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California's Statewide Pricing Pilot

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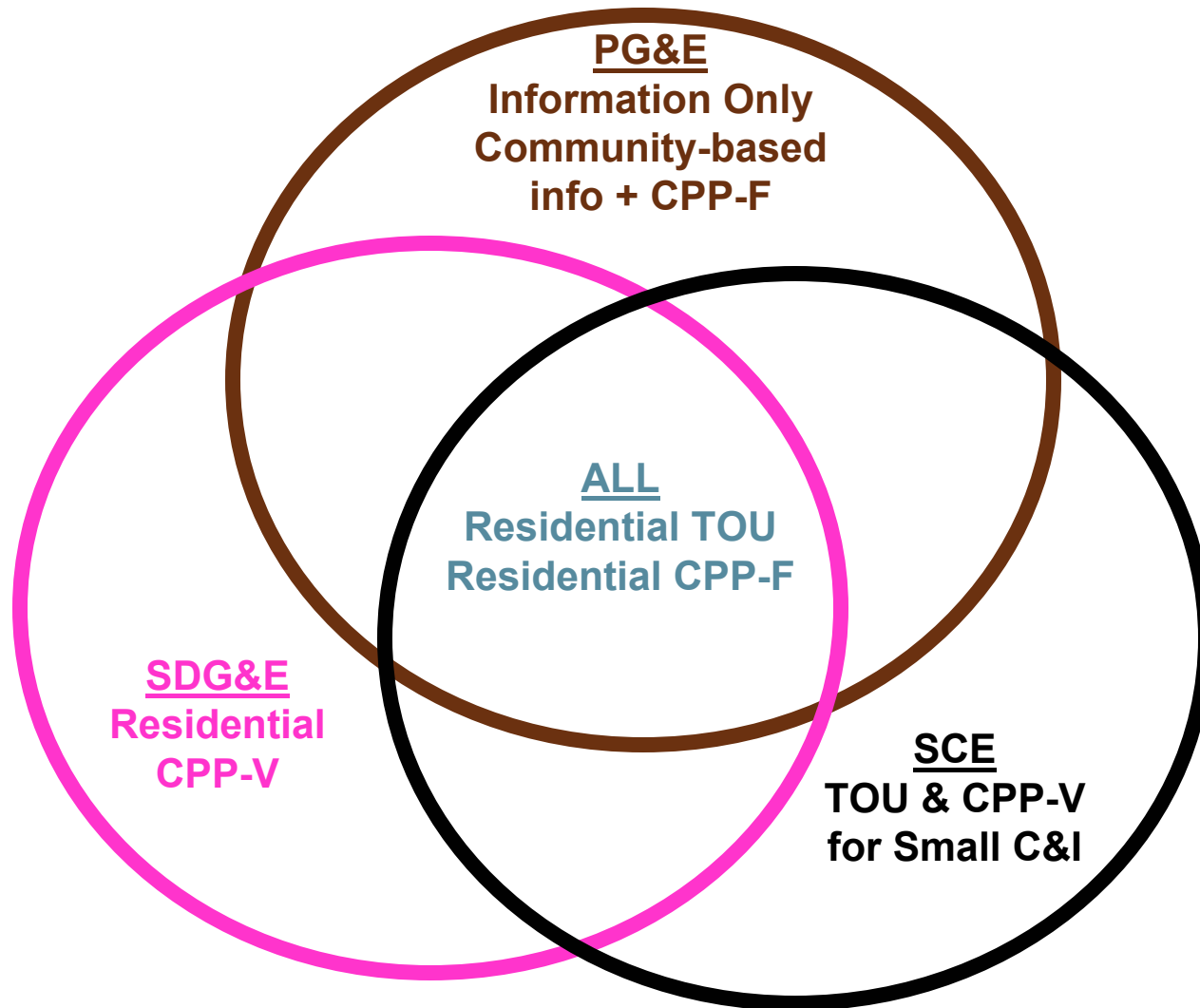
The Statewide Pricing Pilot (SPP) is designed to answer several key questions

- Will customers shift or reduce load in response to time-varying price signals?
- What is the price elasticity of demand for electricity by time period?
- Does responsiveness vary by rate type, climate zone and customer characteristics?
- Will customers accept time-varying and dynamic rates?
- Answers to these questions will provide input to the overriding policy question:
 - Are the benefits from reductions in energy use and coincident peak demand from more economically efficient pricing sufficiently large to off-set the metering costs required to implement rate reform?

