Customer Impacts of Potential Changes in Residential Electricity Tariffs

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Current residential electricity tariffs in California don't reflect costs

- Current Tariff
  - Increasing-Block Pricing
    - Higher monthly consumption => higher marginal price
  - Little or no fixed monthly charge, no time variation
  - Separate tariff for "certified" poor
- Efficient Tariff would be quite different
  - Fixed monthly charge reflects non-volumetric costs
  - Marginal price reflect marginal cost of supply
    - Doesn't vary with customer's aggregate consumption
    - Does vary over time with wholesale price

Who would win and lose from some proposed changes to tariffs?

- Ending increasing-block pricing
  - Or reducing substantially the size of the steps
- Introducing a fixed monthly charge
  - lowering prices on higher tiers to offset
- Time-varying pricing
  - Time-of-Use or Critical-Peak Pricing

- How would impact vary
  - Regionally?
  - Across Income Brackets?

Similar approach to previous analyses constructing alternative tariffs

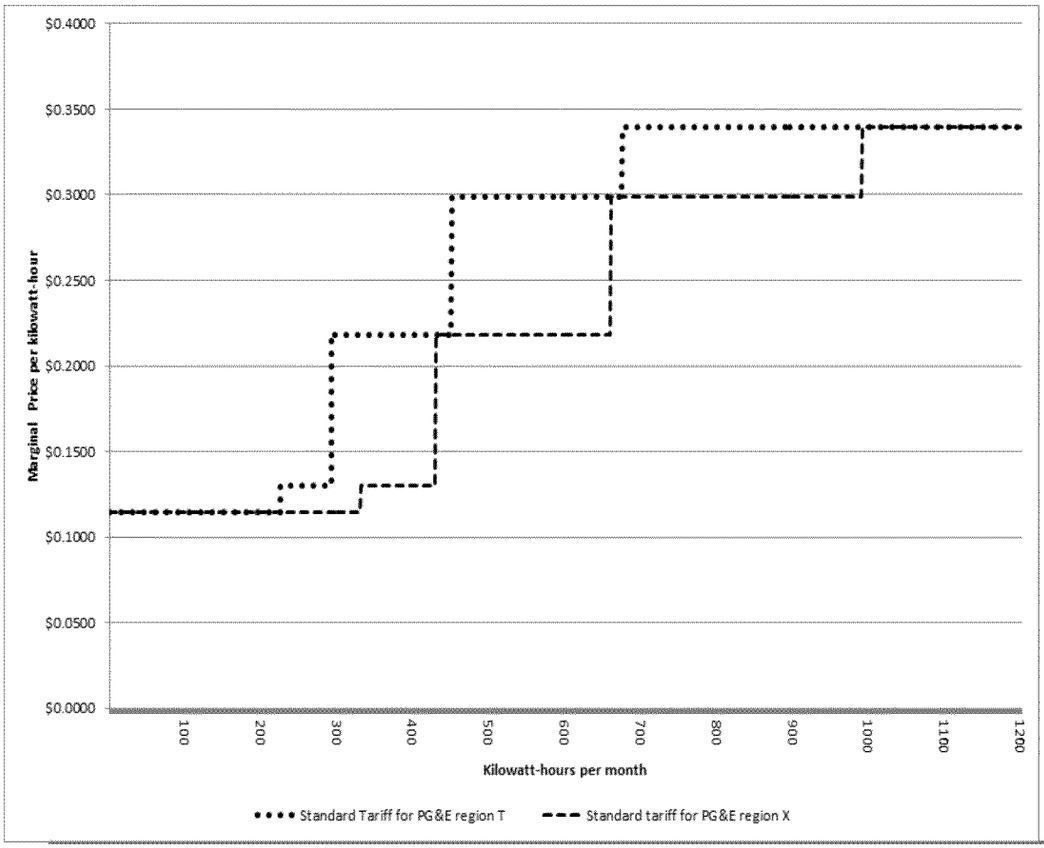
- Revenue-neutral compared to actual tariff
  - Assumes zero price elasticity
    - return to this later
- Aggregate within each class of consumers to see how they would be affected on average
  - Different geographical regions
  - Different income brackets
  - Winners and losers within every group

