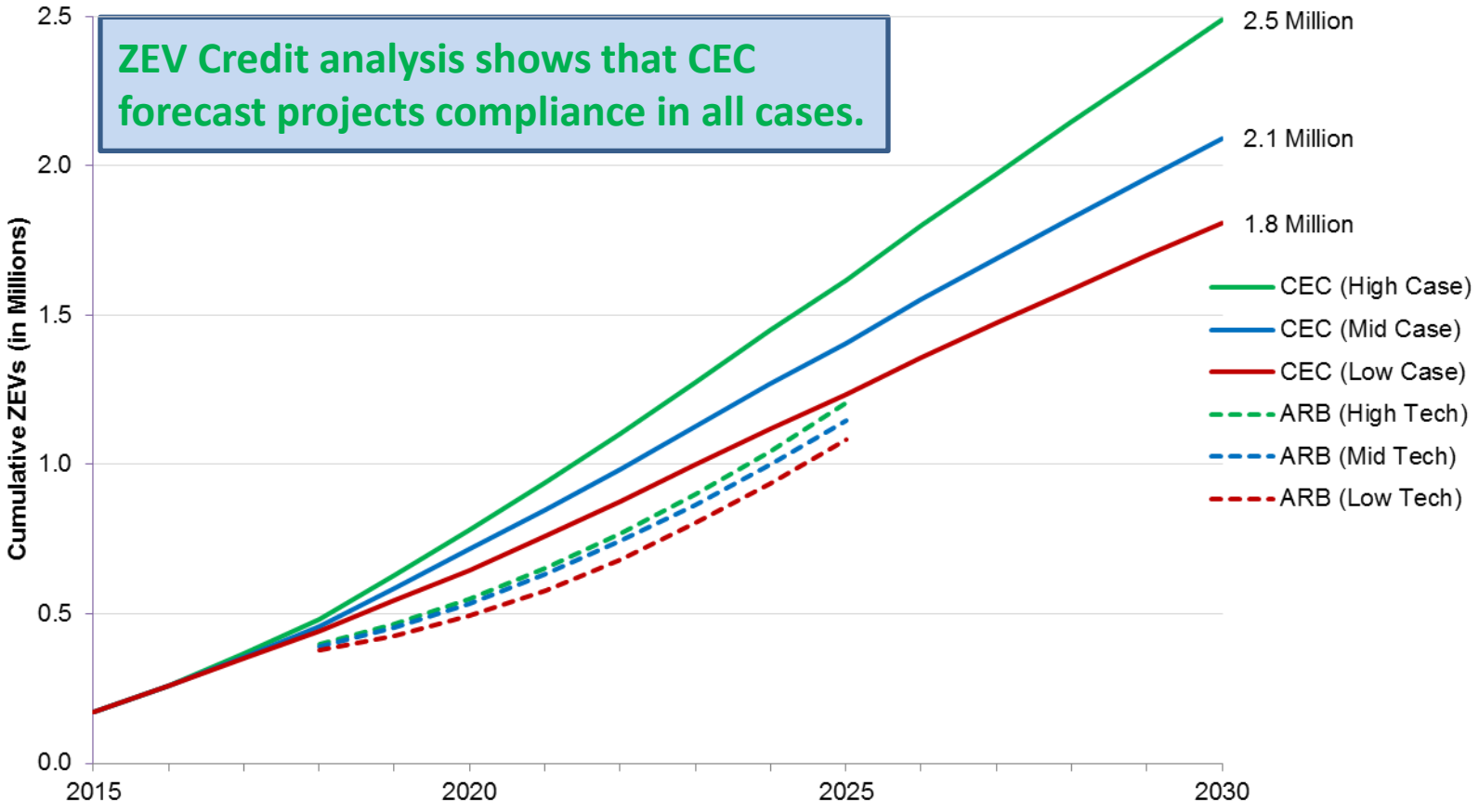


# Closer Look at Alternative Fuel Vehicle Share Throughout Forecast

Light-Duty Vehicle stock Share by Fuel Type , Mid Case



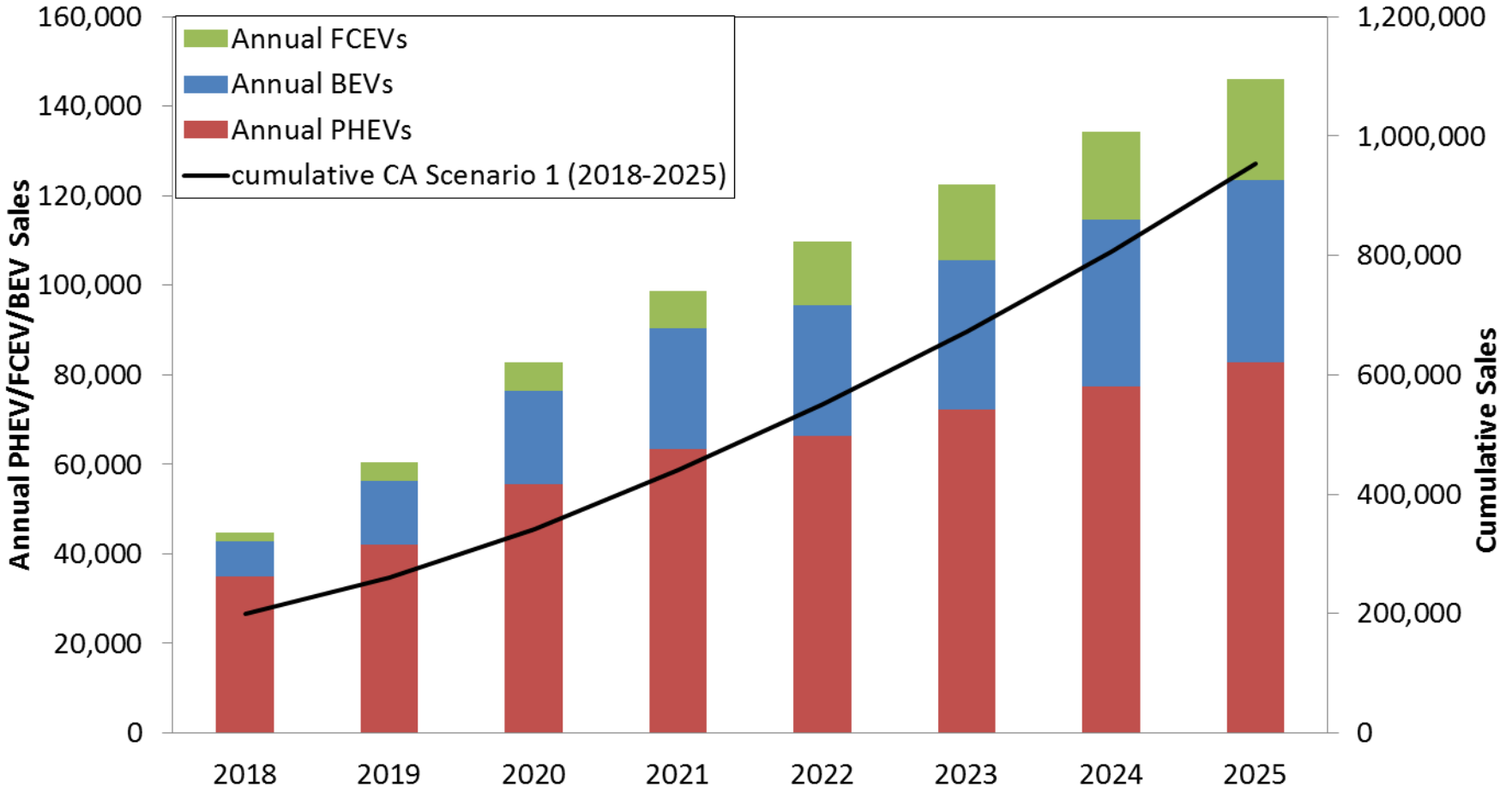
# ZEVs: CEC Stock & ARB Cumulative Sales (2017 Mid Term Review)




| | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| **CEC** (Mid Case) | 171,601 | ~715,000 | ~1.4 Million | 2.0+ Million |

