Stakeholder Workshop

New Construction Building Electrification and Electric Vehicle Reach Codes

Farhad Farahmand, TRC
Craig Johnson, Building Official

February 3rd, 2020

Today's Objectives

- Share information electrification reach codes
- Hear your thoughts and ideas
- Gather feedback to frame reach code options for adoption

Questions welcome throughout

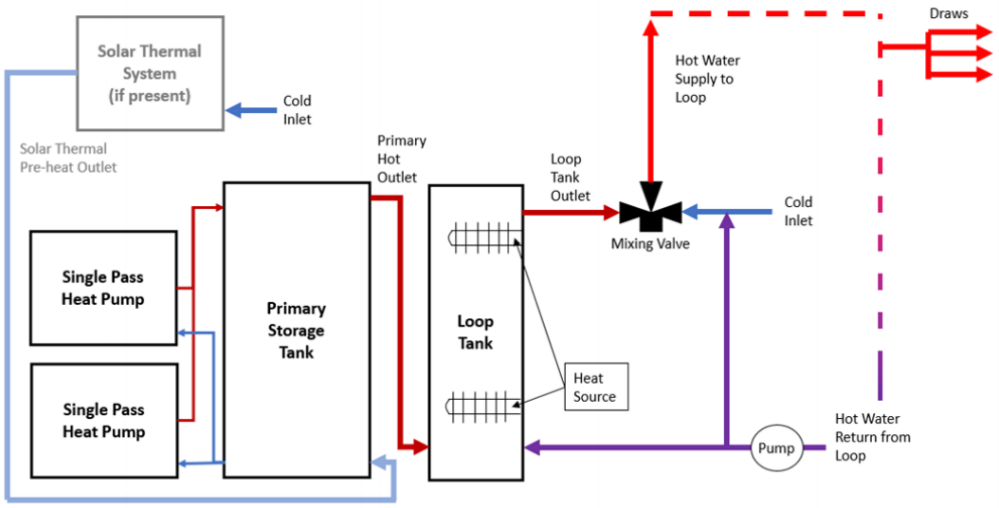
Please introduce yourself

Name, Affiliation, Role / Expertise

Key Feedback Received to Date (1 of 2)

1. 100% of spaces being EV-Ready is too many
2. Underground transformers are not an option
3. Address specific regions with grid constraints appropriately
4. Planning Division, Building Division, and SVP coordination
    a. Monthly Planning Project Clearance Committee meetings

Key Feedback Received to Date (2 of 2)



Danny Tam, CEC, Jan 17, 2020

5. Exemptions
   a. Entitled projects (already included)
   b. Central water heaters (considering)
   c. Commercial kitchens (considering)
6. 50% of solar PV roof coverage likely to affect other building design elements

What are Reach Codes?

- Local enhancements to state code
- May be adopted after rest of state building code (Jan 1, 2020)
- Address:
  - Buildings - electrification
  - Transportation - electric vehicle (EV) charging infrastructure
- Improve economic and environmental performance for NEW construction

Electrification, Compared to Fossil Fuels

- **Emissions reductions** and decarbonization
  - CA Executive Order B-55-18 for Carbon Neutrality by 2045
  - Electricity grid getting cleaner every day with increased renewable generation
- **Cost savings**
  - Lower first costs by not constructing natural gas infrastructure
  - Operational costs (dependent on many factors)
- **Lower-risk** pathway according to California Energy Commission
- **Healthier** indoor air from eliminating indoor combustion

California Gov. Jerry Brown casually unveils history's most ambitious climate target

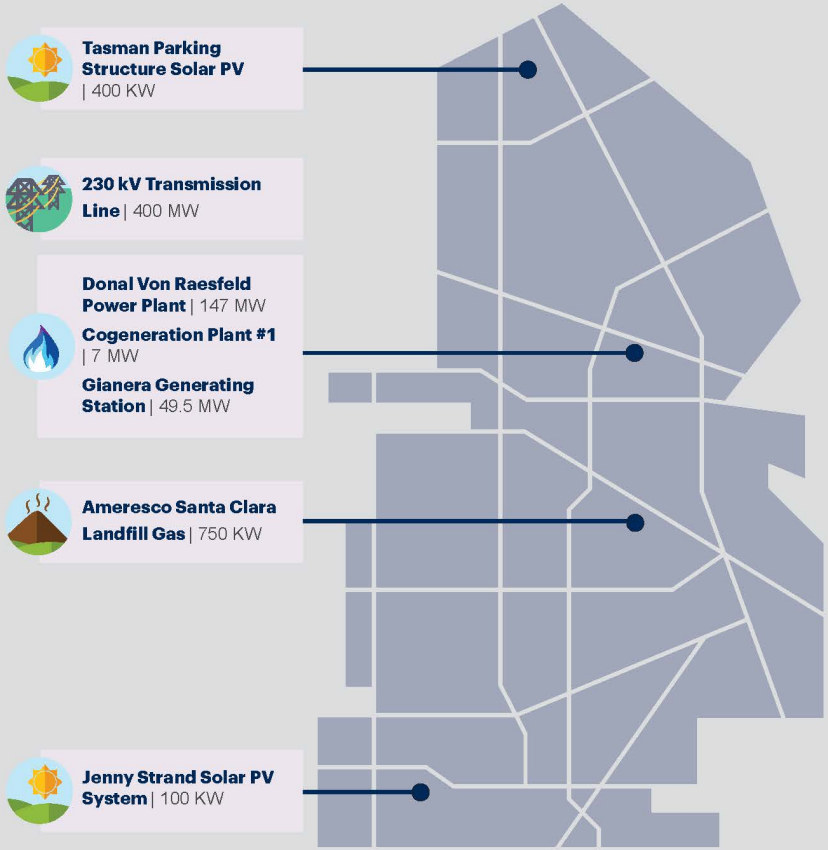
Full carbon neutrality is now on the table for the world's fifth largest economy.

