CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2019 Nonresidential New Construction

Cost Effectiveness Study
DRAFT Results

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Farhad Farahmand

TRC Advanced Energy

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Pacific Gas and Electric Company
SDGE A Sempra Energy utility
SoCalGas A Sempra Energy utility
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Nonresidential Methodology

- Measure definition and research
  - Efficiency packages
  - Solar PV + battery
  - All-electric space and water heating, including utility infrastructure
  - Costs from local contractors

- Ran building simulations
  - EnergySoft collaboration, developers of EnergyPro
  - Engine based on CBECC-Com 2019 0.4 (January)
  - GHG emissions factors built-in

- Cost effectiveness metrics
  - Time Dependent Valuation (TDV) per CEC methodology
  - On-bill with Time of Use Rates

Efficiency Measure Packages

Package		Fuel Type		Energy Efficiency Measures	Solar PV & Battery	High Efficiency Appliances
		Mixed Fuel	All-Electric			
Mixed-Fuel Code Minimum (Baseline for all other packages)		X				
Mixed-Fuel	**+ EE**	X		X		
	+ EE + PV	X		X	X	
	+ HE	X				X
All-Electric	**Fed Code Min**		X			
	+ EE		X	X		
	+ EE + PV		X	X	X	
	+ HE		X			X

EE = Energy Efficiency
PV = Solar PV + Battery
HE = High Efficiency / Preemptive

Nonresidential Building Prototypes

		Medium Office	Medium Retail	Small Hotel
Conditioned Floor Area (ft)		53,628	24,691	42,552
Num. of Stories		3	1	4
Num. of Guest Rooms		0	0	78
HVAC System	**ACM Baseline**	Packaged DX + VAV with HW reheat. Central **gas** boilers.	Single zone packaged DX with **gas** furnaces	NonRes: Packaged DX + VAV with HW reheat. Central **gas** boilers. Res: Single zone DX AC unit with **gas** furnaces
	Proposed All-Electric	Packaged DX + VAV with electric **resistance** reheat.	Single zone packaged **heat pumps**	NonRes: Packaged DX + VAV with electric **resistance** reheat Res: Single zone **heat pumps**
DHW System	**ACM Baseline**	Electric **resistance** with storage	Electric **resistance** with storage	NonRes: **Electric** resistance storage Res: Central **gas** storage with recirculation
	Proposed All-Electric	Electric **resistance** with storage	Electric **resistance** with storage	NonRes: Electric **resistance** storage Res: Individual **heat pumps**

Measure Descriptions and Applications to Each Prototype

Package	Measure	Office	Retail	Hotel
EE	**ENVELOPE**			
	Lower SHGC Fenestration	X	X	
	Fenestration as a Function of Orientation	X		
	DHW/HVAC			
	Drain Water Heat Recovery			X
	VAV Box Minimum Flow	X		X
	Economizers on Small Capacity Systems		X	
	LIGHTING			
	Interior Lighting Reduced LPD	X	X	X
	Institutional Tuning	X	X	X
	Daylight Dimming Plus Off	X		
	Occupant Sensing in Open Plan Offices	X		
PV	Solar PV	135 kW	80 kW	90 kW
	50 kWh Battery	X	X	X
HE	Preemptive efficiencies	X	X	X

Key Considerations While Viewing Results

- Local reach codes must both
  - Have >0% compliance margin
  - Be cost effective

- Solar PV or batteries do not earn compliance credit

- Standard Design HVAC or DHW remain mixed-fuel even when Proposed Design is electric

- Findings are specific to the scenarios analyzed under this methodology and assumptions.

- HE runs for CZs other than CZs 2, 3, 4, 12 will be included in final report

MEDIUM OFFICE – Compliance Margins & Cost Effectiveness

CZ	Utility	Mixed Fuel Compliance Margin			All Electric Compliance Margin			
		EE	EE + PV	HE	Fed Code	EE	EE + PV	HE
CZ1	PG&E	17%	17%		-18%	5%	5%	
CZ2	PG&E	17%	17%	4%	-8%	10%	10%	-5%
CZ3	PG&E	20%	20%	3%	-9%	15%	15%	-8%
CZ4	PG&E	14%	14%	5%	-6%	9%	9%	-3%
CZ5	PG&E	18%	18%		-9%	11%	11%	
CZ6	SCE/SCG	20%	20%		-5%	18%	18%	
CZ7	SDG&E	20%	20%		-2%	20%	20%	
CZ8	SCE/SCG	18%	18%		-2%	18%	18%	
CZ9	SCE/SCG	16%	16%		-2%	14%	14%	
CZ10	SCE/SCG	17%	17%		-4%	13%	13%	
CZ10-2	SDG&E	17%	17%		-4%	13%	13%	
CZ11	PG&E	13%	13%		-5%	9%	9%	
CZ12	PG&E	14%	14%	5%	-5%	9%	9%	-2%
CZ13	PG&E	13%	13%		-5%	9%	9%	
CZ14	SCE/SCG	18%	18%		0%	14%	14%	
CZ14-2	SDG&E	13%	13%		-5%	9%	9%	
CZ15	SCE/SCG	12%	12%		-2%	11%	11%	
CZ16	PG&E	14%	14%		-27%	-13%	-13%	
Avg GHG Savings		**16%**	**44%**	**5%**	**2%**	**18%**	**47%**	**4%**