# ARB Mid-Range Case

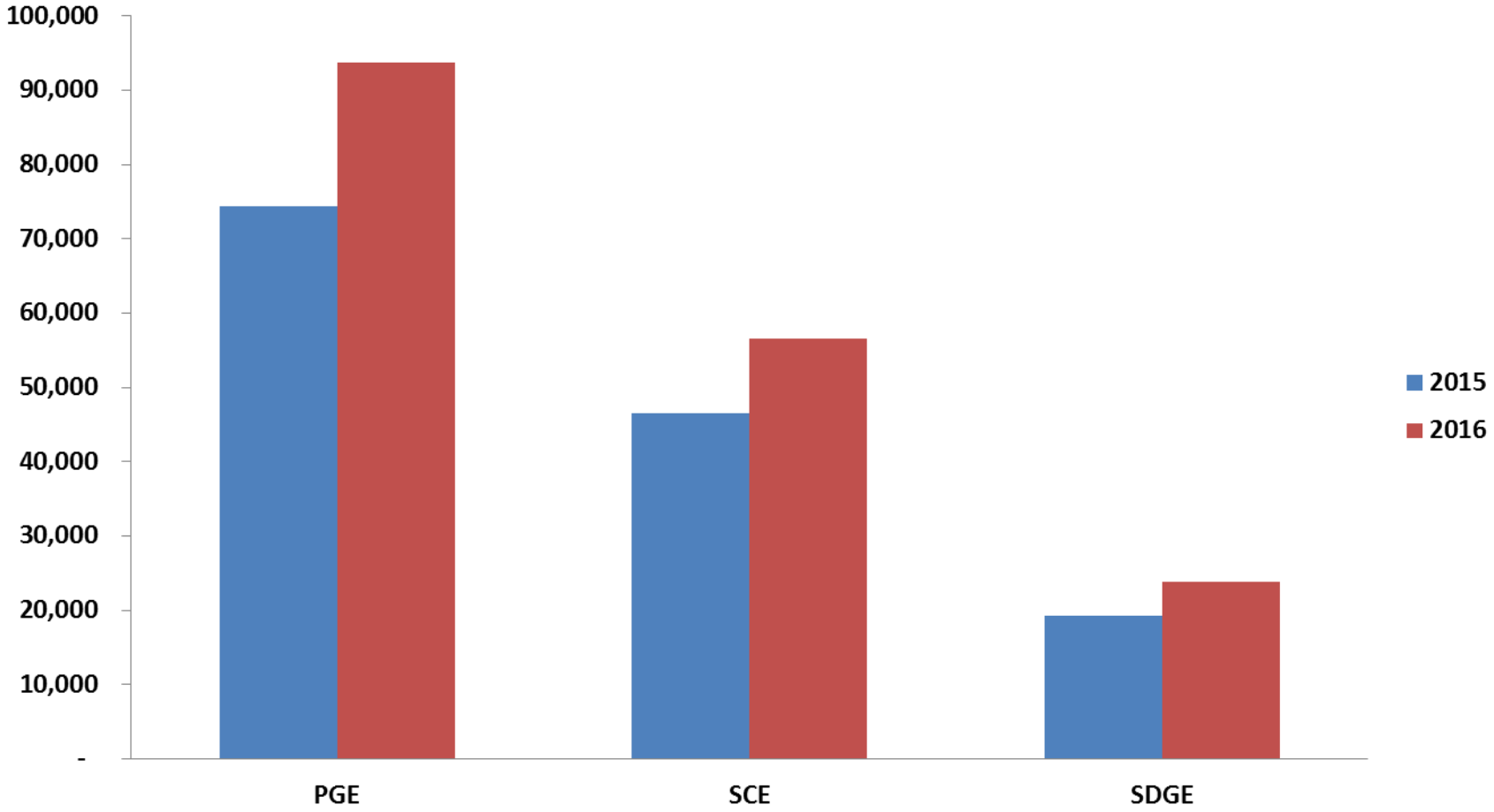
## California Results (2017 ARB Mid Term Review)




Source: ARB Presentation at CEC workshop, June 20, 2017.

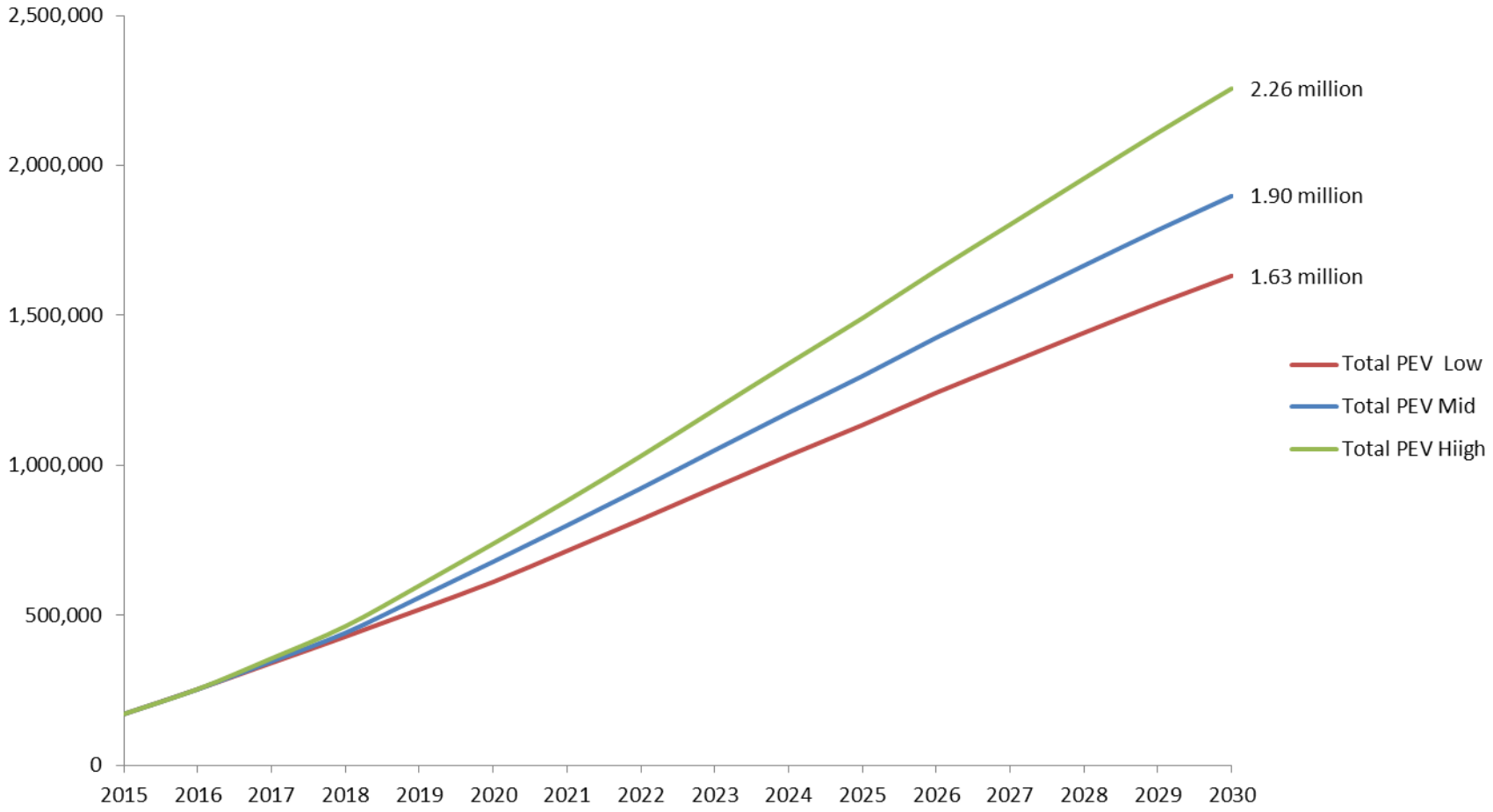
# Plug-in Electric Vehicles (PEV)