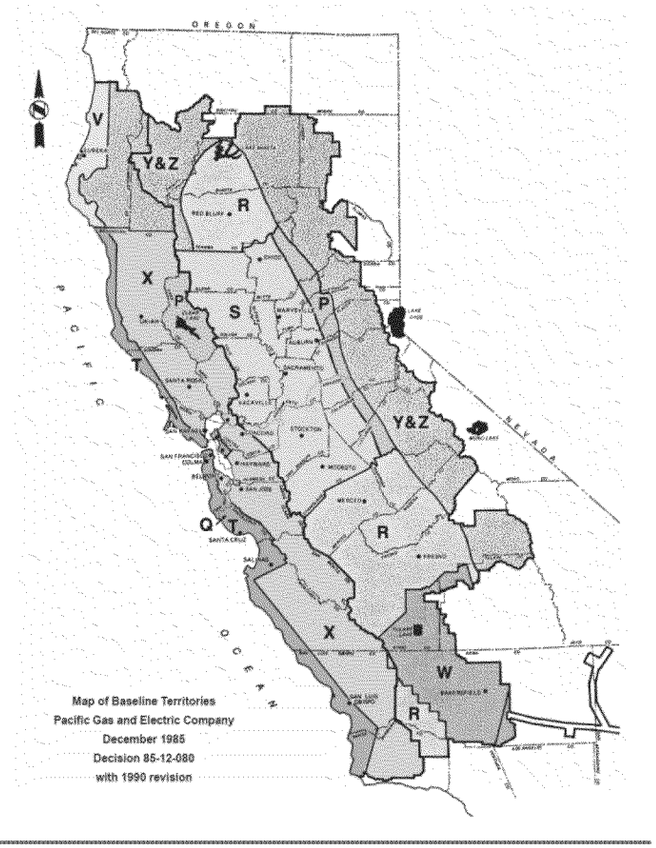
Data for analyzing time-invariant tariffs

- (Nearly) complete residential billing data for the three large California investor-owned utilities
- Using 2006 data
  - Four-day summer heat storm, so possibly somewhat unusual, but otherwise not an outlier
- Data don't include master-metered customers
- Separately identify CARE and standard tariff customers. Focus on change in standard tariff, maintain subsidy to CARE customers.

Increasing-block tariffs differ by region

- Baseline quantities set to cover same percentage of average usage (55%-65%) for each regions





Actual and alternative tariffs

percent of baseline	Fixed Charge	Tier 1 0%-100%	Tier 2 100%-130%	Tier 3 130%-200%	Tier 4 200%-300%	Tier 5 over 300%
Southern California Edison						
IBP	$0.00	$0.1162	$0.1361	$0.2201	$0.3049	$0.3049
Flat rate	$0.00	$0.1731	$0.1731	$0.1731	$0.1731	$0.1731
IBP + FC	$5.00	$0.1162	$0.1361	$0.2023	$0.2802	$0.2802
Pacific Gas & Electric						
IBP	$0.00	$0.1143	$0.1299	$0.2178	$0.2987	$0.3394
Flat rate	$0.00	$0.1643	$0.1643	$0.1643	$0.1643	$0.1643
IBP + FC	$5.00	$0.1143	$0.1299	$0.1963	$0.2692	$0.3058
San Diego Gas & Electric						
IBP	$0.00	$0.1287	$0.1488	$0.2312	$0.2401	$0.2571
Flat rate	$0.00	$0.1690	$0.1690	$0.1690	$0.1690	$0.1690
IBP + FC	$5.00	$0.1287	$0.1488	$0.2055	$0.2134	$0.2285

No regional impact from flattening, slight impact from fixed charge

Region	Share of total residential usage	Share of total residential households	Avg Daily Use	Summer Baseline Quantity	Average Annual Bill with IBP	Average Annual Bill flat rate	% change from IBP to flat	Average Annual Bill IBP+FC	% change from IBP to IBP+FC	$ change from IBP to IBP+FC
Southern California Edison										
10	27.4%	31.1%	17.4	10.2	$1,100	$1,100	0.0%	$1,110	0.9%	$10
13	2.9%	2.1%	26.6	19.4	$1,670	$1,679	0.6%	$1,655	-0.9%	-$15
14	5.6%	4.8%	23.0	17.0	$1,413	$1,456	3.0%	$1,413	-0.1%	-$1
15	3.8%	2.4%	31.5	47.6	$1,982	$1,992	0.5%	$1,953	-1.4%	-$28
16	1.4%	1.6%	17.2	10.0	$1,035	$1,087	5.0%	$1,053	1.7%	$18
17	38.2%	32.8%	23.0	15.4	$1,462	$1,453	-0.7%	$1,455	-0.5%	-$7
Share of Revenue from 13,14,15,17					63.80%	63.73%		63.45%		
Pacific Gas & Electric										
P	3.8%	2.9%	25.4	15.3	$1,400	$1,523	8.8%	$1,402	0.2%	$3
Q	0.1%	0.1%	32.0	7.5	$2,278	$1,922	-15.6%	$2,184	-4.1%	-$94
R	9.1%	6.9%	25.6	17.1	$1,548	$1,537	-0.8%	$1,528	-1.3%	-$20
S	16.2%	12.7%	24.4	15.3	$1,478	$1,464	-0.9%	$1,461	-1.2%	-$17
T	13.8%	19.2%	13.8	7.5	$822	$829	0.9%	$841	2.3%	$19
V	0.7%	0.8%	18.5	12.0	$1,211	$1,109	-8.4%	$1,200	-0.9%	-$11
W	4.2%	3.1%	25.8	18.5	$1,588	$1,549	-2.5%	$1,562	-1.6%	-$26
X	32.2%	32.5%	19.0	11.0	$1,144	$1,141	-0.2%	$1,146	0.2%	$2
Y	1.0%	0.9%	19.7	11.7	$1,108	$1,181	6.6%	$1,120	1.1%	$12
Z	0.04%	0.06%	13.5	7.9	$708	$807	14.0%	$743	5.0%	$35
Share of Revenue from P,R,S,V,W,Y					43.16%	43.13%		42.70%		
San Diego Gas & Electric										
Coastal	46.2%	47.7%	16.5	15.3	$1,015	$1,019	0.3%	$1,021	0.6%	$6
Inland	39.6%	34.0%	19.8	15.3	$1,229	$1,223	-0.5%	$1,221	-0.6%	-$8
Mountain	0.0%	0.0%	18.0	17.1	$1,058	$1,109	4.8%	$1,070	1.1%	$12
Desert	1.2%	0.7%	28.3	7.5	$1,714	$1,744	1.8%	$1,687	-1.6%	-$28
Share of Revenue from Inland/Mountain/Desert					47.08%	46.90%		46.78%		