By David Roberts | @drvox | david@vox.com | Updated Sep 12, 2018, 10:57am EDT

SHARE

California Gov. Jerry Brown is going out with a bang. | Alex Wong/Getty Images

Silicon Valley Power Resource Map



Out-of-Town Electric Resources

Solar
60 MW

Wind
421.5 MW

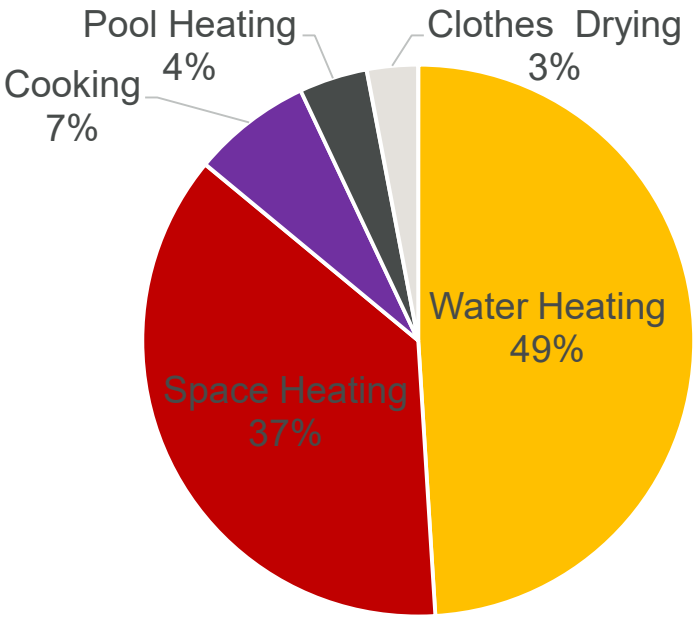
Hydroelectric
416.7 MW

Landfill
10.5 MW

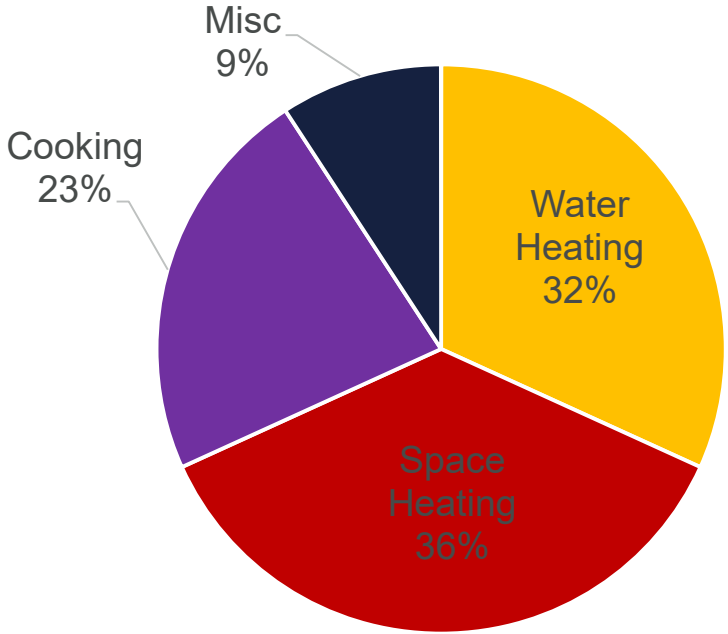
Geothermal
52 MW

CITY OF SANTA CLARA
SILICON VALLEY POWER
CITY OF SANTA CLARA

Thermal Energy Use in CA



Residential



Non-Residential

2009 Residential Appliance Saturation Survey
2006 California Commercial End Use Survey

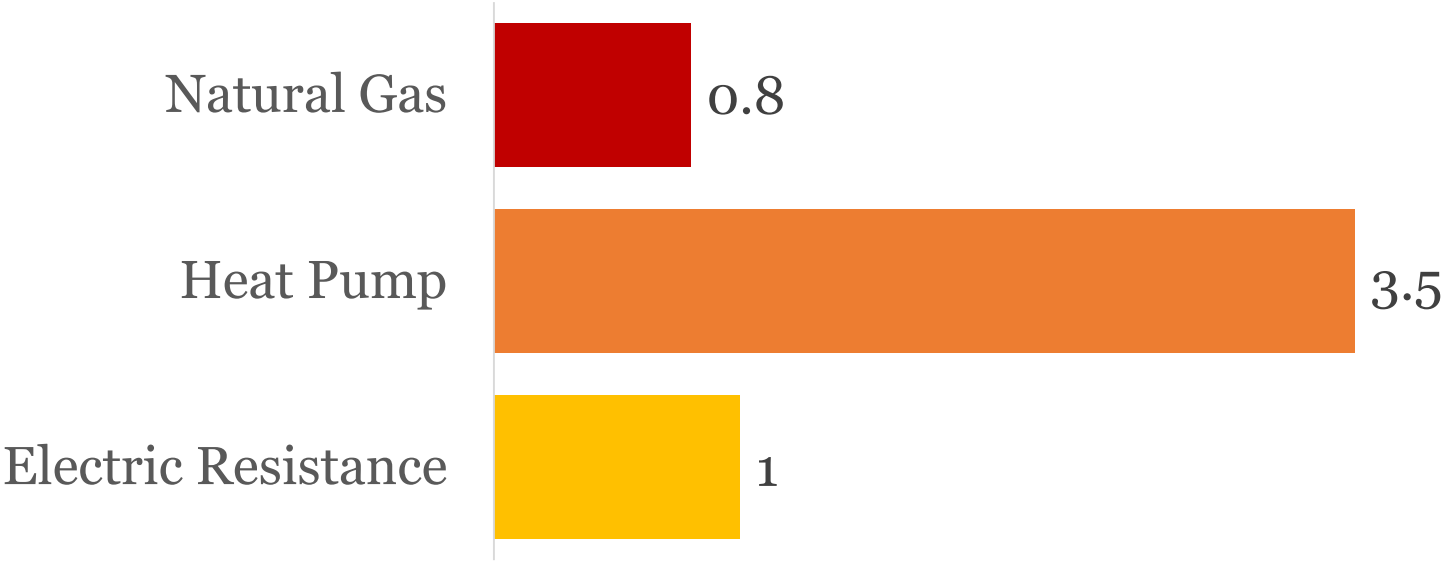
All Electric Building Measures

Residential

Commercial

Space Heating | Water Heating | Cooking | Clothes Drying