# On-Road Registered PEVs : 2015 & 2016

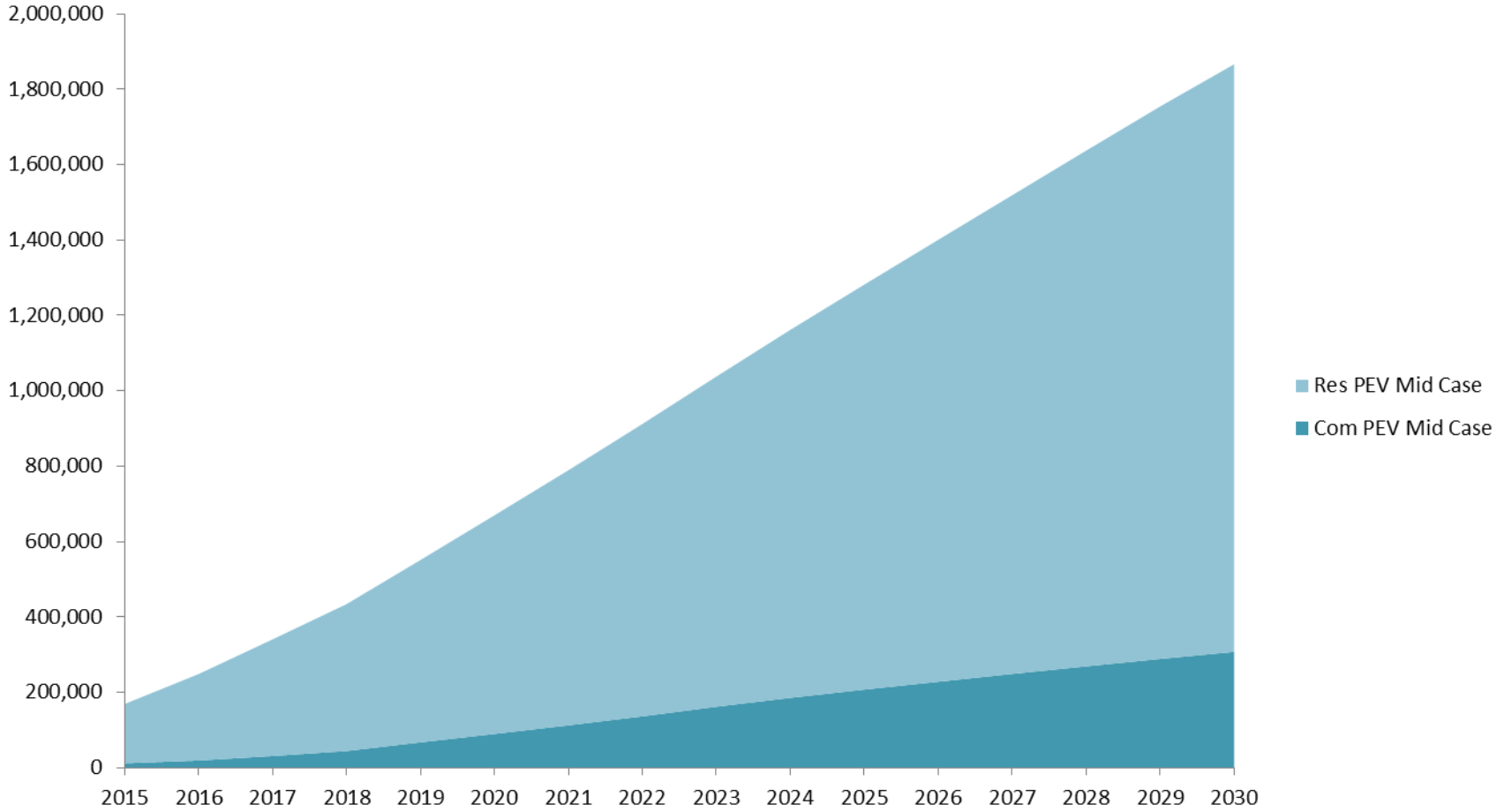



Source: California Energy Commission Analysis of DMV data

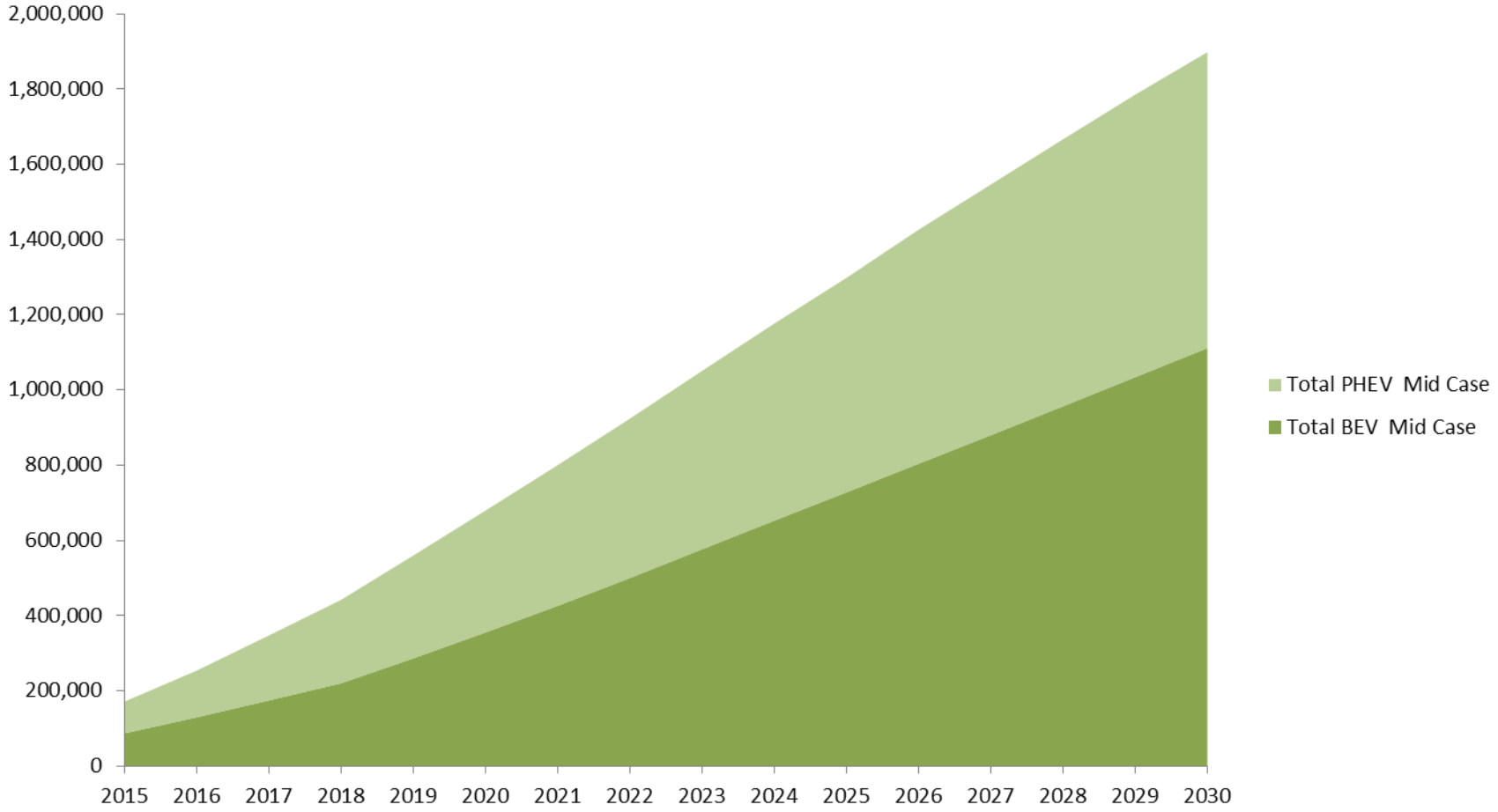
# On-Road PEV Stock Forecast



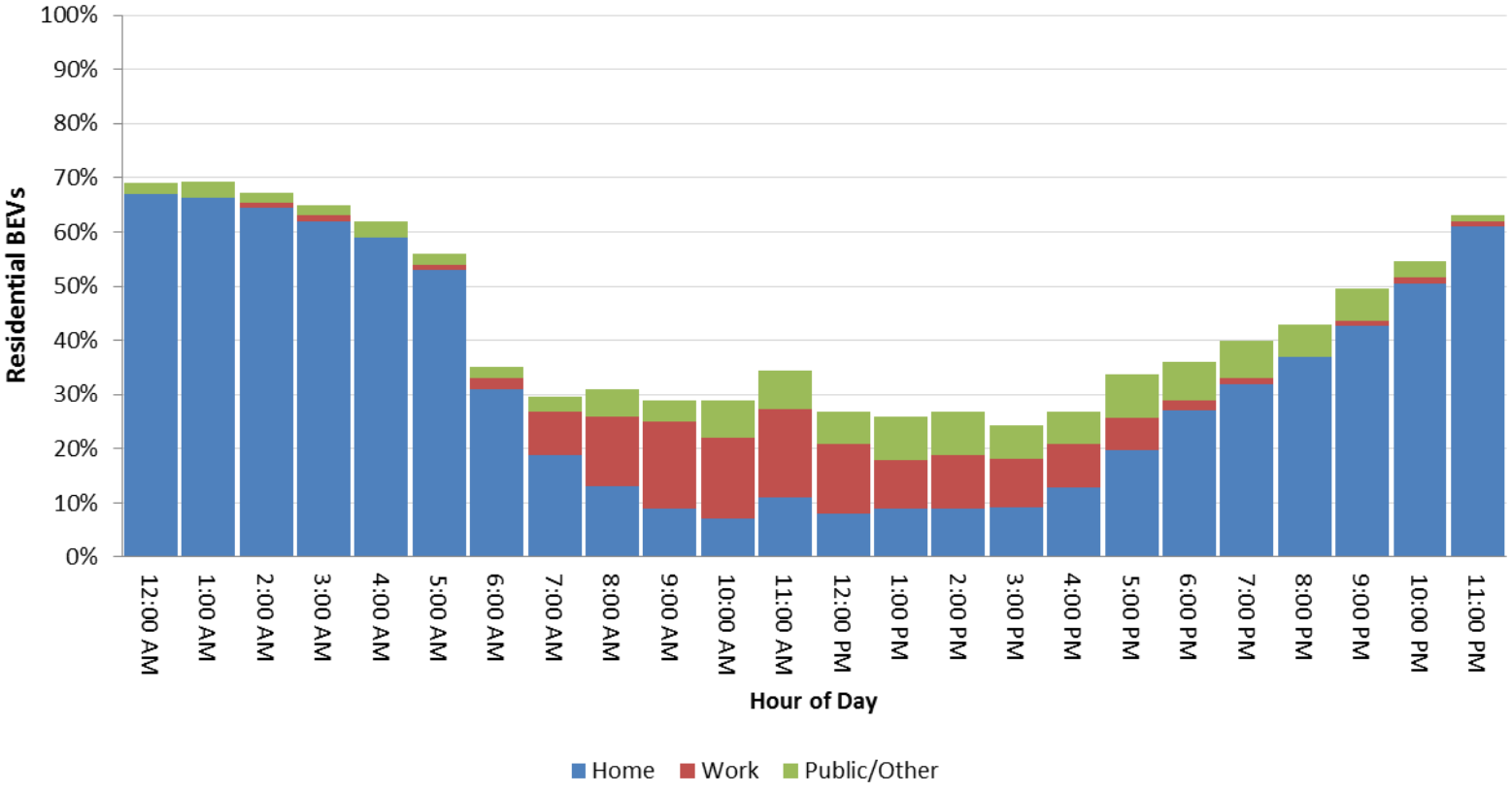