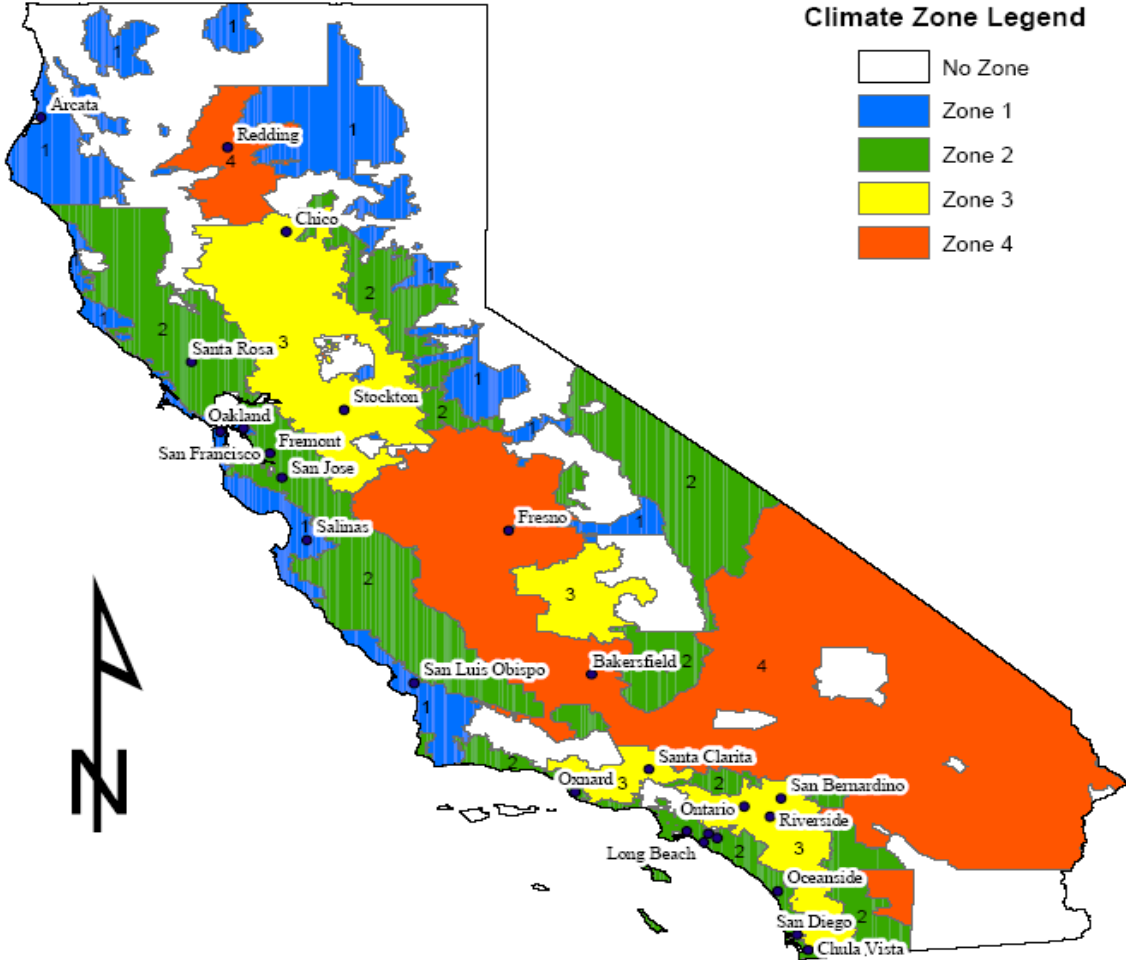
The SPP is testing several pricing concepts

- Time-of-Use (TOU)
 - Traditional two-part TOU rate
 - Peak period from 2 pm to 7 pm
 - Rates vary seasonally
- Critical Peak Pricing-Fixed (CPP-F)
 - TOU rate 350 days a year
 - Much higher price during peak period on up to 15 days a year, the timing of which is unknown
 - Day ahead notification
- Critical Peak Pricing-Variable (CPP-V)
 - Similar to CPP-F except notification can be as short as 4 hours ahead
 - Critical peak period can vary in length from 1 to 5 hours between 2 pm and 7 pm
 - Consumers are offered enabling technology to automate demand response
- The above prices are layered on top of very complex, five-tier, increasing block tariffs

