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The Value of Economic Pricing in a Low-Carbon Electricity System

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These Comments Reflect Only My Views

- Not necessarily those of the California Independent System Operator
- Not necessarily those of any other researchers at the Energy Institute at Haas
- Not necessarily those of the Bay Area Air Quality Management District

- And even my views are subject to change, and have changed over the last decade on dynamic pricing

In the "good" old days…

- A regulator's choices on tariff design were primarily about equity: who shoulders the costs?
  - Cost per unit of consumption varied by time and location, but regulators didn't have information or political inclination to tie prices to that variation
    - » Dumb electricity, gas and water meters begat dumb pricing
  - Cost did not increase with quantity consumed by the household, but regulators adopted increasing-block pricing
  - Common focus on pursuing equity goals
  - "sloppy rate making": unconnected to costs
- BUT "luckily" customers had few choices, so demand was fairly inelastic, resulting in less economic loss from sloppy rate making

But technology is changing all that

- Regulators have much more information about customer consumption patterns, and so do customers
- And customers have much more technology to optimize consumption against whatever tariff the regulators offer
  - smart devices, batteries, optimization algorithms
- Result: Two possible pathways
  - Efficient pricing: technology use optimizes deployment to maximize benefits for society
    - » Two-way communications
    - » Massively distributed responses to scarcity
  - Increased "regulatory arbitrage": customers use technology to take advantage of mis-pricing in the system
    - » Example: "managing electricity demand charges"

Why we care about setting prices to reflect (social marginal) cost?

- Departures from efficient pricing (P=SMC) cause behavior that reduces economic value creation
- Price below SMC encourages overuse
  - P<SMC encourages insufficient energy efficiency and wasteful use
- Price above social marginal cost discourages consumption that creates value
  - If SMC=$0.10, but utility charges P=$0.20, that discourages consumption that creates value
    - » Discourages transportation electrification
      - Makes cost of charging an electric vehicle gasoline equivalent price of $3.15/gallon rather than $1.58/gallon
    - » Discourages building electrification
    - » Discourages outdoor lighting that improves safety and other valuable uses

Two Ways in Which Electricity Pricing Fails to Reflect SMC

- Static retail price is too low or too high compared to average SMC
  - Typically driven by the need to cover total utility costs
- SMC actually can fluctuate quite a lot hour to hour, but retail price does not
  - Due to both technology and some customer aversion
- Both mispricings are exacerbated by lack of locational price variation
- Both mispricings are exacerbated by intermittent generation

- Borenstein & Bushnell (2019), "Do Two Electricity Pricing Wrongs Make a Right?: Costs Recovery, Externalities, and Efficiency" puts numbers to these problems

Static residential price is well above avg SMC in some parts of US, below in others