# Commercial vs Residential PEV Stock, Mid Case



# BEV and PHEV Stock, Mid Case



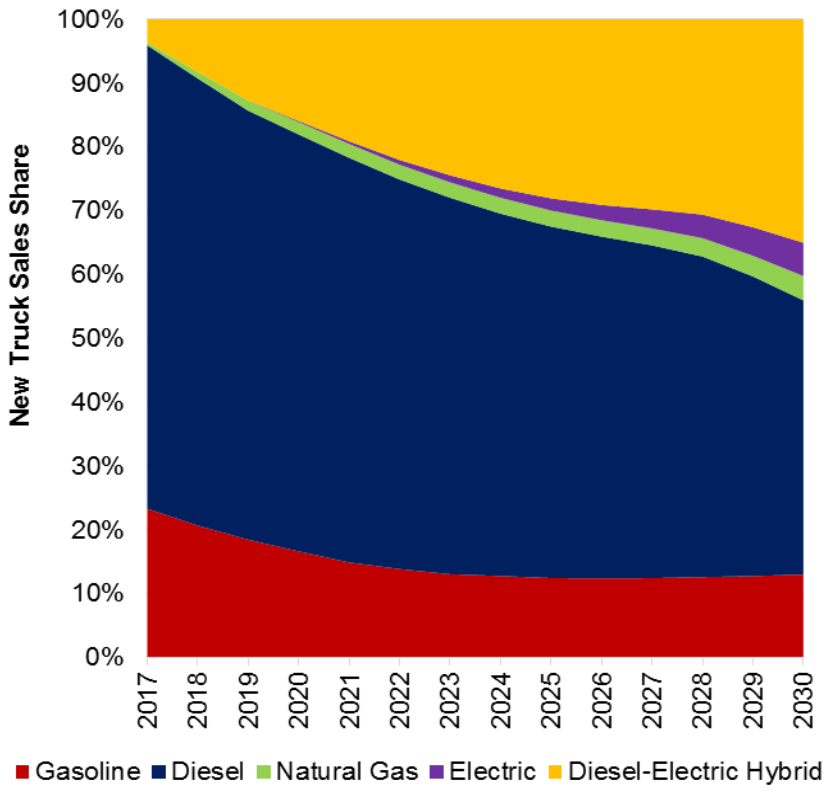
# Residential Charging Primarily Occurs at Home and Overnight
(Self-Reported)