SPP treatments vary across the state

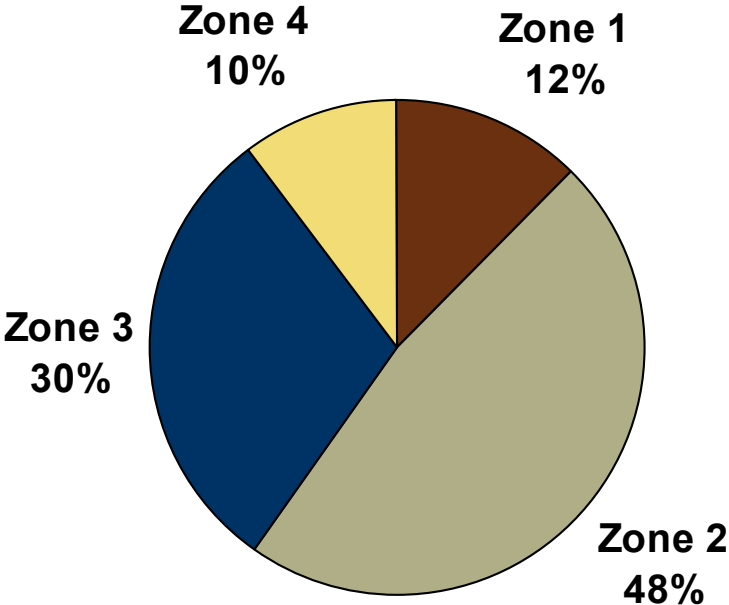


The SPP samples were segmented into four climate zones



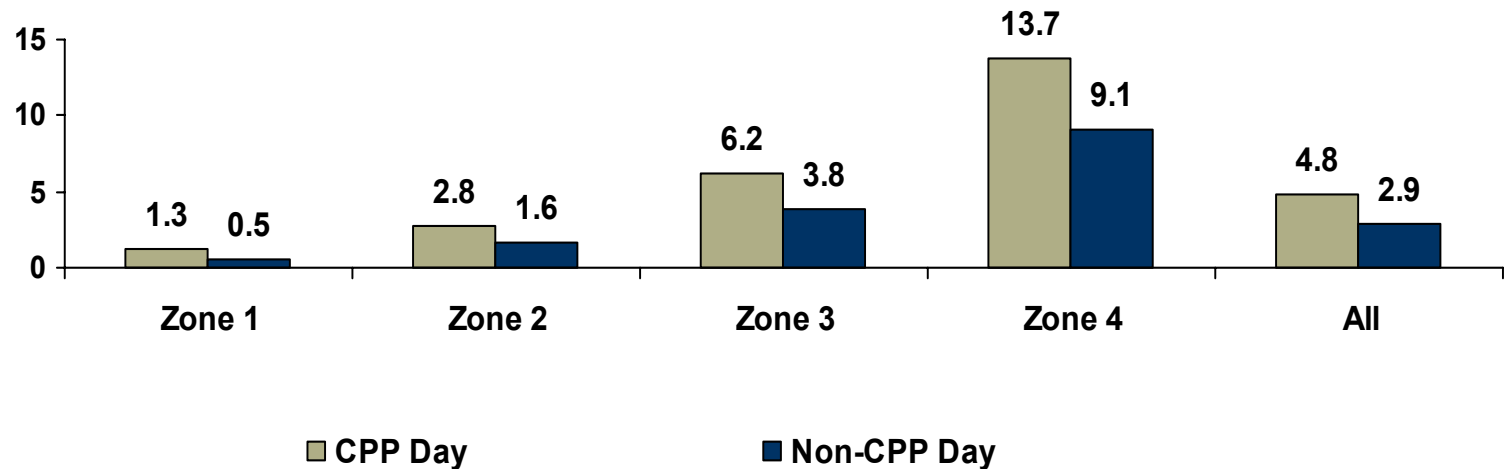
Sixty percent of California's population lives in the cool or moderate climate zones 1 and 2

Distribution Of Population Across Climate Zones



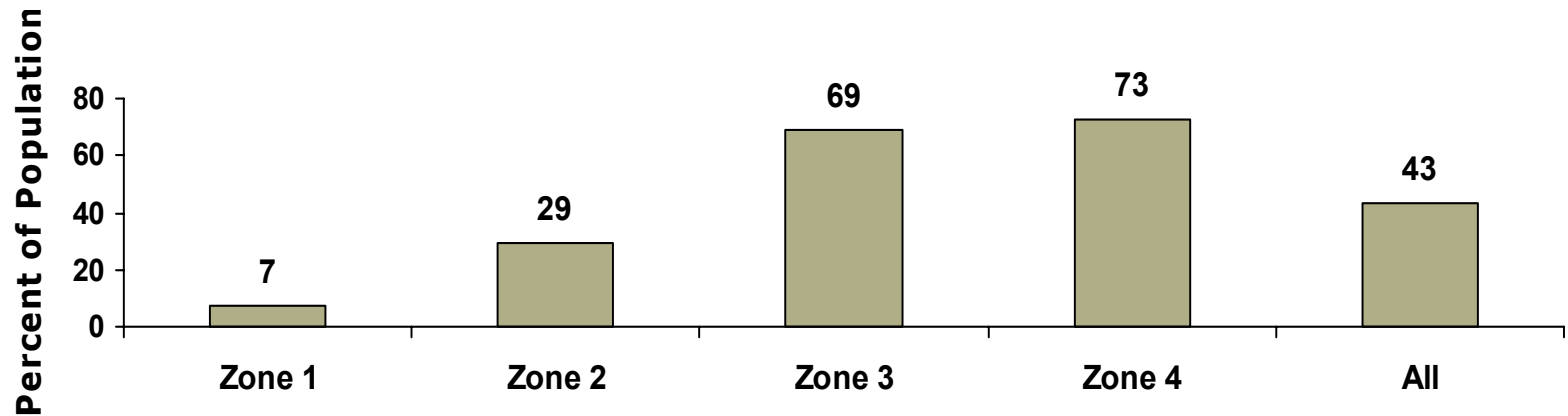
There is significant climatic variation across climate zones within California