Note: Usage and household shares do not add to 100% -- remainder are on CARE program.

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Note: Usage and household shares do not add to 100% -- remainder are on CARE program.

Evaluating impact on low-income is more difficult: have to identify them

- Census gives percentage in income brackets within a census block group (CBG), but not matched to specific houses
- In earlier work, I developed an approach to statistically match households to usage within CBGs that accounts for income/usage correlation
- Apply the same approach here. Because these are estimated, average gains/losses are also estimated

Impact of tariff changes by income bracket (among non-CARE customers)

Income Bracket	Share of Total Residential Usage	Average Annual Bill with IBP	Average Annual Bill flat rate	% chg from IBP to flat	Average Annual Bill IBP+FC	% change from IBP to IBP+FC	$ change from IBP to IBP+FC	95% confidence interval
Southern California Edison								
$0-$20k	3.2%	$581	$738	27.0%	$629	8.3%	$48	[42,53]
$20k-$40k	9.8%	$930	$1,046	12.6%	$958	3.1%	$28	[21,36]
$40k-$60k	16.1%	$1,134	$1,198	5.7%	$1,148	1.3%	$14	[12,19]
$60k-$100k	25.2%	$1,325	$1,337	0.9%	$1,326	0.1%	$1	[0,1]
over $100k	24.9%	$1,996	$1,790	-10.3%	$1,947	-2.5%	-$49	[-60,-40]
Pacific Gas & Electric								
$0-$20k	3.8%	$628	$744	18.5%	$669	6.6%	$41	[34,47]
$20k-$40k	11.4%	$980	$1,046	6.7%	$998	1.8%	$18	[13,23]
$40k-$60k	16.0%	$1,096	$1,130	3.1%	$1,104	0.7%	$8	[6,10]
$60k-$100k	24.2%	$1,181	$1,191	0.8%	$1,182	0.1%	$1	[1,1]
over $100k	25.7%	$1,531	$1,421	-7.2%	$1,501	-2.0%	-$30	[-36,-24]
San Diego Gas & Electric								
$0-$20k	3.1%	$387	$479	23.7%	$442	14.3%	$55	[50,58]
$20k-$40k	10.8%	$639	$730	14.3%	$681	6.5%	$42	[28,54]
$40k-$60k	16.2%	$887	$947	6.8%	$910	2.6%	$23	[12,39]
$60k-$100k	26.5%	$1,170	$1,180	0.9%	$1,169	-0.1%	-$1	[-2,1]
over $100k	30.4%	$1,909	$1,728	-9.5%	$1,833	-4.0%	-$76	[-107,-53]