Comparison of Typical Energy Factors



Electric Vehicle Code Options

Speed

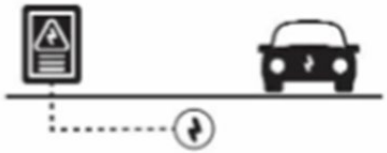
Level 1
"Trickle Charging"

Level 2
"Standard Charging"

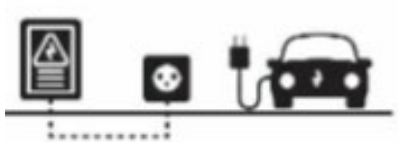
Level 3
"DC Fast / SuperCharging"

Readiness

EV **Capable**



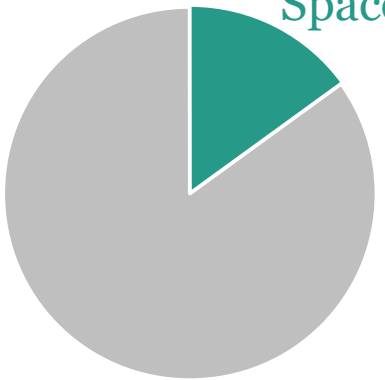
EV **Ready**



EV **Installed**

Number

Percent of Parking Spaces

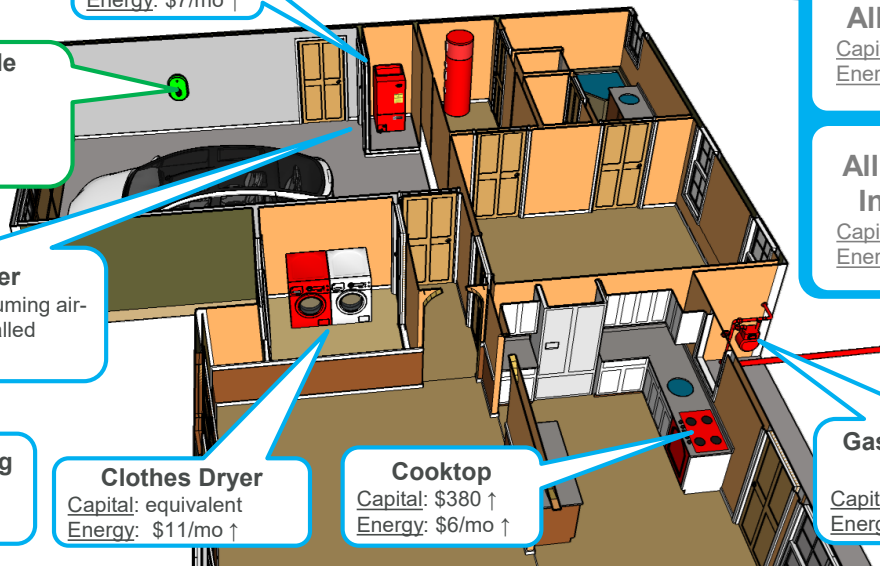


Cost/Benefit Analysis

- Required for local energy ordinance application and CEC approval
- Cost-effective packages determined
  - Building fuels (mixed fuel or all-electric)
  - Building types
    - Residential (single family and low-rise multifamily)
    - Nonresidential (office, retail, and hotel)
  - Measures (e.g., efficiency, solar PV)