Daily Cooling Degree Hours per Hour



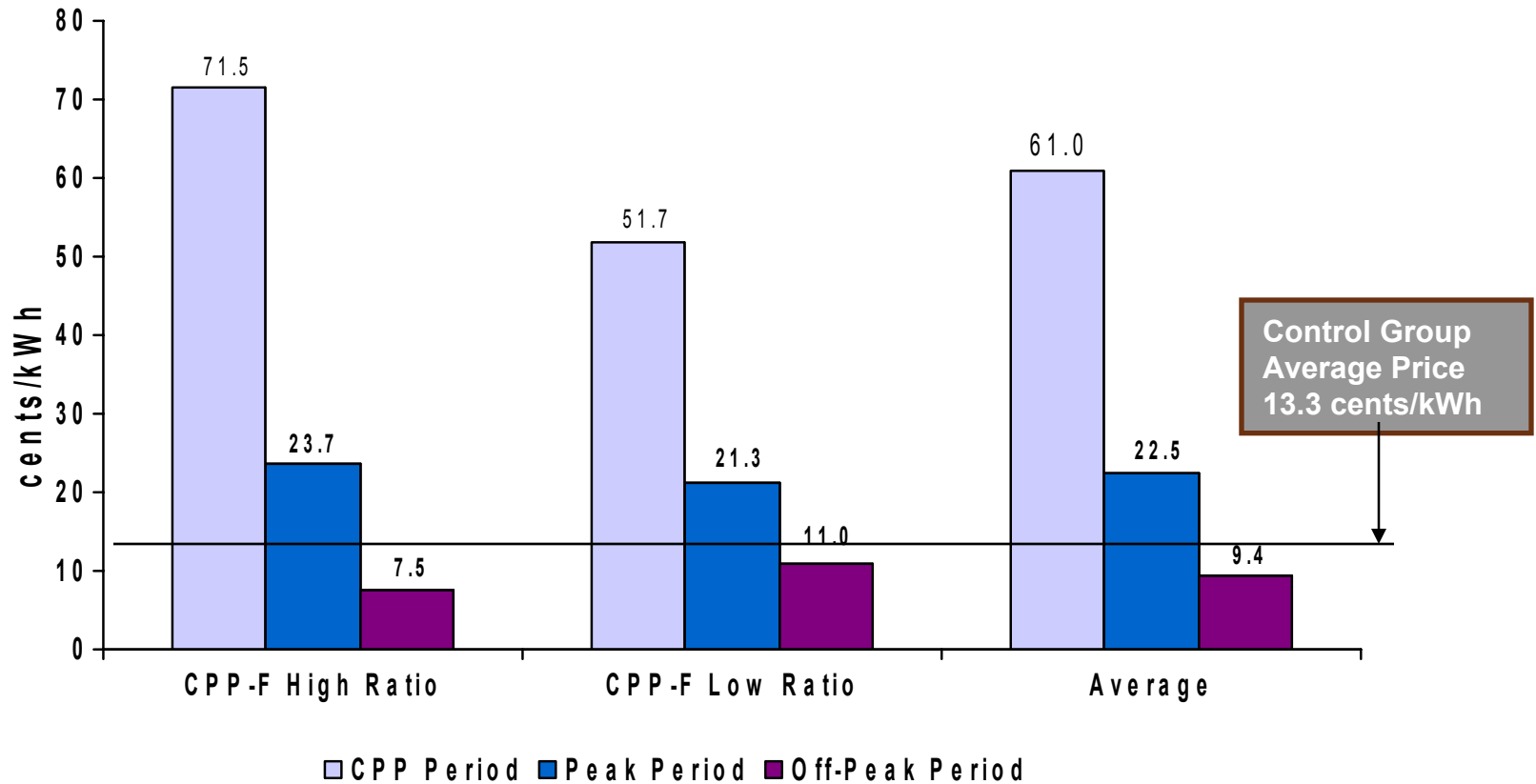
Air conditioning saturations also vary significantly across climate zones

Central Air Conditioning Saturations



Multiple price levels were tested for each rate type so that demand models could be developed and impacts estimated for price levels not included in the experiment

Residential Price For Consumer At Midpoint of Tier 3
(Weighted Average, Climate Zone 2)

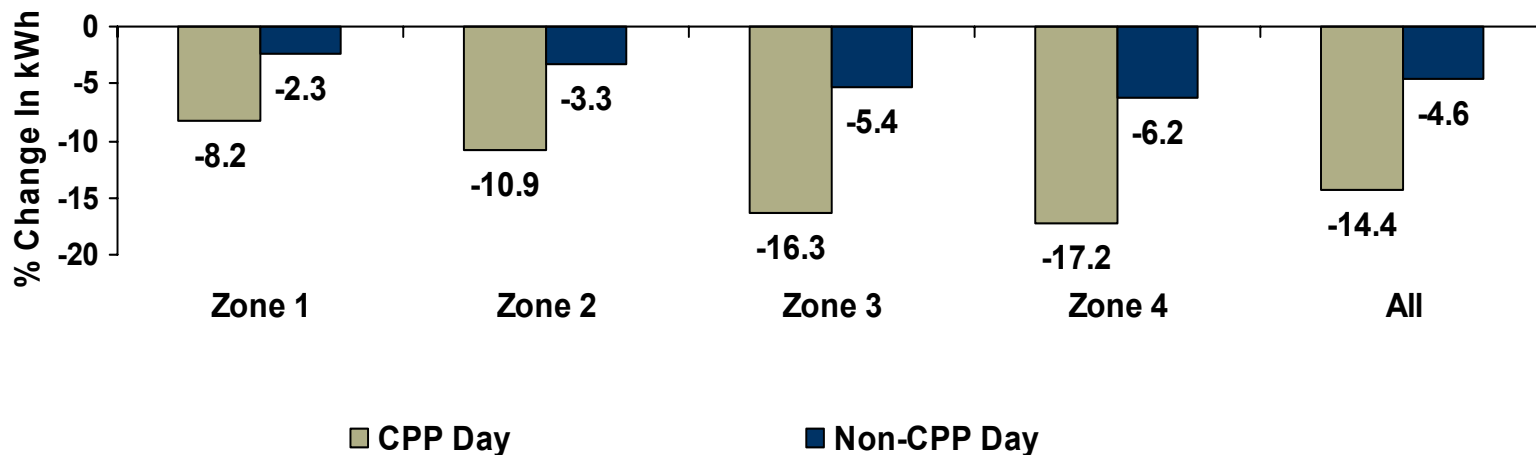


The primary analysis relies on the Constant Elasticity of Substitution (CES) demand system