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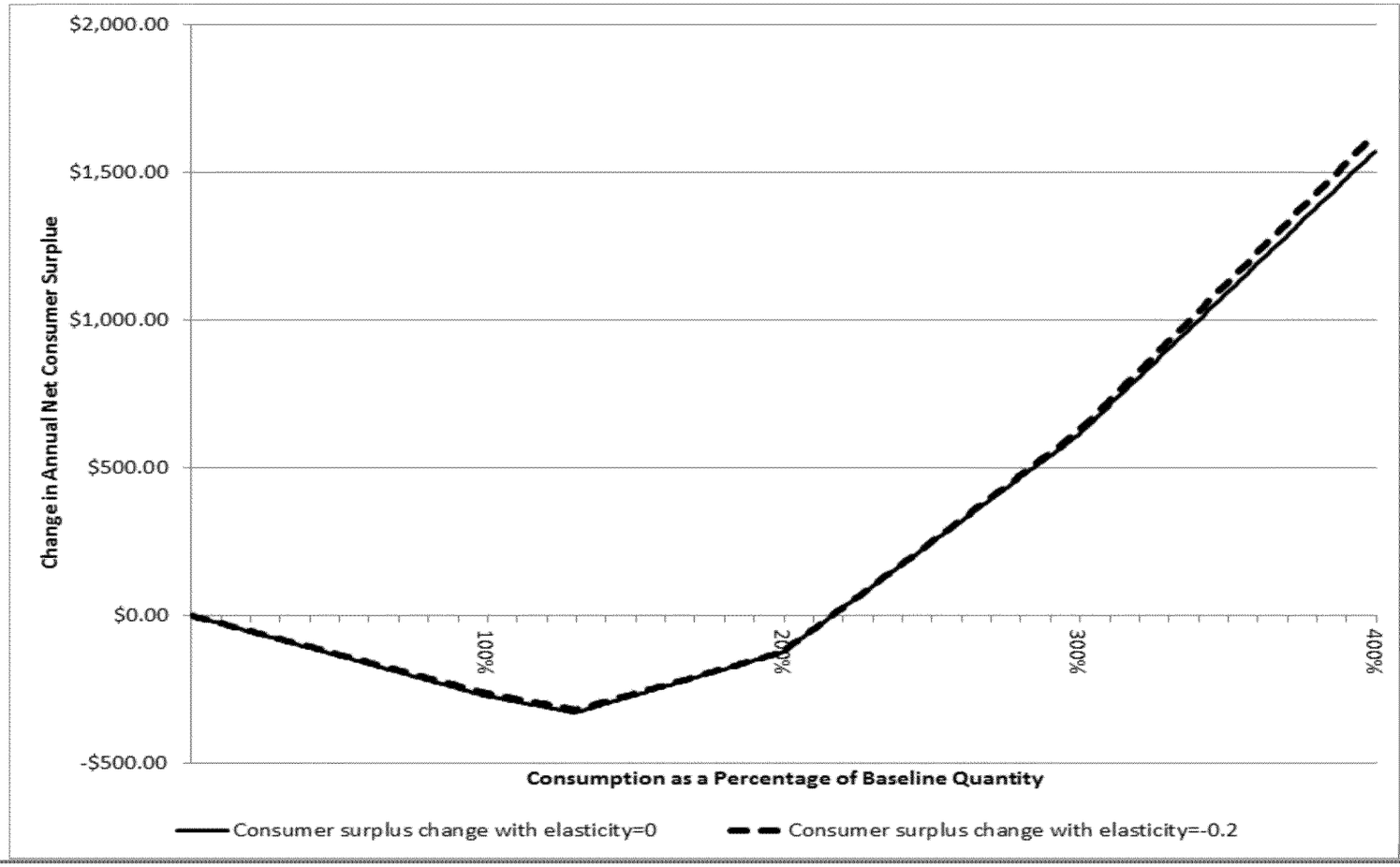
Incorporating demand elasticity changes the results very little

- How much is a customer's gain or loss from the tariff change altered if they respond to the price change?
  - Very little, because elasticity is small and quantity change is only on the marginal consumption, while price change is across the entire schedule
- Quantity impact of move to flat rate is especially small if customer's respond to average price rather than marginal

Illustration of small consumer surplus impact from customer response



Data for analyzing time-varying tariffs

- PG&E load research data
  - Similar results using SCE load research data
- Hourly data on 859 to1034 premises 2006-09
- Data include region, consumption, tariff, service type (*e.g.,* electric heat), and load
- Know census block group, estimate income
- Compare a systemwide flat rate ($0.16) to TOU and CPP that are revenue-neutral over 4 years for total load shape
  - Assume zero elasticity, include all customers