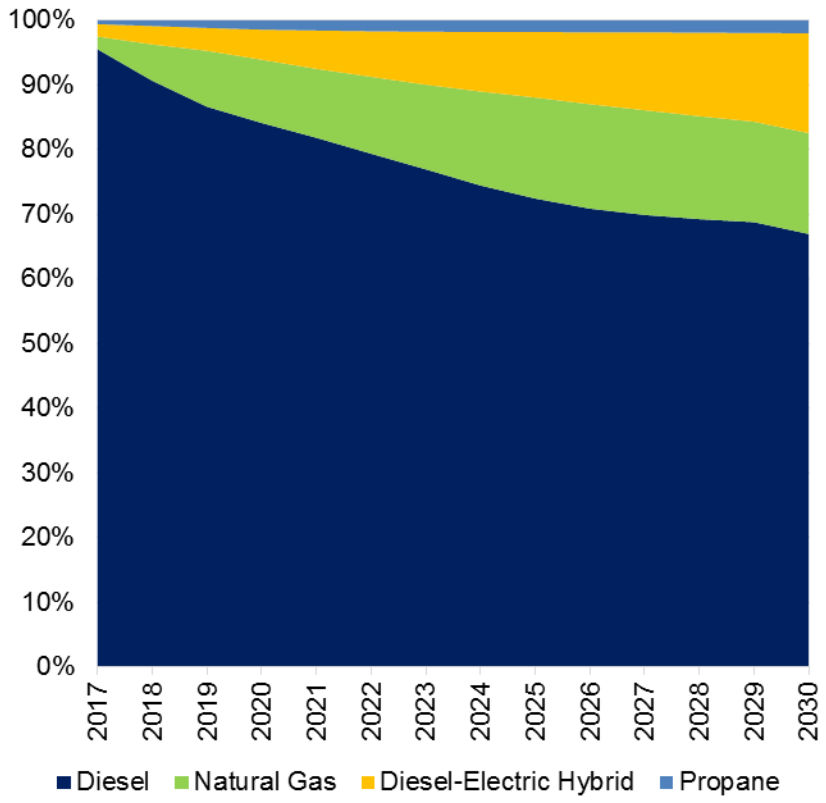

Source: 2016-2017 California Vehicle (PEV Owner) Survey, conducted by RSG for California Energy Commission

# Trucks by Fuel Type & Technology

## Mid-Size Trucks




## Heavy Trucks



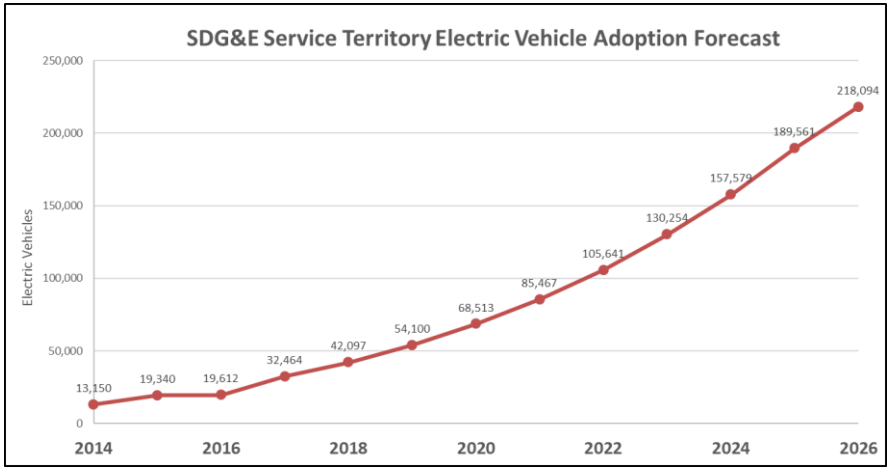
# Vehicle Forecasts in Utility Applications

# Standard Review Workshop

Vehicle Forecasts in Utility Applications

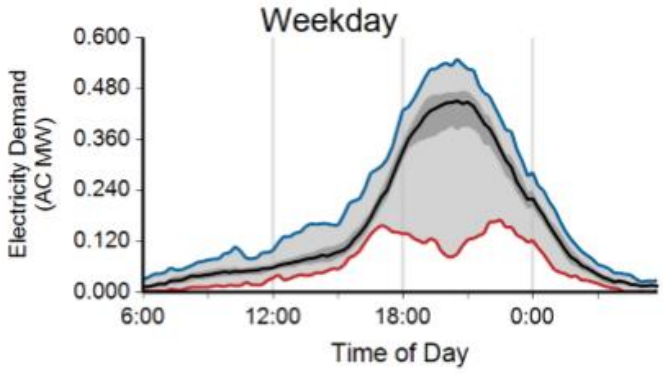
**July 11, 2017**

# SDG&E EV Forecast

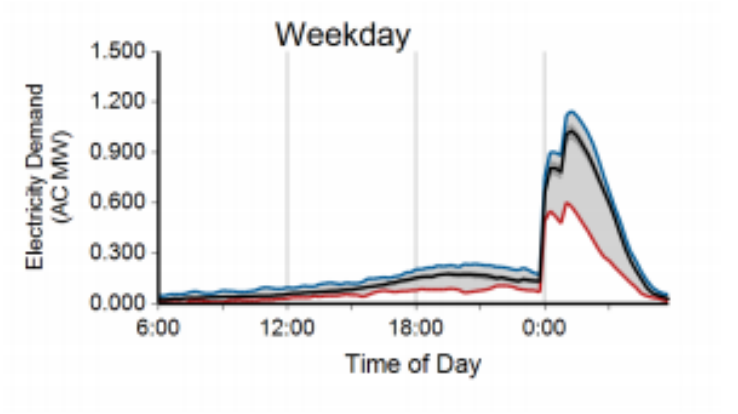



Source:
SDG&E's 2017
IEPR Submittal

## Illustrative Examples Of Unmanaged Vs. Managed Charging Profiles




**Nashville Charging – No TOU**




**SDG&E Managed Charging – EV rates**

Source: https://avt.inl.gov/sites/default/files/pdf/EVProj/EVProjInfrastructureQ32013.pdf

# SCE Standard Review Project Workshop

CPUC – July 11, 2017

SOUTHERN CALIFORNIA EDISON®

# Forecasting Vehicle Adoption

| TEA Study SCE Total Population by Year | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forklifts | Class 1 + 2 | 21,426 | 22,630 | 23,902 | 25,061 | 26,277 | 27,551 | 28,887 | 30,288 | 31,757 | 33,297 | 34,912 | 36,605 | 38,380 |
| | Class 3 | 23,591 | 24,489 | 25,422 | 26,262 | 27,130 | 28,026 | 28,952 | 29,909 | 30,897 | 31,918 | 32,973 | 34,062 | 35,188 |
| Truck Stop Electrification (Spaces) | | 350 | 449 | 578 | 606 | 635 | 667 | 699 | 733 | 769 | 807 | 846 | 888 | 931 |
| Transport Refrigeration Units | | 3,962 | 4,893 | 6,042 | 6,980 | 8,063 | 9,315 | 10,760 | 12,431 | 14,360 | 16,589 | 19,164 | 22,138 | 25,574 |
| Port Cargo Handling Equipment | Yard Tractors | 216 | 259 | 302 | 341 | 384 | 433 | 488 | 551 | 621 | 700 | 789 | 890 | 1,003 |
| | Forklifts | 83 | 99 | 116 | 128 | 142 | 158 | 176 | 195 | 216 | 240 | 267 | 296 | 329 |
| | Cranes | 26 | 32 | 37 | 41 | 46 | 52 | 59 | 66 | 74 | 83 | 93 | 104 | 117 |
| Airport GSE | | 258 | 292 | 330 | 347 | 364 | 383 | 402 | 422 | 443 | 466 | 489 | 514 | 540 |
| Medium-Duty Vehicles | | 1,161 | 1,667 | 2,394 | 3,354 | 4,700 | 6,585 | 9,226 | 12,927 | 18,113 | 25,378 | 35,558 | 49,821 | 69,806 |
| Heavy-Duty Vehicles | | 266 | 284 | 304 | 426 | 598 | 838 | 1,175 | 1,648 | 2,310 | 3,239 | 4,542 | 6,369 | 8,930 |
| | | **51,338** | **55,094** | **59,426** | **63,546** | **68,340** | **74,007** | **80,825** | **89,169** | **99,561** | **112,717** | **129,633** | **151,687** | **180,798** |

- SCE used the "In-between" Scenario from Phase 1 of the Transportation Electrification Assessment (TEA Study) (ICF and E3, 2014).
- Key assumptions for MD/HD project proposal
  - SCE territory assumed to be 38% of TEA Study California-wide forecasts (11% for Airport GSE).
  - Only Class 1 and 2 forklifts (conversion from non-electric) used in program (Class 3 forklifts not included).
  - Proposal would serve incremental annual vehicle population from 2019 through 2023.