- The CES consists of two equations
- One equation models the rate of substitution between peak and off-peak electricity consumption
- A second equation models the change in daily electricity consumption given a change in the daily electricity price
- Both equations are needed to predict the impact of time-varying prices on electricity use in the peak and off-peak periods
- For the residential CPP-F rate, both the substitution and daily equations allow price response to vary with central air conditioning ownership and weather
 - The impact of other customer characteristics on demand response are also being investigated

Statewide, the residential CPP-F rate reduces peak period demand on CPP days by more than 14 percent. The impact is twice as large in the hotter climate zones compared with the cooler zones

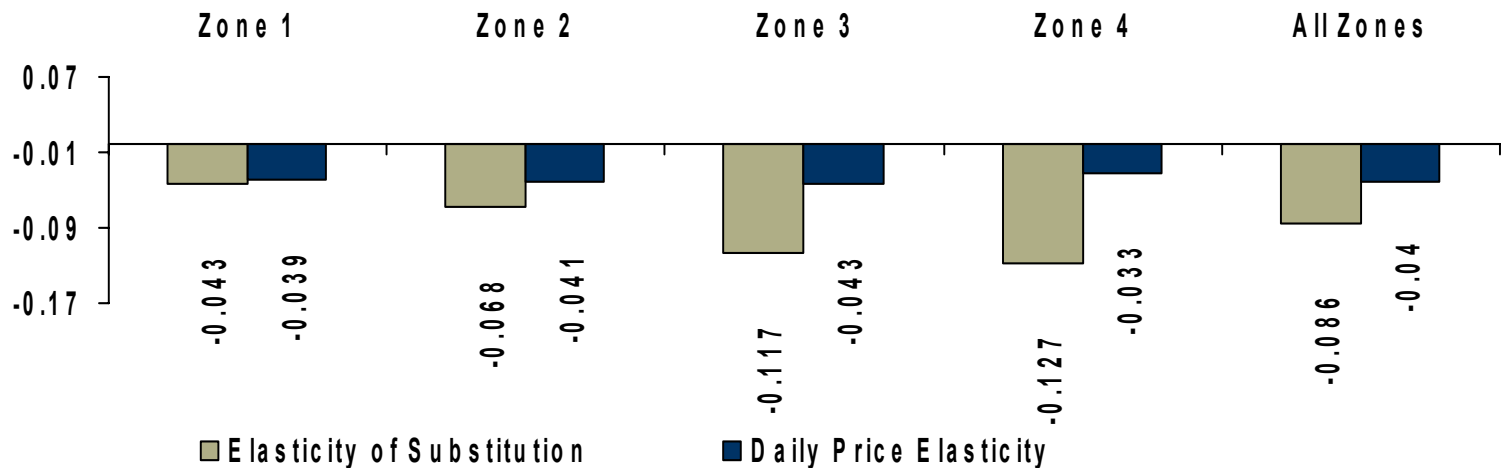
Percent Change In Residential Peak Energy Use for the Inner Summer Months of July through September (Avg CPP-F Prices/Avg 2003/2004 Weather)*



*The “all zone percentage impact” equals population-weighted absolute impacts compared with population weighted starting values. It does not equal the weighted average of zone-specific percentage impacts.

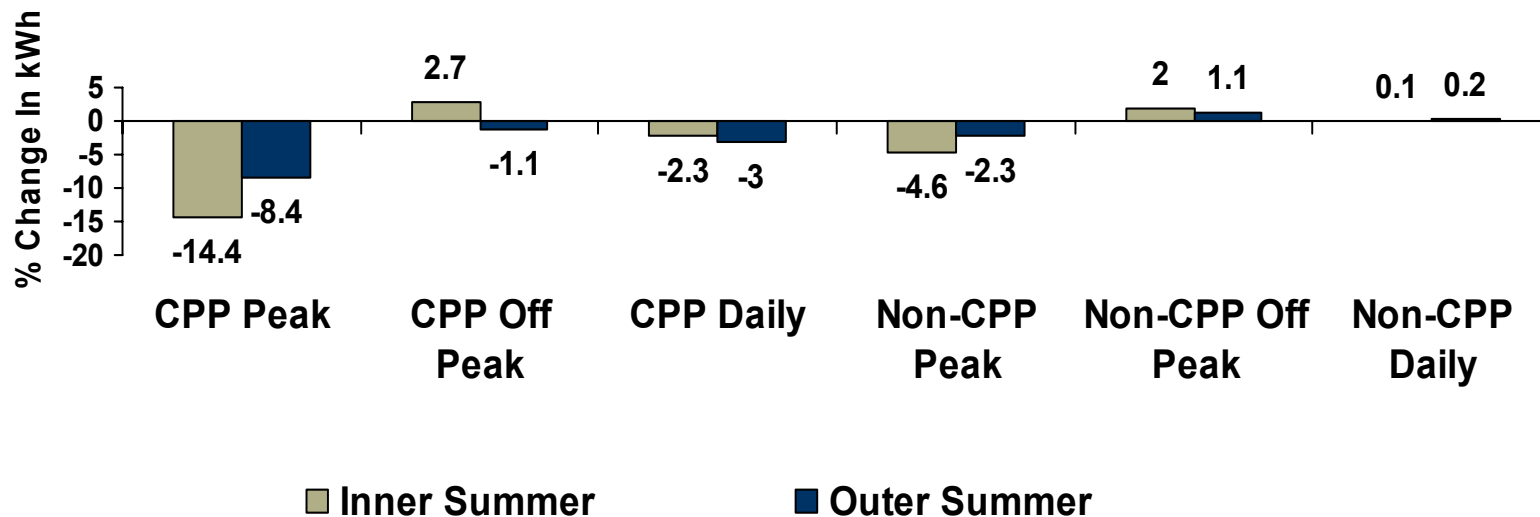
The elasticity of substitution for residential customers on the CPP-F rate varies three-fold from the coolest to the hottest climate zone. The daily price elasticity varies very little across climate zones (because it is not sensitive to variations in air conditioning).