Electrifying New Single Family Homes in the Bay Area – The Cost Story

SILICON VALLEY POWER
CITY OF SANTA CLARA



Water Heater
Capital: $510 ↓
Energy: $7/mo ↑

Electric Vehicle Charger
Capital: Same cost, including incentives
On-going: $138/mo ↓

Space Heater
Capital: $2000 ↓, assuming air-conditioning also installed
Energy: $10/mo ↓

Indoor Gas Piping Not Needed
Capital: $2,450 ↓

Clothes Dryer
Capital: equivalent
Energy: $11/mo ↑

Cooktop
Capital: $380 ↑
Energy: $6/mo ↑

Gas Meter & Service Not Needed
Capital: $6,000 ↓
Energy: $7/mo ↓

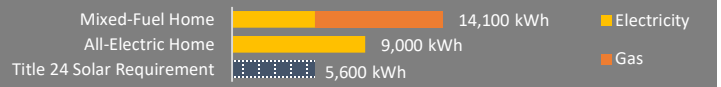
Summary

All-Electric Home
Capital: $10,580 ↓
Energy: $7/mo ↑

All-Electric Home, Increased Solar
Capital: Equivalent
Energy: $5/mo ↓

Capital Cost of Thermal Systems

Annual Energy Use & Generation



$191 Net Lifecycle Cost Savings per year for an all-electric home versus the mixed-fuel equivalent

3 MT CO2e Carbon Emissions Savings per home, per year based on 2030 grid mix

Capital and energy costs of thermal systems are based on Residential Building Electrification in California by E3 (April 2019); electricity costs specific to PCE/SVCE territory. SVP electricity rates are lower and would result in greater savings. All-Electric Home, Increased Solar bill impacts are based on Low-Rise Residential New Construction 2019 Cost Effectiveness Study by Frontier Energy (August 2019). 10/21/2019 Version

Summary

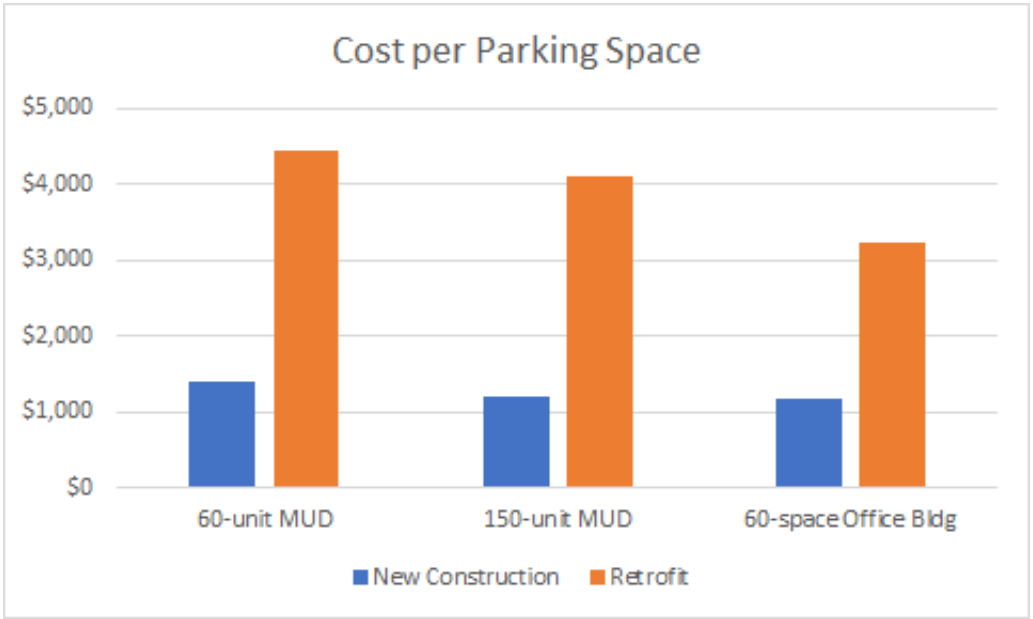
All-Electric Home

Construction: $10,580 ↓
Monthly: $7/mo ↑

All-Electric Home, Increased Solar

Construction: Equivalent
Monthly: $5/mo ↓

Why Adopt EV Measures?