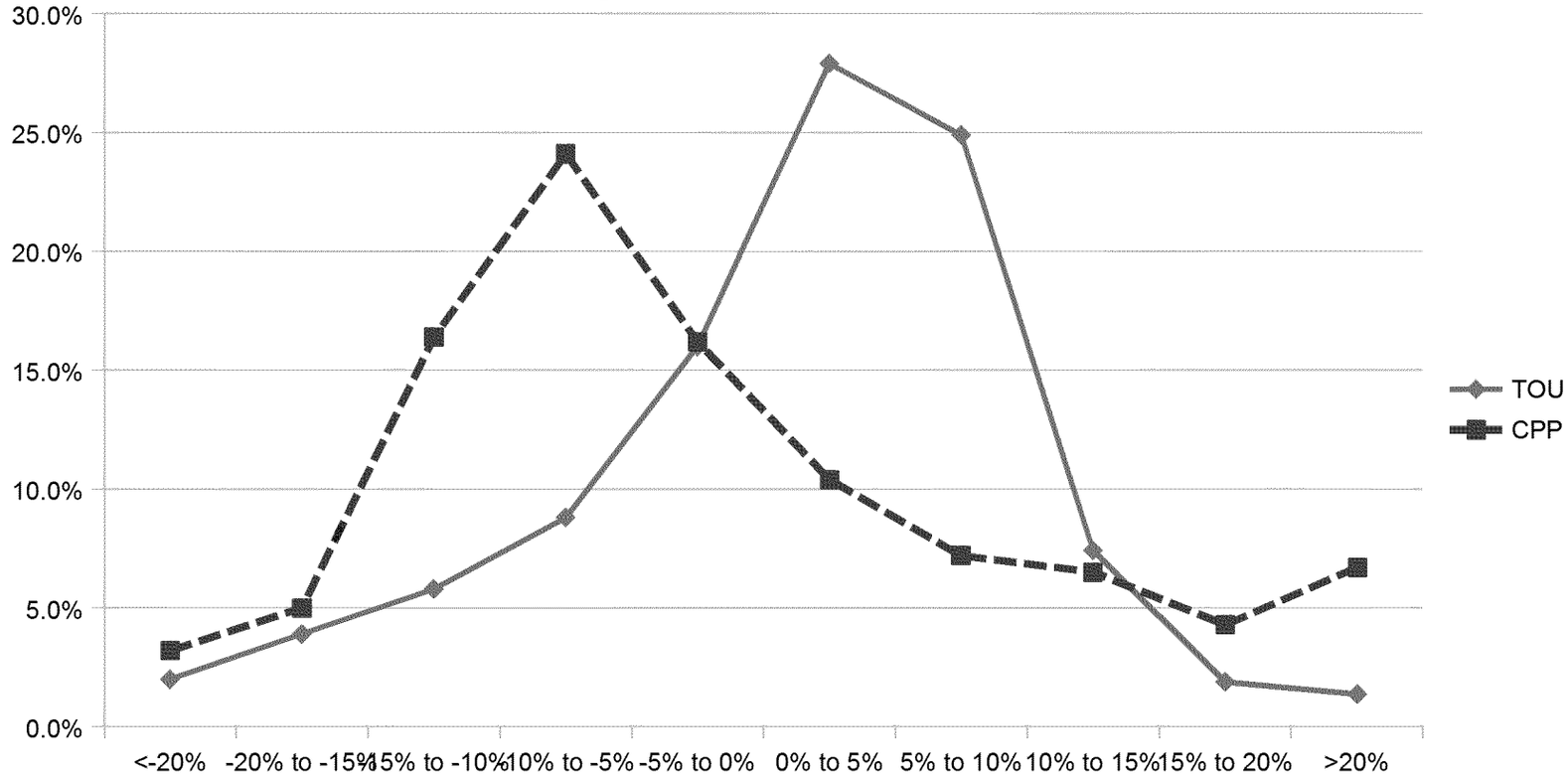
Alternative Mandatory Tariffs

	Winter Off-peak	Winter Peak	Summer Off-Peak	Summer Part-Peak	Summer Peak	Summer Critical-Peak
Flat Rate	$0.160	$0.160	$0.160	$0.160	$0.160	$0.160
TOU	$0.120	$0.133	$0.120	$0.200	$0.399	$0.399
CPP	$0.111	$0.123	$0.111	$0.185	$0.370	$1.000
Effective	Nov-Apr all other winter hours	Nov-Apr Mon-Fri 5pm-8pm except holidays	