**Elasticity of Substitution and Daily Price Elasticities
by Climate Zone
(Based on CPP-Day Weather Values)**



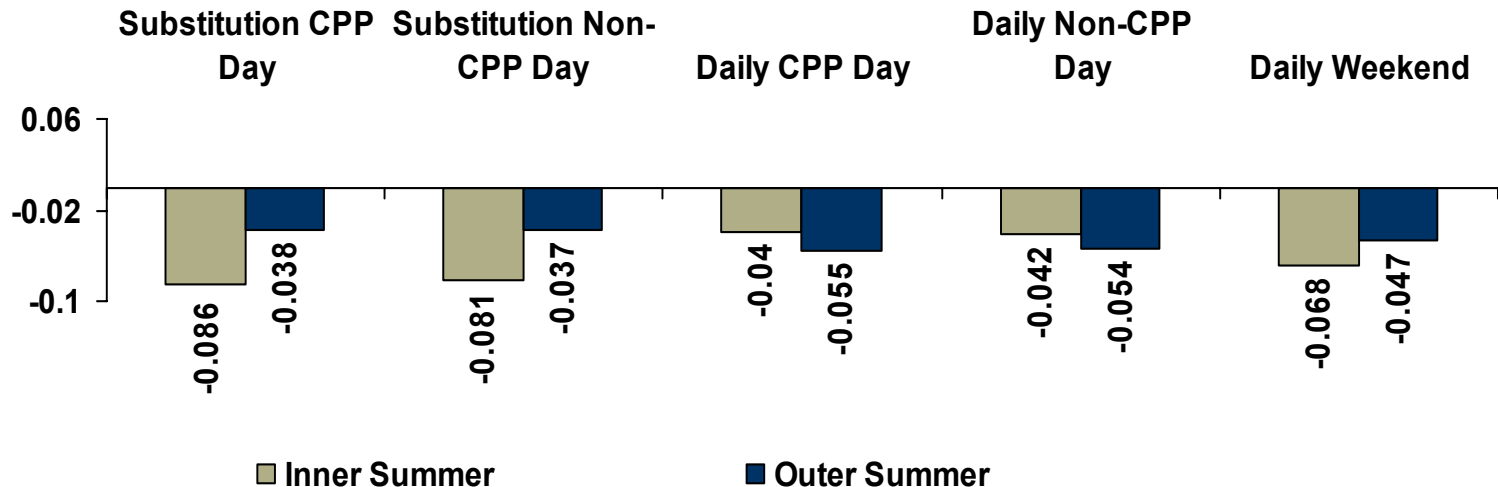
Residential peak-period impacts on CPP and Non-CPP days are significantly greater during the warm summer months compared with the milder shoulder months

Percent Change In Residential Energy Use by Rate Period
 Inner Summer versus Outer Summer
 (Avg CPP-F Prices/Avg 2003/2004 Weather)



The elasticity of substitution is significantly greater during the inner summer months (July – Sept.) than in the outer summer months (May, June & October)

Elasticity of Substitution and Daily Price Elasticities (All Zone Average)