# FleetReady: vehicle adoption scenarios

David Sawaya
Strategy and Policy Design
July 11th, 2017

Together, Building a Better California

# FleetReady: CA vehicle adoption scenarios

CA vehicle adoption forecast, by sector → PG&E-specific forecast → Estimate # of sites and site characteristics → PG&E estimators determine cost per site → Calculate program cost

- PG&E relied on publicly-available 3rd party adoption scenarios for all sectors, except public transit
- PG&E developed a public transit forecast, which assumes nearly full electrification in 2040 for the high scenario and half that adoption in the reference case, because existing forecasts:
  - Contain out-of-date data related to current adoption
  - Do not account for possible regulatory requirements (e.g. CARB's Innovative Clean Transit Rulemaking)

| | | Forecast source | | | |
|---|---|---|---|---|---|
| Sector | | Low | Reference | High | Source rationale if reference not CEC/CARB |
| Medium duty | | CARB Draft Scoping Plan | CalETC Trans. Electrification Assessment (in-between) | CalETC Trans. Electrification Assessment (aggressive) | CARB MSS and CEC IEPR have limited info on MD |
| Heavy duty | Trucks | CARB Draft Scoping Plan | CARB Mobile Source Strategy (CT&F scenario) | CalETC Trans. Electrification Assessment (aggressive) | N/A |
| | Transit buses | CARB Draft Scoping Plan | PG&E transit bus forecast (mid-case) | PG&E transit bus forecast (high-case) | CARB transit forecasts not credible in light of market knowledge |
| | Other buses (incl. school buses) | CARB Draft Scoping Plan | CARB Mobile Source Strategy (CT&F scenario) | CalETC Trans. Electrification Assessment (aggressive) | N/A |
| Off-Road | Airport ground support equip. (GSE) | CEC Off-road study (low-case) | CEC Off-road study (mid-case) | CEC Off-road study (high-case) | N/A |
| | Port cargo handling equip. (CHE) | CEC Off-road study (low-case) | CEC Off-road study (mid-case) | CEC Off-road study (high-case) | N/A |
| | Transport refrigeration units (TRU) | CEC Off-road study (low-case) | CEC Off-road study (mid-case) | CEC Off-road study (high-case) | N/A |
| | Truck-stop electrific-ation spaces (TSE) | PG&E electrification study, EPRI (low-case) | PG&E electrification study, EPRI (mid-case) | PG&E electrification study, EPRI (high-case) | Study is market based & PG&E-specific |
| | Forklift (class 1) | PG&E electrification study, EPRI (low-case) | PG&E electrification study, EPRI (mid-case) | PG&E electrification study, EPRI (high-case) | Study is market based & PG&E-specific |

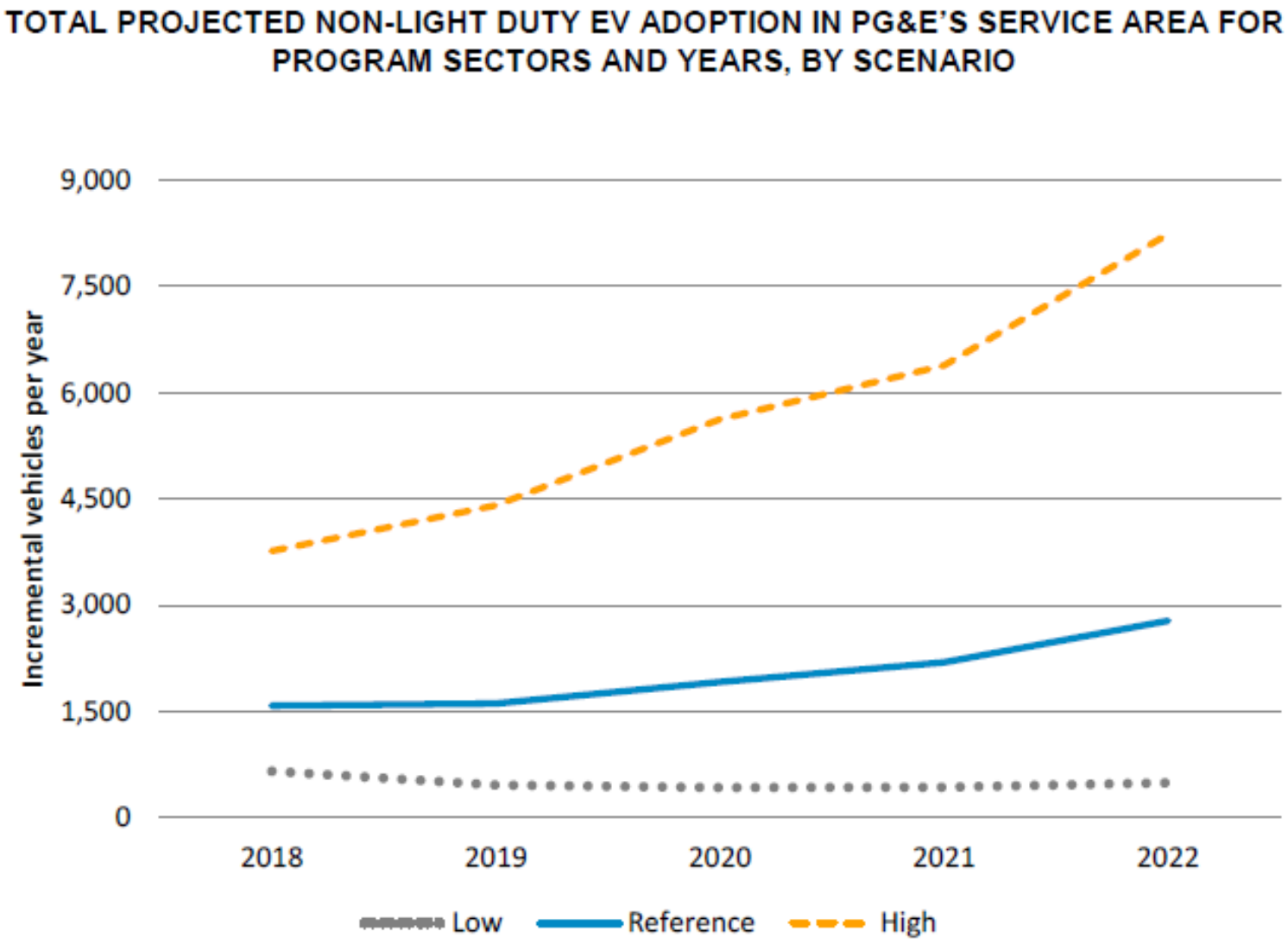
# FleetReady: CA vehicle adoption scenarios

CA vehicle adoption forecast, by sector → PG&E-specific forecast → Estimate # of sites and site characteristics → PG&E estimators determine cost per site → Calculate program cost

- PG&E's share of CA adoption in each sector were estimated using best available information

| Sector | | PG&E share of CA adoption | Methodology |
|---|---|---|---|
| Medium Duty | | 43% | PG&E share of CA |
| Heavy Duty | Transit buses | 41% | Based upon number of buses in PG&E territory per the US DOT FTA National Transit Database[8] |
| | Other buses (incl. school buses) | 43% | PG&E share of CA |
| | Trucks | 43% | PG&E share of CA |
| Off-Road | Airport ground support equip. (GSE) | 31% | Based on emplanements at airports that are PG&E customers |
| | Port cargo handling equip. (CHE) | 15% | Based on portion of total CA tonnage at ports that are PG&E customers |
| | Transport refrigeration units (TRU) | 43% | PG&E share of CA |
| | Truck-stop electrification spaces (TSE) | N/A | Source is PG&E-specific |
| | Forklifts (class 1) | N/A | Source is PG&E-specific |