May-Oct all other summer hours	May-Oct Mon-Fri 10am-1pm & 7pm-9pm except holidays	May-Oct Mon-Fri 1pm-7pm except holidays and CPP days	May-Oct M-F, 1pm-7pm 15 days of max demand of summer

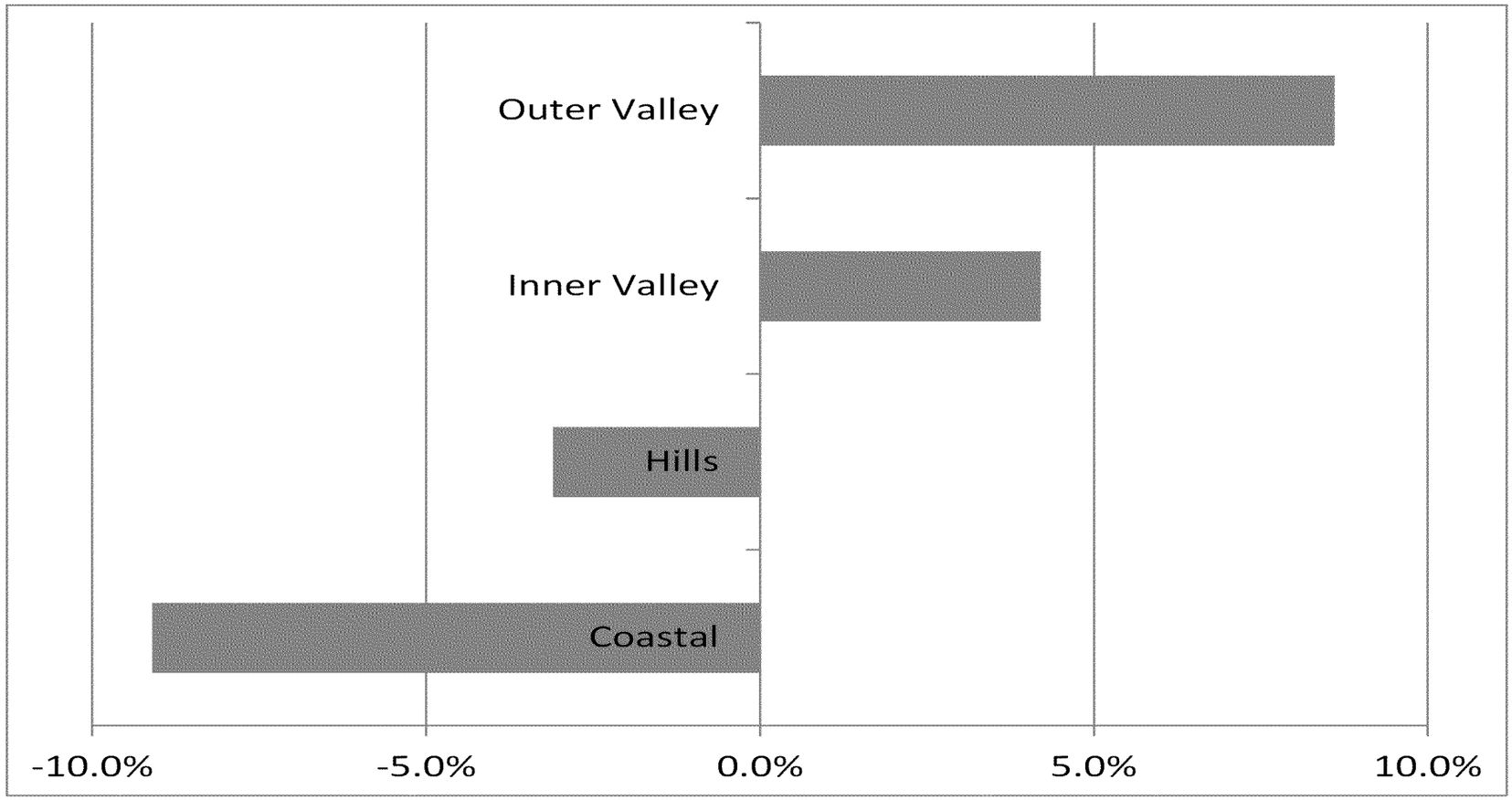
- Calculate monthly bills of each customer under each tariff
- Look at distribution of winners and losers under switch to TOU or CPP
- Look at impact on bill volatility