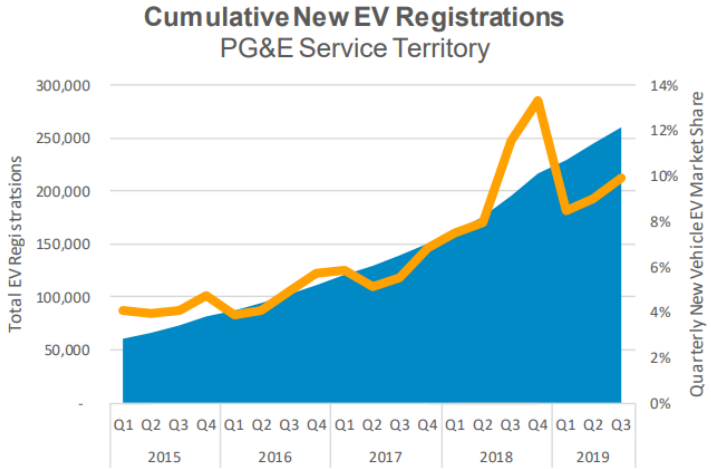


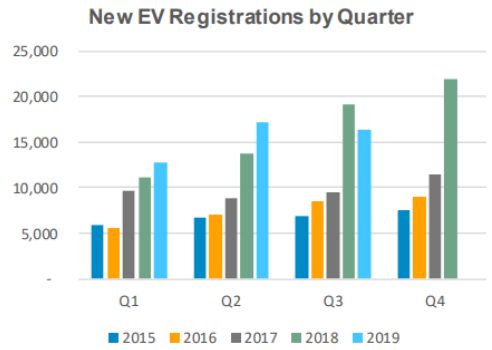
- Represent costs compared to CALGreen Mandatory for 25% Level 2 and 75% Level 1
- Costs include wiring, switch gear, conduit, trenching, and secondary transformer
- PG&E 'cost-per-port' is $18,000 for retrofits

Electric Vehicle Infrastructure Cost Analysis Report for PCE and SVCE
Pacific Gas and Electric Company EV Charge Network Quarterly Report, Q1 2019

Why Adopt EV Measures?

270,557 **EVs registered** in PG&E service territory, through November of 2019





EPRI, based on external registration data through Nov 2019

Expressed Concerns (1 of 2)

Concern	Response
Distribution grid upgrades are expensive	**Sometimes true**. Costs may be offset from the savings of all-electric construction.
Resilience, power-shutoffs	**Real problem, but gas does not help**. Gas appliance ignition is electric. State policy for grid hardening is key.
Uniformity of requirements	**Fair concern, but all-electric is simpler & not adopting ensures future risk**. Regional partners are encouraging consistency. All-electric is simple and inaction locks in future cost (retrofits, rates) and risk (fire).
Central heat pump water heating requires more design expertise and space than gas boilers.	**True, training needed**. There are scores of working systems, but best practice is still under development. We recommend exempting projects with significant space concerns (i.e., entitled projects).

Expressed Concerns (2 of 2)

Concern	Response
Electric heating uses too much energy	**False. Electric heat pumps are highly efficient and effective** in weather far colder than ours. DOE studies show heat pump space heaters as highly efficient at as little as 5 degrees Fahrenheit.
Energy is not clean	**False**. SVP residential service is 100% GHG free today.
Equipment is not available	**Mostly false**. Some scenarios for high-volume or steam applications are more challenging to address with electric heating. Heat pumps and induction stoves have a long-established history but market awareness needs to grow.

What about your concerns or hopes for the future construction?

What benefits or challenges would you anticipate?

Discussion Questions

Building Electrification Code Context

- **Title 24 Building Standards** for energy, electrical, plumbing, etc…
  - **Part 6:** Building Energy Efficiency Standards (Energy Code)
  - **Part 11:** CALGreen Green Building Standards
  - Updated every 3 years, last update January 1, 2020
- **Planning and Zoning Code,** governing area of building, height, appearance, etc…
- Several other pathways, including **Health and Safety Code, GHG mitigation fees/limits, CEQA mitigation**

Building Options for New Construction

Reach Code Type	How it Works
Natural Gas Ban*	No gas hookup allowed (via Land Use Code)
All-Electric Required*	Appliances must be electric (via Energy Code)
All-Electric Preferred	Allows mixed-fuel buildings with high energy performance: • additional energy efficiency measures • battery storage • electric-ready (pre-wiring)

* Exceptions where necessary

EV Model Code for New Construction

Code Element	Approach - "Plug and play" access to vehicle charging
Single Family	• Level 2 + Level 1 "EV Ready"

Multifamily	• Multi-unit dwellings: one "EV Ready" space per unit
	  • 25% Level 2 + 75% Level 1
	  • Allows for load-sharing to mitigate electrical infrastructure impacts

Nonresidential	• Office:
	  • 10% Level 2 "EV Installed"
	  • 10% Level 1 "EV Ready"
	  • 30% "EV Capable"
	• Other Non-Res
	  • 6% Level 2 "EV Installed"
	  • 5% Level 1 "EV Ready"
	  • DC Fast Charge option

City		Status	Reach Code Type				
			No Reach	Electric-Preferred	All-Electric	Natural Gas Ban	EV Code
Santa Clara County	Campbell	Evaluating		X			
	Cupertino	Approved			X		
	Gilroy	Decision	X				
	Los Altos Hills	Evaluating			X		
	Los Gatos	Evaluating		X			
	Milpitas	Approved		X			
	Morgan Hill	Approved				X	
	Mountain View	Approved				X	X
	Saratoga	Approved			X		
	Sunnyvale	Evaluating				X	
	County of Santa Clara	Evaluating		X			
San Mateo County	Burlingame	Evaluating			X		X
	Menlo Park	Approved			X		X
	Redwood City	Evaluating			X		X
	San Mateo	Approved		X			X
	County of San Mateo	Evaluating			X		X
Neighbors	Berkeley	Approved		X		X	X
	Fremont	Evaluating		X			X
	Marin County	Approved		X			X
	Palo Alto	Approved		X (NonRes)	X (Res)		X
	San Jose	Approved		X (NonRes)		X (Res)	X