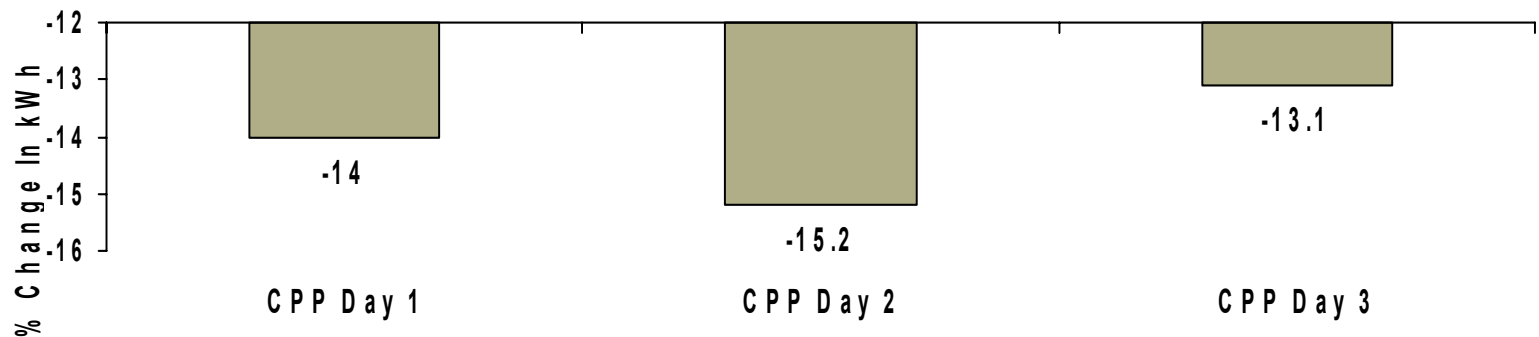


Peak-period impacts for the residential CPP-F rate held steady from 2003 to 2004

- Comparison based on customers that are common across years
 - Differences in the elasticity of substitution were not statistically significant
 - The daily price elasticity increased by a statistically significant amount between 2003 and 2004, from $-.035$ to $-.054$
 - Peak-period and daily impacts on CPP days do not differ by a statistically significant amount across the two years
 - Off-peak impacts on CPP days were smaller in 2004 than in 2003 (2.6% in '03 versus 1.2% in '04)
- Comparison based on all customers
 - There was a turnover of roughly 13 percent in both the control and treatment samples between 2003 and 2004
 - The conclusions with respect to the elasticity of substitution and daily price elasticities are the same as for common customers
 - Peak-period impacts on CPP days do not differ across the two years
 - Both off-peak and daily impacts are statistically different across the years, with the off-peak impact smaller and daily impact larger in 2004

CPP-day, peak-period impacts held steady on the second and third days of a multi-day CPP event

Percent Change In Residential Peak Energy Use on CPP Days
for the Inner Summer Months
(Avg CPP-F Prices/Avg 2004 CPP-Day Weather)



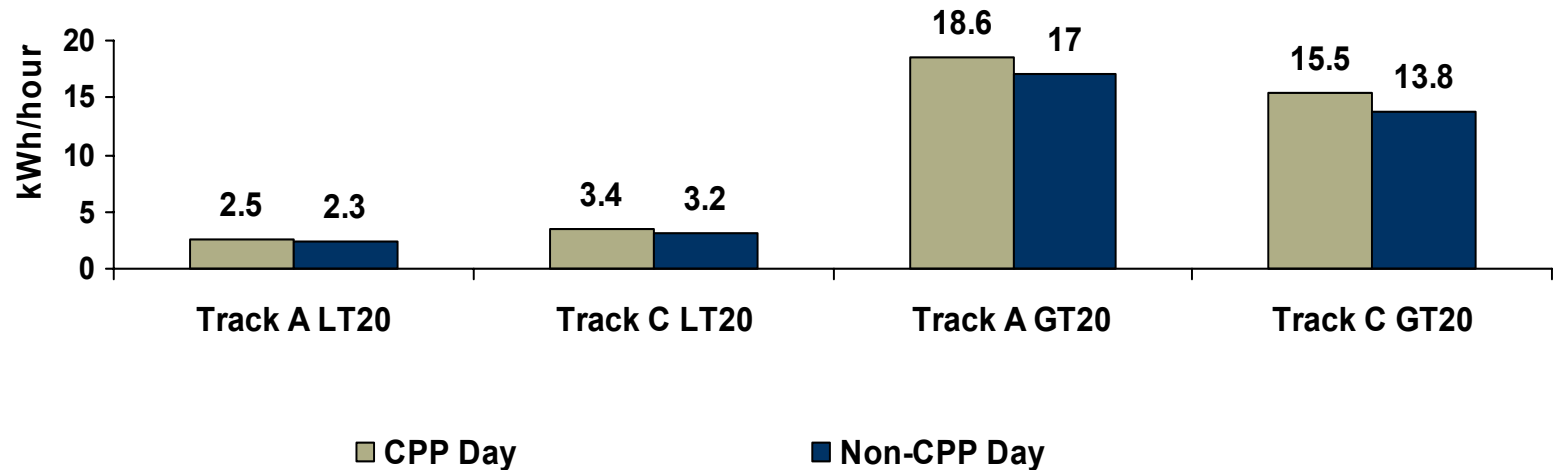
The three day-type impacts are not statistically different from each other based on the Chi-square test.

The SPP for commercial and industrial (C&I) customers involves two rates and three samples all located within the SCE service territory

- The C&I experiment segmented customers into two groups, those with demands less than 20 kW (LT20) and those with demands between 20 and 200 kW (GT20)
- Track A CPP-V
 - More representative of the general population than Track C
 - Has a variable length peak period on CPP days with “day-of” notification
 - Each customer was offered a Smart Thermostat to help control air conditioning load—1/3 of LT20 customers and 60% of GT20 customers chose the technology
 - Treatment implemented in 2004 only
- Track C CPP-V
 - Participants selected from a pre-existing Smart Thermostat pilot
 - Same rate treatment as Track A
 - All customers in both control and treatment groups have Smart Thermostats
 - Both control and treatment customers have thermostats dispatched on CPP days
 - Treatment implemented in both 2003 and 2004
- Track A TOU
 - Representative of the general population
 - Two period TOU rate
 - Treatment implemented in both 2003 and 2004

Track A customers use between 5 and 12 percent more energy per day than do Track C customers

Daily Energy Use per Hour
(2004)