# FleetReady adoption scenarios



Together, Building
a Better California

# EV MODELING IN THE CPUC INTEGRATED RESOURCE PLANNING PROCEEDING

# Integrated Resource Planning (IRP) in California

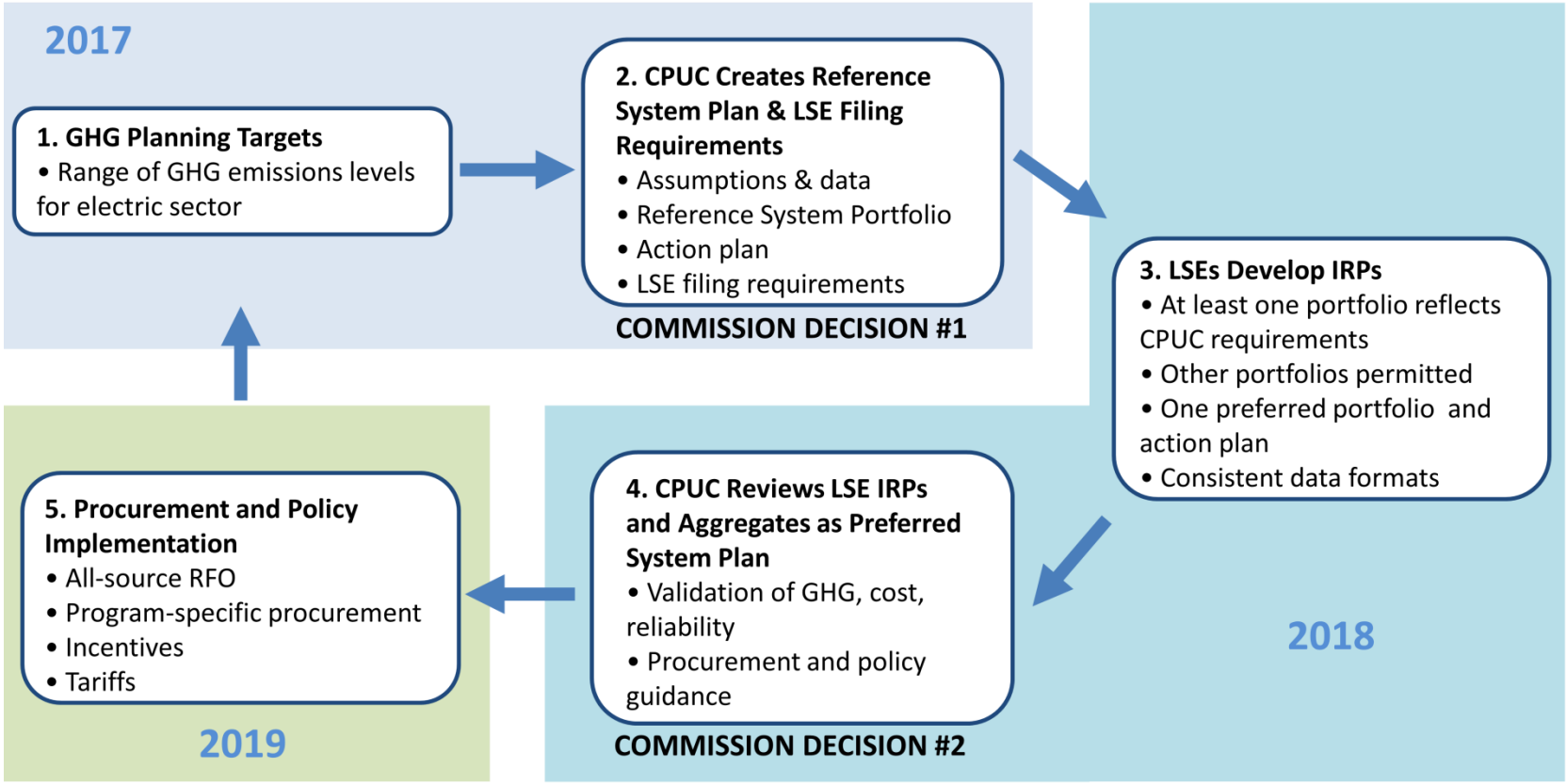
**Statutory basis for IRP**:

- Identify a diverse and balanced portfolio of resources that provides optimal and cost-effective integration of renewables (Section 454.51)
- Adopt a process for each load-serving entity to file an integrated resource plan that ensures state policy goals are met (Section 454.52)
  - Reduces GHG emissions consistent with 40% below 1990 levels by 2030
  - Ensures system and local reliability
  - Achieves other policy goals (50% RPS by 2030, minimize localized air pollution, etc.)

**Implementing IRP at the CPUC**:

- The value proposition of integrated resource planning at the CPUC is to reduce the cost of achieving GHG goals by looking across individual LSE boundaries and resource silos and identifying solutions that might not otherwise be found
- Goal of IRP 2017-18 cycle at CPUC is to develop a functional IRP-filing process and to move through the entire process once

# Proposed Two Year CPUC IRP Process



# RESOLVE Model Overview

- RESOLVE is a capacity expansion model designed to inform long-term planning questions around renewables integration.
- RESOLVE optimizes the selection of additional resources needed to meet specified targets and policy goals (e.g., RPS, GHG reduction target, or a planning reserve margin) over a multi-year planning horizon.
- Scope of RESOLVE optimization in IRP 2017-18:
  - Optimizes across all LSEs in the CAISO balancing area
  - Does not optimize most demand-side resources, such as EE, EVs and BTM PV (but does include sensitivities that examine different levels of demand side resources)
  - Does not optimize loads and resources outside CAISO
  - Does not optimize "baseline resources," which are included in a model run as assumptions

# Using RESOLVE to Study EVs in IRP 2017-18

## Study Question

- To what extent does EV charging flexibility affect portfolio costs?

## Assumptions/Forecasts Used

- CEC 2016 IEPR Mid Demand forecast
- CARB's Proposed Scoping Plan scenario with 3.6M light-duty EVs by 2030 (excludes hydrogen fuel-cell vehicles)
- CARB's Proposed Alternative 1 scenario with 4M light-duty EVs by 2030 (excludes hydrogen fuel-cell vehicles)
- EV load profiles developed by E3 based on the 2009 National Household Transportation Survey
- Ranges of the fraction of vehicle charging that will be flexible by 2030

# Modeling EVs in Future IRP Cycles

- In the future, IRP staff expects to model DERs (including EE, EVs, BTM PV, etc.) as candidate resources that can be selected as part of the optimal solution
  - Could enable better comparison of the relative cost-effectiveness of different EV programs and incentives
  - Could inform a cross-sectoral analysis of GHG reduction solutions
  - Could inform a barriers assessment to EV deployment
- Research questions:
  - What is the cost to the electrical system of compensating for a lower level of GHG reduction from transportation electrification?
  - How might Energy Division forecast EV adoption attributable specifically to new utility programs?

# Contact Information

- IRP Analysts:
  - Forest Kaser, forest.kaser@cpuc.ca.gov
  - Jason Ortego, jason.ortego@cpuc.ca.gov
- Visit the IRP website for more information: http://www.cpuc.ca.gov/irp/

# Discussion of EV Adoption

1. What data should the utilities collect during program implementation to assess total or incremental vehicle adoption?
2. Are there reasonable methodologies, for certain utility proposals, to:
   a. Collect data to estimate actual EV adoption due to project implementation?
   b. Forecast incremental EV adoption attributable to proposed projects?