Exceptions		All-Electric or Limited Gas Ordinances									
		Berkeley	Brisbane	Cupertino	Menlo Park	Mountain View	Morgan Hill	Pacifica	Palo Alto	San Jose	Saratoga
Low-Rise Res	Cooking										
	Clothes Drying, Pools, Spas										
	Fireplaces										
	ADUs									attached only	
High-Rise Res	Cooking										
	Fireplaces										
Non-Residential	Cooking		With BO approval		With BO approval	With BO approval		With BO approval			
	Factories										
	Hazardous										
	Laboratory/Science Buildings				With 3rd party verification						
	Public agency owned and operated Emergency Centers			"Essential facilities" as defined in CBC	With 3rd party verification .						With 3rd party verification .
Other	Cost considerations/financial hardship										
	Not physically/code feasible										
	Public interest exemption										

Nonresidential Solar PV Ordinance Alternatives

1. Require 3-5 kW system, depending on building size

2. Require solar-ready zone to have PV installed

3. Require solar PV on 50 percent of roof area

Exceptions for over-generation, shading, or vegetative roofs

What types of ordinances are most appropriate for Santa Clara?

What types of exceptions are most appropriate?

Discussion Questions

Summary of Benefits

- Major economic value for residents
- Safer and healthier homes (reduce burn risks, respiratory issues)
- Advance climate goals
- Enable much greater EV adoption
- Fiscal prudence – more cost effective to address at new construction

Current effort applies only to NEW construction

Contact

Craig Johnson
Building Official, Community Development
CJohnson@santaclaraca.gov
(408) 615-2401

Shelton Honda
Business Analyst, Silicon Valley Power
SHonda@svpower.com
(408) 615-6640

Farhad Farahmand
TRC Companies
FFarahmand@trccompanies.com
(510) 473-8421

Questions and Discussion

Backup Slides

Electric Vehicle - ALMS

- **Automatic Load Management Systems (ALMS):** A control system which allows multiple EV chargers or dedicated EV circuits to share a circuit or panel and automatically reduce power at each charger, providing the opportunity to reduce electrical infrastructure costs and/or provide demand response capability. ALMS is only allowed for Level 2 EVCS, Level 2 EV Ready, and Level 1 EV Ready Circuits. ALMS systems must be designed to deliver at least 1.4kW to each EV Capable, EV Ready, or EVCS space. The connected amperage on-site shall not be lower than the required connected amperage per Part 11, 2019 California Green Building Code for the relevant building types.

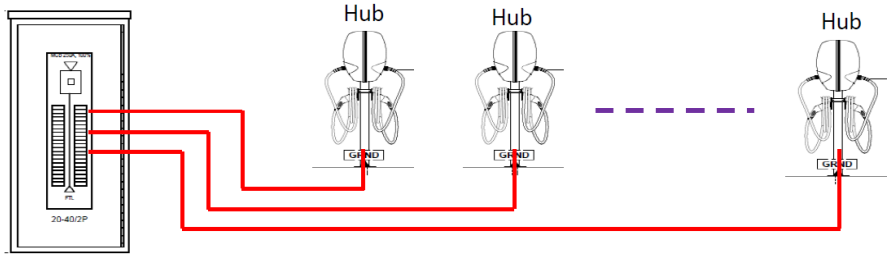
- **For Multifamily Buildings:** ALMS may be installed to decrease electrical service and transformer costs associated with EV Charging Equipment subject to review of the authority having jurisdiction.

Electric Vehicle - ALMS

Panel Level Load Management

All vehicles charging share equal power based on their maximum charge rate.

Pedestal Level Load Management



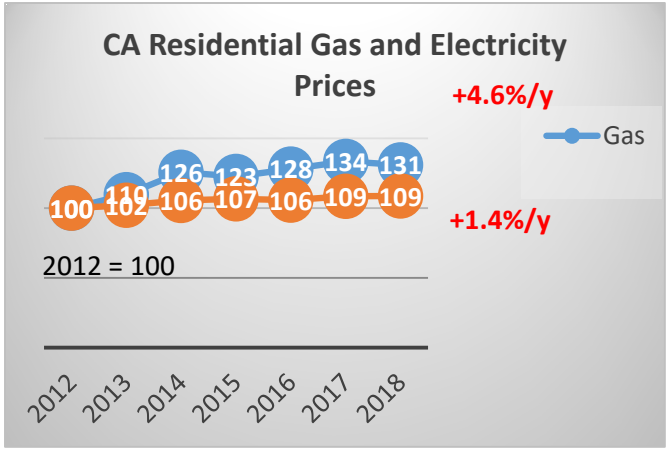
Share 6.7 kW (or 32A) of power between the 2 chargers at the same pedestal

- Use a single 40A branch circuit for each dual port charger location
- Pull only one set of (2) #6 and (1) #8 AWG THWN-2 CU from breaker panel to each of the dual charger location
- Use POWER LIMIT feature to limit the power draw to 6.7 kW (or 32 amps) for the 2 chargers on the same pedestal