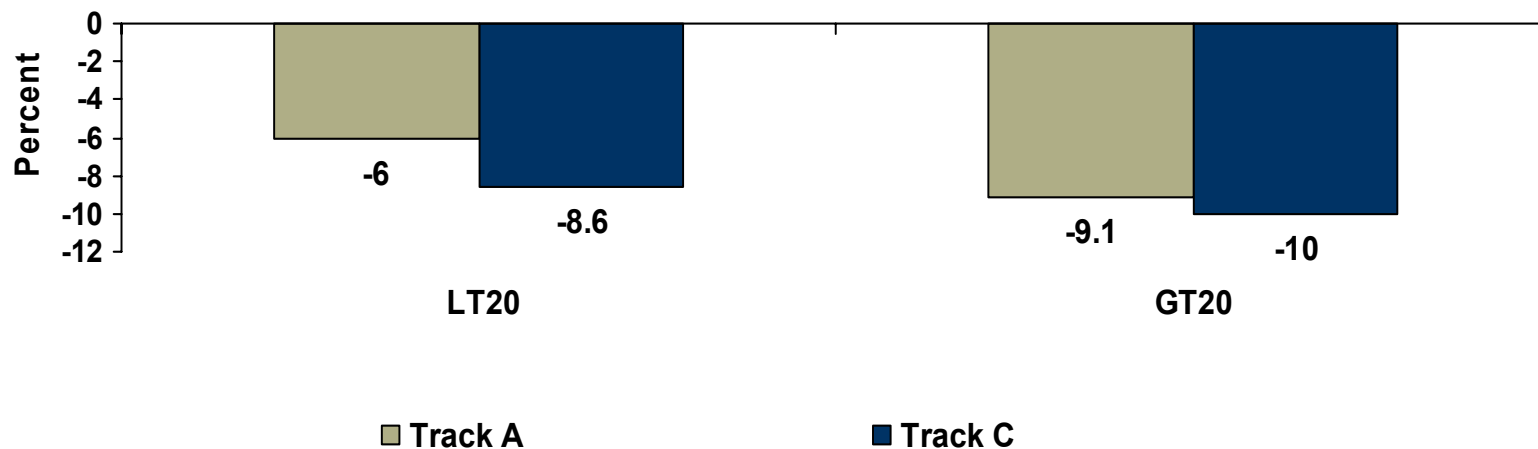


The C&I analysis is not yet complete but some preliminary results are available for the CPP-V tariff

- Track A CPP-V results (2004)
 - The price ratio in the substitution equation is statistically significant for both the LT20 and GT20 customer segments
 - The elasticity of substitution equals -0.045 for LT20 and -0.069 for GT20
 - Price is not statistically significant in the daily equation
 - Price response is greater for larger customers than smaller ones
 - Responsiveness is nominally higher for customers with enabling technology but the difference is not statistically significant
- Track C CPP-V results (2004)
 - The results are surprisingly similar to those for Track, in spite of significant differences in sample composition and the fact that the control group is dispatched on CPP days along with the treatment group (so that on these days, the impact is incremental to the enabling technology impact)
 - The price ratio in the substitution equation is statistically significant for both the LT20 and GT20 customer segments
 - The elasticity of substitution equals -0.055 for LT20 and -0.063 for GT20
 - Price is not statistically significant in the daily equation
 - Price response is greater for larger customers within the LT20 segment but smaller for larger customers within the GT20 segment

The smallest customers show peak-period reductions on CPP days in the 6 to 9 percent range. Reductions for medium sized C&I customers are somewhat higher.

**Percent Reduction in Peak Period
Energy Use on CPP Days
(2004)**



Previews of coming attractions—a significant amount of additional analysis has been done but the results are not quite ready for prime time

- Winter analysis for residential CPP-F treatment
 - The peak period was the same in the winter as in the summer (e.g., 2 to 7 pm)
 - Three CPP days were called during the winter, all in the inner winter months
 - The elasticity of substitution is larger in the inner winter months of December, January and February than in the shoulder months of November, March and April
 - The inner winter elasticity of substitution is significantly less than the summer value
- Residential Information Only treatment
 - Customers in climate zones 2 and 3 were asked to voluntarily reduce peak-period use on CPP days but they were not placed on time-varying rates
 - There was no statistically significant response in zone 2 in either 2003 or 2004
 - A large impact was found in zone 3 in 2003 but this disappeared in 2004—we believe the 2003 impact was anomalous
 - In our opinion, there is no evidence from this experiment that a request for voluntary reductions in response to dynamic notification can significantly reduce peak period demand in the absence of time-varying prices and be sustained over a two-year period

So what's the bottom line?

- Price matters
 - Big price differentials are needed to obtain reductions in the 10 to 15 percent range
 - Appealing for peak reductions in the absence of price incentives doesn't do the job
- Impacts persist
 - Across multiple CPP days
 - Across two years of the experiment
- Residential customers are more price responsive than C&I customers
 - But absolute impacts may be greater for C&I customers
- Central air conditioning ownership and climate are key drivers of demand response for residential customers

While a lot has been done, there is always more to do

- We are correcting some data problems with the residential CPP-V treatment and will estimate demand models for both Track A and Track C customers
 - Treatment was implemented in SDG&E service territory only
- The residential and C&I TOU analysis
- Residential Track B
- Examine the impact of other customer characteristics on demand response
- Finalize the impact simulators
- Draft report by end of January
- Final report