LEGEND

>0% Compliance

and both

TDV Cost Effective
and
On-Bill Cost Effective

>0% Compliance

and either

TDV Cost Effective
or
On-Bill Cost Effective

<0% Compliance

or

not cost effective

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MEDIUM RETAIL – Compliance Margins & Cost Effectiveness

CZ	Utility	Mixed Fuel Compliance Margin			All Electric Compliance Margin			
		EE	EE + PV	HE	Fed Code	EE	EE + PV	HE
CZ1	PG&E	18%	18%		-4.1%	15%	15%	
CZ2	PG&E	14%	14%	3%	-1.1%	15%	15%	2%
CZ3	PG&E	16%	16%	2%	-0.4%	16%	16%	2%
CZ4	PG&E	15%	15%	3%	-0.1%	15%	15%	3%
CZ5	PG&E	16%	16%		-1.2%	15%	15%	
CZ6	SCE/SCG	10%	10%		0.5%	11%	11%	
CZ7	SDG&E	13%	13%		0.3%	13%	13%	
CZ8	SCE/SCG	10%	10%		0.4%	10%	10%	
CZ9	SCE/SCG	9%	9%		0.4%	10%	10%	
CZ10	SCE/SCG	12%	12%		0.1%	12%	12%	
CZ10-2	SDG&E	12%	12%		0.1%	12%	12%	
CZ11	PG&E	13%	13%		0.5%	12%	12%	
CZ12	PG&E	13%	13%	4%	-0.1%	13%	13%	4%
CZ13	PG&E	12%	12%		-0.4%	12%	12%	
CZ14	SCE/SCG	12%	12%		0.5%	12%	12%	
CZ14-2	SDG&E	12%	12%		0.5%	12%	12%	
CZ15	SCE/SCG	11%	11%		0.9%	10%	10%	
CZ16	PG&E	13%	13%		-12%	3%	3%	
Avg GHG Savings		**11%**	**68%**	**2%**	**6%**	**15%**	**74%**	**9%**

LEGEND

>0% Compliance

and both

TDV Cost Effective
and
On-Bill Cost Effective

>0% Compliance

and either

TDV Cost Effective
or
On-Bill Cost Effective

<0% Compliance

or

not cost effective

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SMALL HOTEL – Compliance Margins & Cost Effectiveness

CZ	Utility	Mixed Fuel Compliance Margin			All Electric Compliance Margin			
		EE	EE + PV	HE	Fed Code	EE	EE + PV	HE
CZ1	PG&E	7%	7%		-68%	-51%	-51%	
CZ2	PG&E	7%	7%	2%	-52%	-39%	-39%	-25%
CZ3	PG&E	9%	9%	1%	-58%	-41%	-41%	-28%
CZ4	PG&E	7%	7%	1%	-54%	-42%	-42%	-27%
CZ5	PG&E	9%	9%		-60%	-42%	-42%	
CZ6	SCE/SCG	8%	8%		-50%	-37%	-37%	
CZ7	SDG&E	9%	9%		-50%	-36%	-36%	
CZ8	SCE/SCG	7%	7%		-49%	-41%	-41%	
CZ9	SCE/SCG	6%	6%		-44%	-37%	-37%	
CZ10	SCE/SCG	5%	5%		-40%	-34%	-34%	
CZ10-2	SDG&E	5%	5%		-40%	-34%	-34%	
CZ11	PG&E	4%	4%		-42%	-35%	-35%	
CZ12	PG&E	5%	5%	3%	-47%	-38%	-38%	-21%
CZ13	PG&E	4%	4%		-41%	-35%	-35%	
CZ14	SCE/SCG	4%	4%		-41%	-34%	-34%	
CZ14-2	SDG&E	4%	4%		-41%	-34%	-34%	
CZ15	SCE/SCG	3%	3%		-27%	-24%	-24%	
CZ16	PG&E	5%	5%		-78%	-59%	-59%	
Avg GHG Savings		1%	20%	2%	-3%	-1%	13%	14%

LEGEND

>0% Compliance

and both

TDV Cost Effective
and
On-Bill Cost Effective

>0% Compliance

and either

TDV Cost Effective
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not cost effective

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Summary and Conclusions

1. Medium Office and Retail mixed-fuel scenarios achieve higher compliance margins, but all-electric scenarios achieve higher GHG savings reductions.

2. Small Hotel is challenging to show cost-effectively exceeding the state's budget, and uncertain precision given modeling limitations.

3. High efficiency appliances must be integrated into design, but are not a panacea.

4. ACM updates regarding HVAC and DHW baselines, and treatment of solar PV, would change results.

Reach Code Measure Considerations

- Develop measures specific to building types and/or building systems.
  - Groceries, labs, spas… have very different energy demands

- Lower GHG emissions with
  - All-electric design
    - "Office and retail buildings less than 50,000 ft^2…"
    - "All rooftop packaged units …"
  - Higher compliance margins for mixed-fuel buildings
  - Increased solar PV penetration