Primary Sources: ChargePoint and EV Box

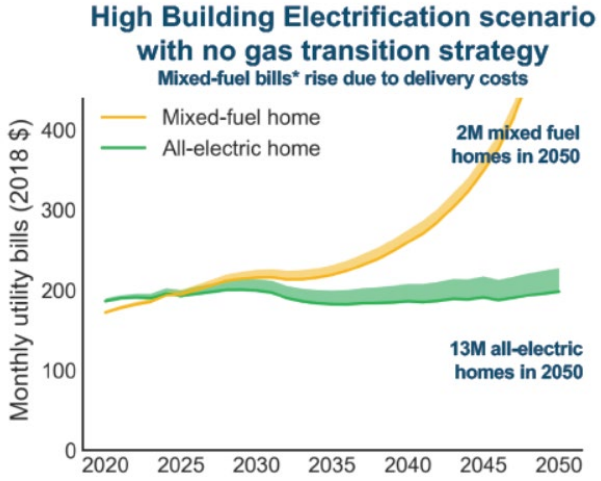
Natural Gas Costs Climbing

CA residential natural gas prices increased 3x faster than electricity prices from 2012 to 2018



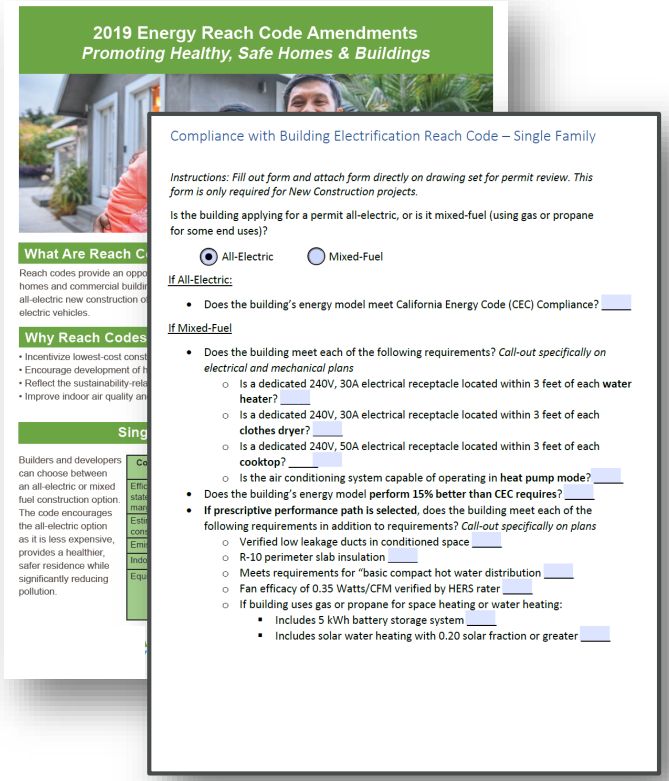
Source: EIA
https://www.eia.gov/dnav/ng/hist/n3010ca3m.htm
https://www.eia.gov/electricity/data/browser/#/topic/7?agg=2,0,1&geo=g&freq=M

Trend expected to accelerate:



CEC Workshop June 6, 2019: Draft Results from E3 study on the Future of Natural Gas Distribution in California

Resources for Implementation



Adoption Resources

- Ordinance Language
- Staff Report & Slides
- Homeowner Flyer
- FAQs
- Cost Effectiveness Infographic

Permitting, enforcement, and inspection resources

- Permit Checklist
- Inspection Checklist
- Training for Building Department Staff
- FAQs

Example Cost Breakdown – Water Heater

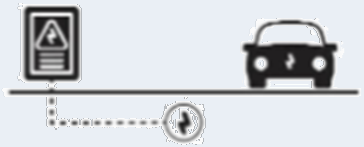
Single Family New Construction Gas Option Zone 4				
Installation				
Water Heater				
New water heater, equipment price	1	EA	1,200.00	1,200
190 kBtu/h, 0.81 UEF (0.82 EF) gas tankless in garage				
Miscellaneous supplies	1	LS	50.00	50
Labor	12	HR	95.00	1,140
Piping				
Materials				
Connection/modification of hot water piping, including valves	1	LS	400.00	400
Modification to gas piping	1	LS	200.00	200
Labor	2	HR	95.00	190
Gas and Electrical Supply				
New electrical circuits to equipment	1	EA	75.00	75
Panel and main service modification			*Not required*	
Gas supply piping	20	LF	3.00	60
Labor	16	HR	95.00	1,520
	55		2,213	4,835
Subtotal				4,835
General Conditions, Overhead and Profit	11.00%			532
Design and Engineering	4.00%			215
Permit, testing and inspection	1.25%			70
Contractor Profit/Market Factor				
Recommended Budget				5,652