CPP shifts bill change distribution left compared to TOU, but has fatter right tail

- 90% have change of (-20%, +20%)

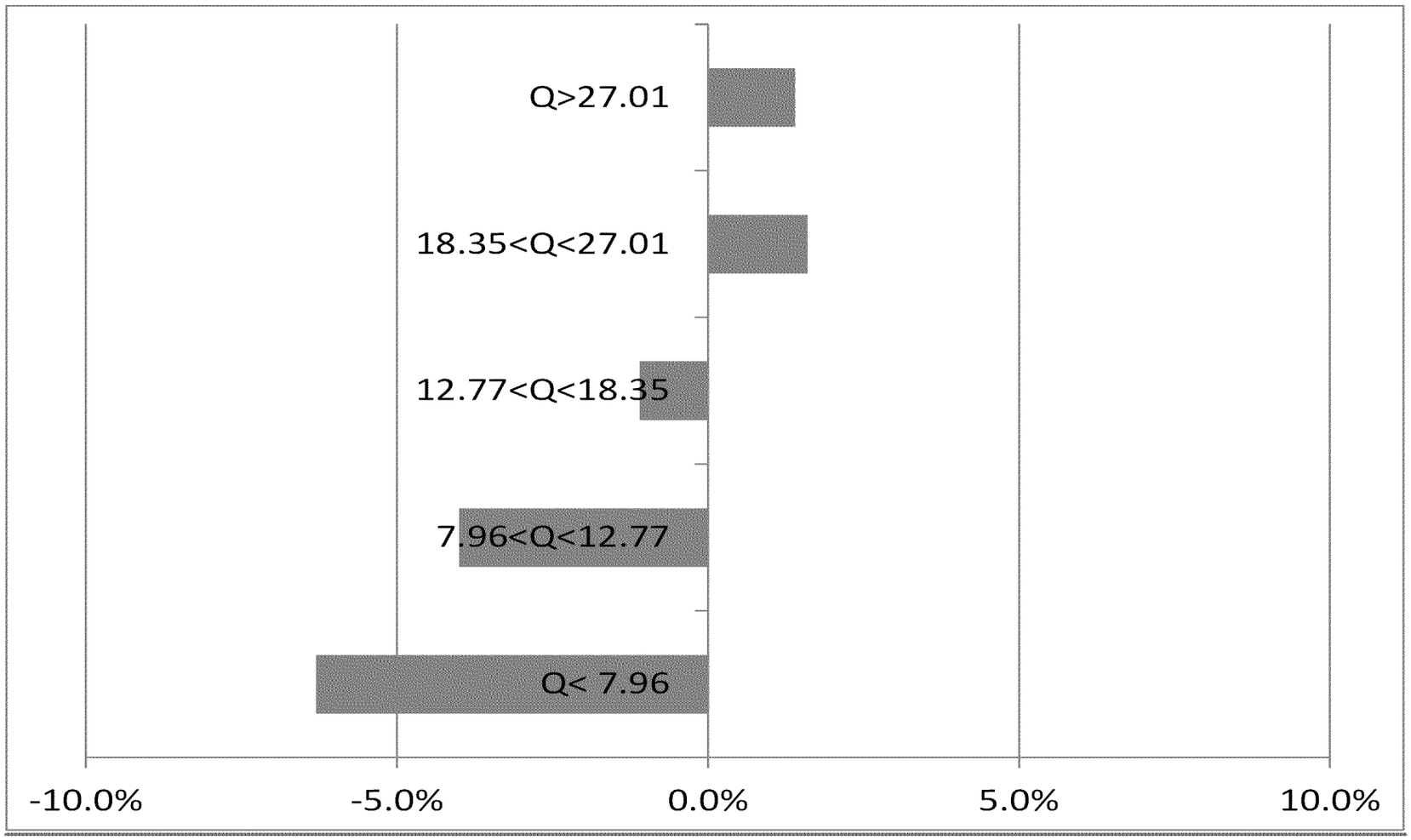


Large regional differences from flat vs CPP

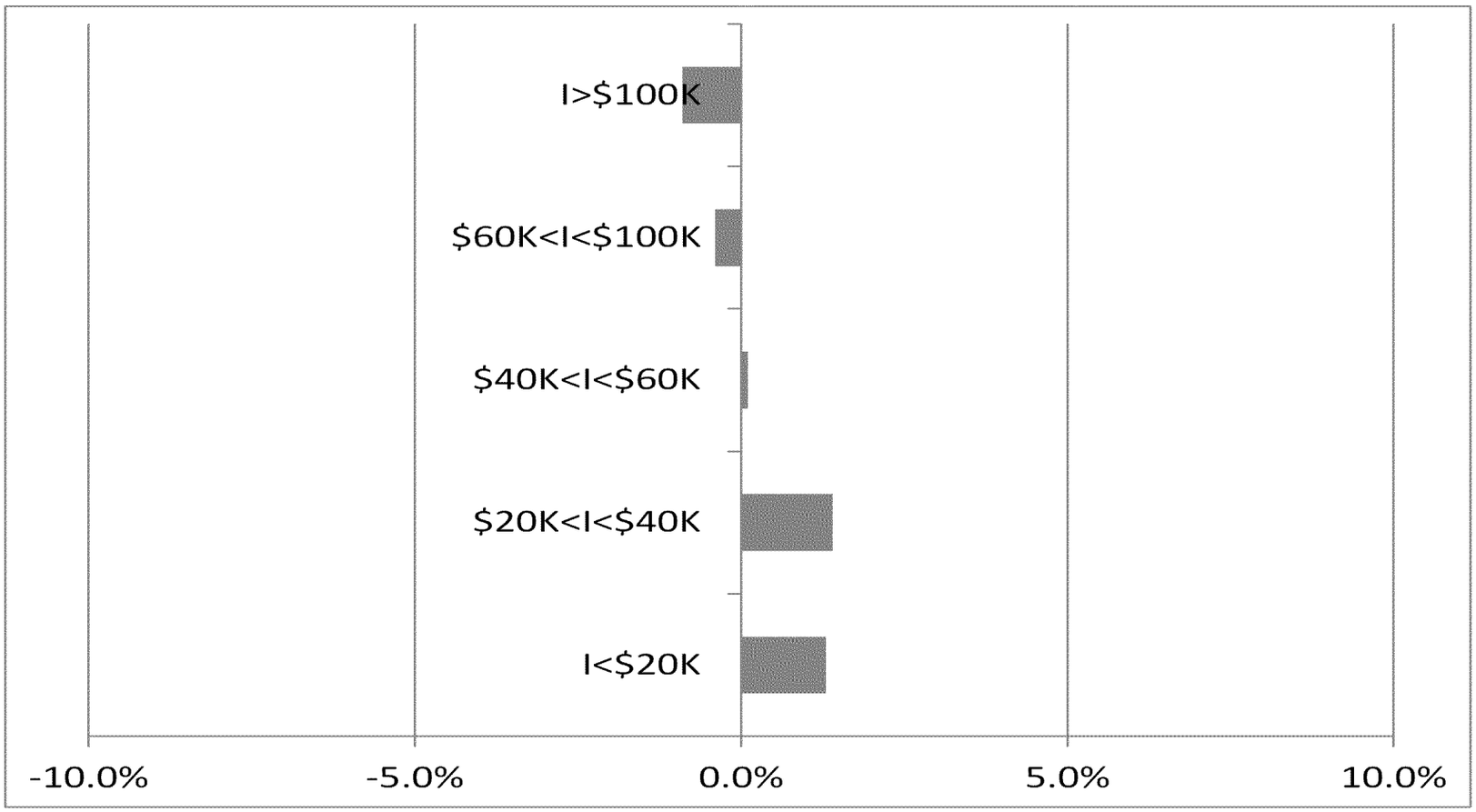


- Can be offset with differential fixed charges or marginal prices by region

Average bill change by daily usage (kWh/day)