# Measuring GHG and Criteria Pollutant Emissions Reductions

# Spreadsheet Tool for Estimating Impacts of Light-Duty Plug-In Electric Vehicle Deployment

Gary Yowell and Dave Vidaver
Supply Analysis Office
Energy Assessments Division

CPUC Workshop
San Francisco, CA
July 11, 2017

# SB 350 and IRPs for Publicly-Owned Utilities

- Requires 16 POUs to file an IRP by April 30, 2019; Energy Commission to review "for consistency with Sect. 9621"
- IRP "must address procurement for transportation electrification"
- POUs have incentives to secure Energy Commission "approval" of impacts of investments in transportation electrification infrastructure.

# LD PEV Spreadsheet Tool

- Looks at the impact of LD PEV deployment on
  - Energy, GHG and criteria pollutant (NOx, $PM_{2.5}$) emissions from the transportation sector
  - Incremental electrical loads and associated emissions

- Does not look at relationship between investment $, infrastructure development, and LD PEV deployment.

- POUs develop assumptions regarding the $CO_{2e}$ and criteria pollutant emissions intensity of incremental generation.

# GHG Emissions Savings on Transportation Side

- LD PEV fleet composition (3 vehicle types)
  - Long range battery electric vehicle (BEV-greater than 150 mi range)
  - Short range BEV (less than 150-mi range)
  - Plug-in hybrid vehicle
- Operating/performance characteristics of LD PEVs
  - VMT/yr (reduces as PEV ages)
  - Share of VMT on electricity (Plug-in Hybrid Vehicle)
  - Energy efficiency kWh/mile traveled
  - Vehicle survivability - share of PEVs sold in year t still on road in year t+x
- Characteristics of the baseline gasoline car/gasoline
  - MPG (increases over time for new vehicles) [EPA regulation driven]
  - $CO_{2e}$ of gasoline (declines over time) [ARB LCFS]

# Incremental Electrical Load

- Once LD PEV electricity consumption is estimated, POU estimates GHG emissions from generation based on
  - Share of consumption met with distributed generation
  - Transmission and distribution losses for utility-provided energy
  - $CO_2$ emissions intensity of utility-provided energy 2017-2030

# Criteria Pollutant Emissions

- IRP must "[H]minimize localized air pollutants and other greenhouse gas emissions, with early priority on disadvantaged communities identified pursuant to Section 39711 of the Health and Safety Code."
  - Tool includes $PM_{2.5}$ and $NO_x$ emission rates for cars using ARB Vision (2017-2030) values
  - Utilities provide $PM_{2.5}$ and $NO_x$ emissions intensities, distributed generation %, and T&D losses
  - Not equipped to specifically address disadvantaged community issue

# Heavy Duty Energy and Emissions (HD) Calculator

- Introducing new precise laboratory diesel and PEV energy rates for efficiency comparisons (Diesel vs EV energy data first available May 2015).
- Evaluates - 6-fuels and technologies
- Captures PEVs annual mileage differences
- Estimates;
  - Criteria Pollutants (HC, CO, $NO_x$, $PM_{10}$), and $CO_{2e}$
  - Well-to-Wheel (WTW) energy use,
  - PEV energy use and EER from the diesel counterpart
  - Petroleum gallons used and reduced by PEVs
  - Annual fuel expense for electric, diesel and NGVs (optional)

# Inputs for the HD Calculator

- Fuel /Technology Choices:
  - (electric, diesel, NGV, diesel-hybrid, renewable diesel or bio-NG)
- Number of vehicles
- Diesel or NGV mpg / vehicle miles traveled-
  - EV efficiency is estimated from diesel's mpg
- Electricity emission intensity, utility defined, zero, Greet 2.0 estimates
- Localized air pollution levels, (zero, low, mid, highest pollution)
- Localized vehicle activity (city-congested / urban / non-congested highway)
- Compare PEV $NO_x$ reduction with 2015 model-year diesel $NO_x$ emission levels (5-levels)

# Discussion on Measuring GHG and Criteria Pollutant Emissions Reductions

1. What type of data must IOUs collect to enable future forecasting of emissions reductions?
2. Is it possible to attribute emissions reductions to specific projects?
3. State-wide or service-territory based measurement?
4. Is CEC's Spreadsheet Tool a reasonable way to estimate emissions benefits from IOU projects?
   a. Should the IOUs use this tool now, to forecast emissions reductions, or once the projects have been completed to estimate project impacts?
   b. Does the tool use reasonable data and inputs?

# Next Steps

# Timeline for Standard Review Proposals in Scoping Memo

| Item | Date |
|---|---|
| Opening testimony on fast charging infrastructure due | July 25, 2017 |
| Opening testimony on MD/HD charging infrastructure and commercial EV rates due | August 1, 2017 |
| Opening testimony on residential charging infrastructure and residential EV rate due | August 7, 2017 |
| Concurrent rebuttal testimony due | September 5, 2017 |
| Hearings (as needed) at 10am each weekday (with the exception of October 5) | September 25 - October 13, 2017 |
| Concurrent opening briefs due (to be determined) | Est. November 13, 2017 |

# Questions?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**www.cpuc.ca.gov/sb350te/**

# Appendix

# The Interest of Ratepayers is Defined as:

Direct benefits that are specific to ratepayers, consistent with both of the following:

- Safer, more reliable, or less costly gas or electrical service, consistent with Section 451, including electrical service that is safer, more reliable, or less costly due to either improved use of the electric system or improved integration of renewable energy generation.
- Any one of the following:
  - Improvement in energy efficiency of travel.
  - Reduction of health and environmental impacts from air pollution.
  - Reduction of greenhouse gas emissions related to electricity and natural gas production and use.
  - Increased use of alternative fuels.
  - Creating high-quality jobs or other economic benefits, including in disadvantaged communities identified pursuant to Section 39711 of the Health and Safety Code.

California Public Utilities Code Section 740.8.

# SCE's Current and Proposed Commercial EV-Rate TOU Periods

## TOU-EV-3 & TOU-EV-4 (Approved)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weekday | *Hour Beginning* | | | | | | | | | | | | | | | | | | | | | | | | |
| | Winter / Summer | **Off-Peak** | | | | | | | **Mid-Peak** | | | | **On-Peak** | | | | | | **Mid-Peak** | | | | | **Off-Peak** | |
| Weekend | *Hour Beginning* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | Winter / Summer | **Off-Peak** | | | | | | | | | | | | | | | | | | | | | | | |

## TOU-EV-6 (Approved)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weekday | *Hour Beginning* | | | | | | | | | | | | | | | | | | | | | | | | |
| | Winter / Summer | **Super-Off-Peak** | | | | | | | **Off-Peak** | | | | | | **On-Peak** | | | | | | **Off-Peak** | | **Super-Off-Peak** | | |
| Weekend | *Hour Beginning* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | Winter / Summer | **Off-Peak** | | | | | | | | | | | | | | | | | | | | | | | |

## TOU-EV-7, TOU-EV-8, & TOU-EV-9 (Proposed A.17-01-021)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weekday | *Hour Beginning* | | | | | | | | | | | | | | | | | | | | | | | | |
| | Winter | **Off-Peak** | | | | | | | **Super-Off-Peak** | | | | | | | | **Mid-Peak** | | | | | **Off-Peak** | | | |
| | Summer | **Off-Peak** | | | | | | | | | | | | | | | **On-Peak** | | | | | | | | |
| Weekend | *Hour Beginning* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | Winter | **Off-Peak** | | | | | | | **Super-Off-Peak** | | | | | | | | **Off-Peak** | | | | | **Off-Peak** | | | |
| | Summer | **Off-Peak** | | | | | | | | | | | | | | | **Mid-Peak** | | | | | | | | |