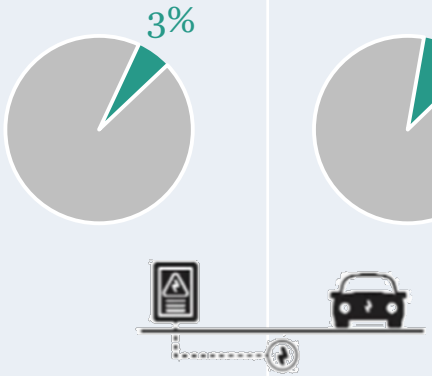
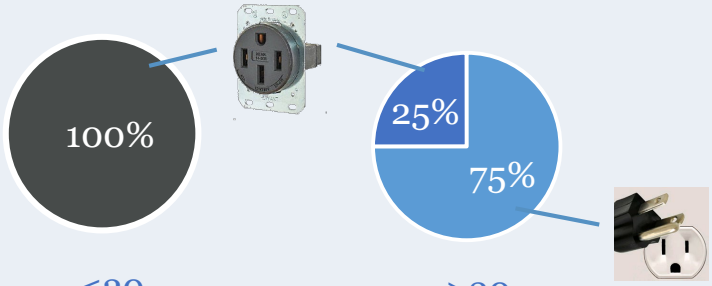
Single Family New Construction Electric Option Zone 4				
Installation				
Water Heater				
New water heater, equipment price	1	EA	1,500.00	1,500
80gal heat pump water heater in garage 3.0 UEF, NEEA Tier 3				
Miscellaneous supplies	1	LS	50.00	50
Labor	6	HR	95.00	570
Piping				
Materials				
Connection/modification of hot water piping, including valves	1	LS	400.00	400
Condensate piping	1	LS	100.00	100
Labor	2	HR	95.00	190
Gas and Electrical Supply				
New electrical circuits to equipment	1	EA	125.00	125
Panel and main service modification				*Not required*
Gas supply piping				*Not required*
Labor	8	HR	95.00	760
	21		2,460	3,695
Subtotal				3,695
General Conditions, Overhead and Profit	11.00%			406
Design and Engineering	4.00%			164
Permit, testing and inspection	1.25%			53
Contractor Profit/Market Factor				
Recommended Budget				4,318

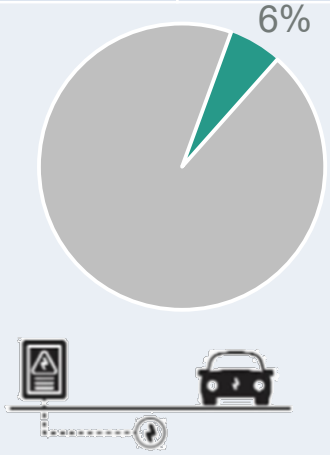
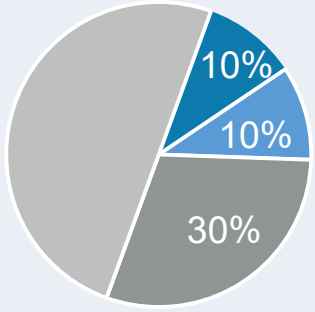
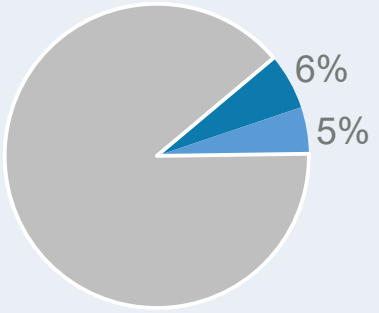
Fire and Health

- **Ignition Source**: Natural gas is a significant fire ignition source
  - Pipeline fires: San Bruno, San Francisco
  - Half of earthquake fires
- **Safer Equipment**: Induction ranges automatically turn off, eliminating a leading cause of house fires
- **Faster Recovery**: Electrical distribution recovery is repaired faster than natural gas
- **Health**: Gas stoves in homes increase children's asthma risk by 42%

EV Model Code vs CALGreen

	2016 CALGreen	2019 CALGreen	PCE/SVCE Proposed
	Mandatory	Mandatory	
Single Family Two-Family Townhome	(1) Level 2 EV Capable for one parking space per dwelling unit 		2 EV spaces total: • 1 Level 2 EV Ready circuit • 1 Level 1 EV Ready circuit 

	2016 CALGreen	2019 CALGreen	PCE/SVCE Proposed
	Mandatory	Mandatory	
Multi-Family			 ≤20 dwelling units >20 dwelling units
	3% Level 2 EV Capable for buildings with ≥17 units	**10%** Level 2 EV Capable	≤20 units: One Level 2 EV Ready **per dwelling** >20 units: Of all dwelling units, • **25%** Level 2 EV Ready (10% in affordable housing) • **75%** are Level 1 EV Ready (90% in affordable housing) *Allow load-sharing*

	2016 CALGreen	2019 CALGreen	PCE/SVCE Proposed	
	Mandatory	Mandatory		
Non-Residential	 **~6%** Level 2 EV Capable (for buildings with at least 10 parking spaces)		 Office building: • **10%** Level 2 EVSE • **10%** Level 1 EV Ready • **30%** EV Capable or EV Ready	 Commercial: Of all parking spaces, • **6%** Level 2 EVSE • **5%** Level 1 EV Ready • Over 100 spaces: option for 80kW DC Fast Charger per 100 spaces

Consumer Reports Prefers Induction

Top 9 Ranges for 2018 were electric

Fuel	Model	Rating	Cost
Induction	Kenmore Elite 95073	89	$1,530
Induction	Kenmore 95103	88	$1,000
Electric Smoothtop	Samsung NE58F9710WS	85	$1,800
Induction	GE Profile PHS930SLSS	83	$2,430
Electric Smoothtop	Samsung NE59J7850WS	82	$1,300
Electric Smoothtop	Samsung NE59J7750WS	82	$1,600
Induction	LG LSE4617ST	82	$3,330
Induction	Frigidaire Gallery FGIF3036TF	82	$990
Gas	LG Signature LUTD4919SN	81	$3,000