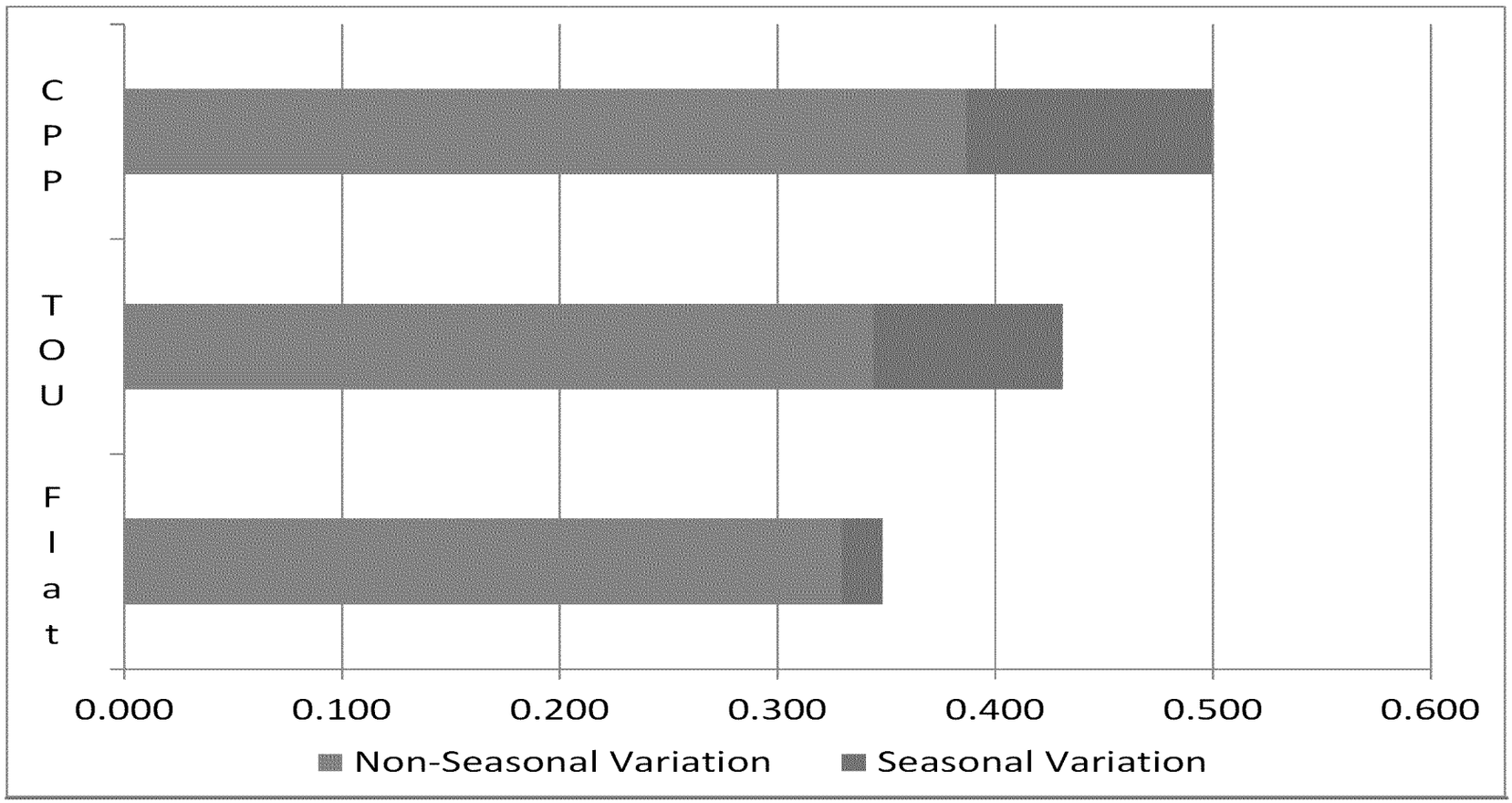
No Significant Difference by Income



- Even the small change reverses *within* regions

Bill Volatility Increases with TOU and CPP, mostly due to seasonal variation

(average coefficient of variation in monthly bills)



Impact of an opt-in CPP tariff under equitable pricing

- Impact on default flat-rate customers depends on who and how many opt in and how the dynamic prices change their load
- Simple calculation for a pretty bad case
  - Opt ins are drawn only from customers who would save at least $1 per month
  - Random 1/3 of those customers opt in
  - No change to their consumption pattern
- Would raise flat rate by 1.92% to 0.163/kWh

Conclusions

- Flatter tariff (drop IBP) or adding a fixed fee:
  - Has almost no cross-regional impact
    - Fixed fee might help inland areas slightly
  - Raises bills for poor consumers not on CARE
    - Most consume little above second tier so their loss is most of the fixed fee
    - Tradeoff between maintaining inefficient structure and using other programs to help low-income customers?
- Time-Varying tariffs (TOU or CPP)
  - Hurts valley regions
    - can be offset with adjustments to average rate
  - Small impact of opt-in tariff on non-participants