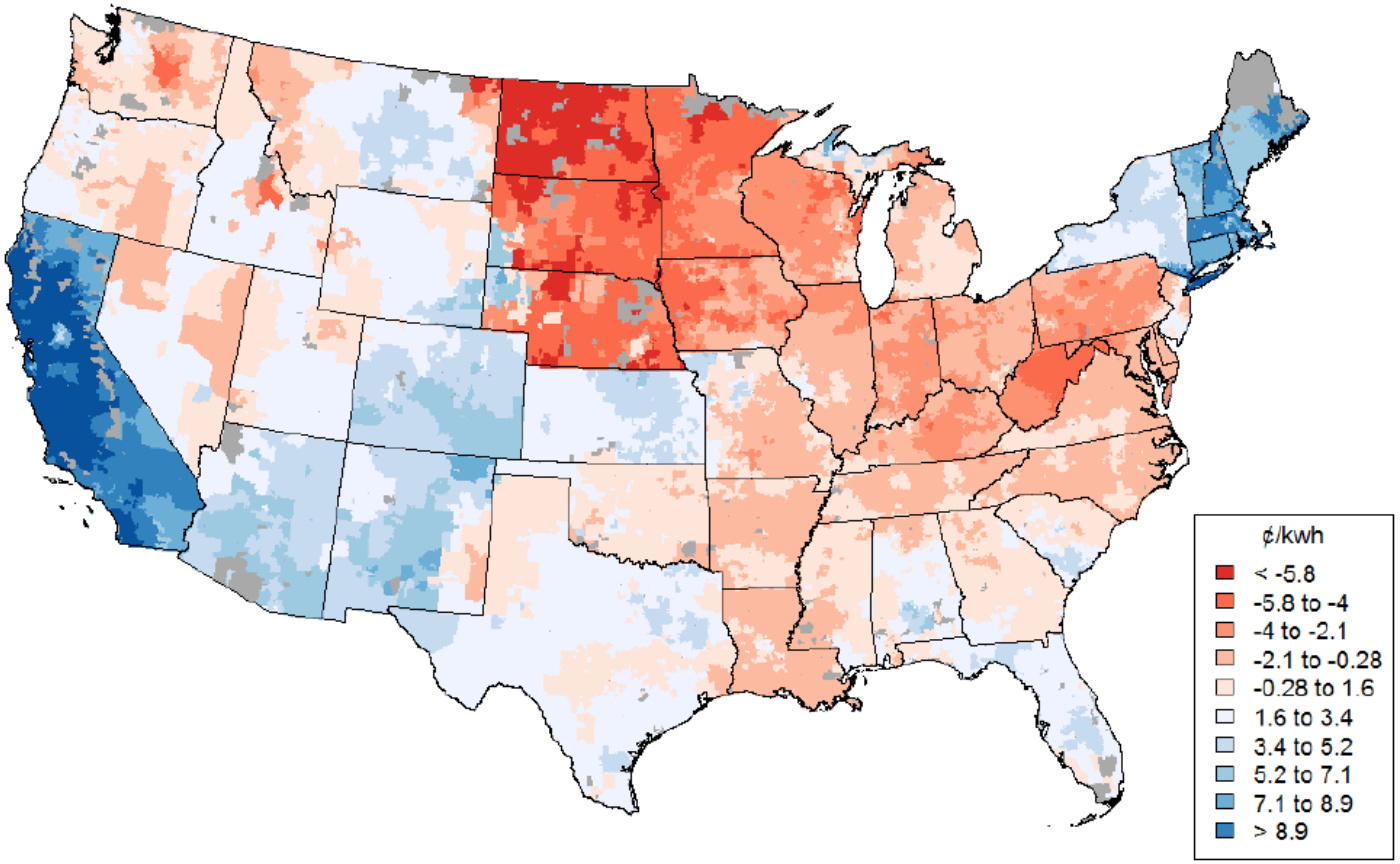

Figure 9: Marginal Price minus Average Social Marginal Cost per kWh

Price doesn't vary with time, so it is below SMC in some hours, above in others

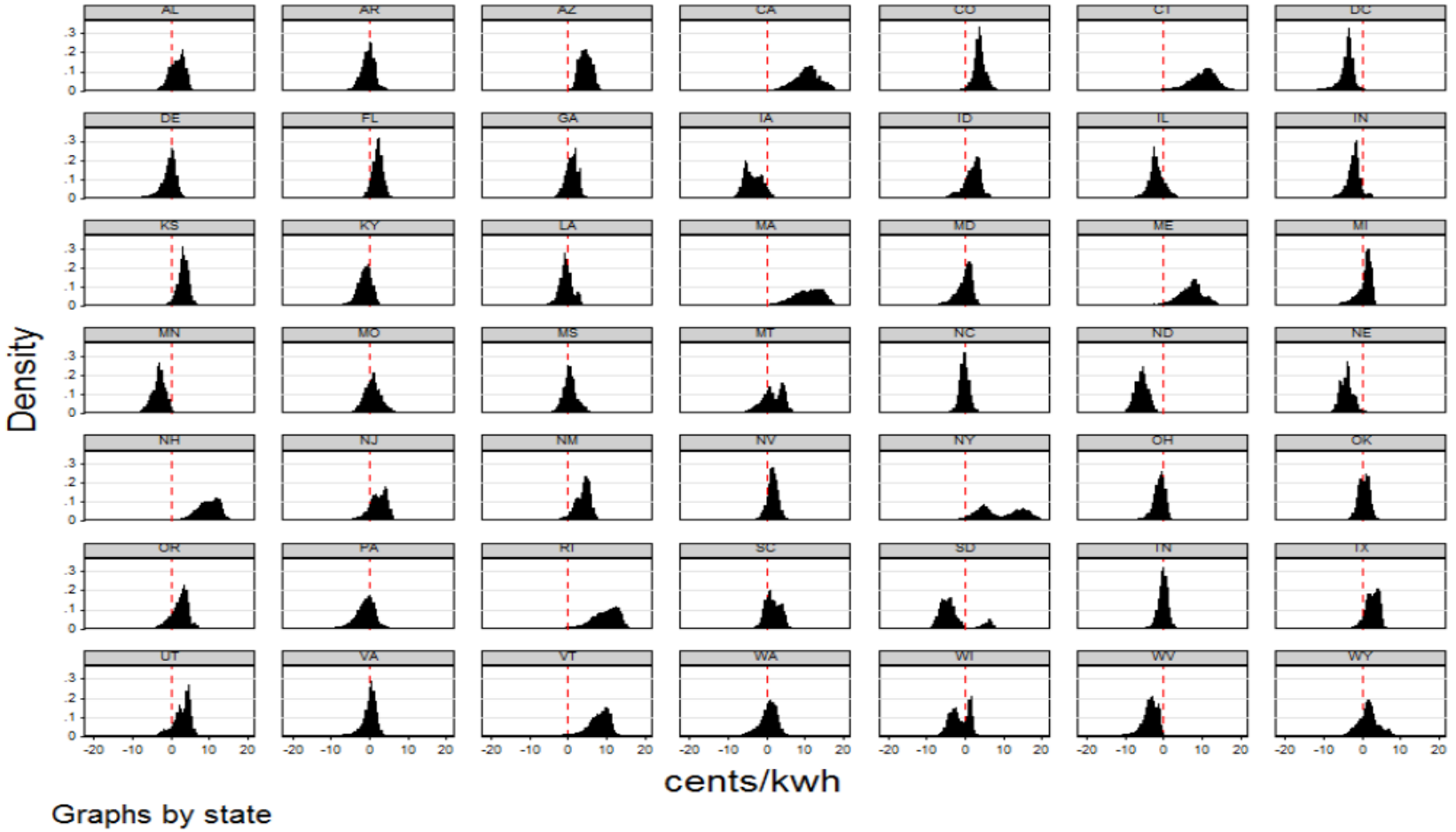

Figure 10: Marginal Price minus Hourly Social Marginal Cost by State

So why don't prices today reflect Social Marginal Cost more closely?

- More price and bill volatility than some customers want
  - But offering *optional* flat rate and providing hedging/bill smoothing can address these concerns
- Not worth the administrative cost, particularly if customers can't/won't respond to price
  - Widespread evidence that customers will respond
  - New technology is raising potential elasticity, but still have chicken/egg problem of technology adoption and usage
- Equity concerns
  - for low-income customers
  - for any customers whose bills would rise
- Revenue shortfall

In California, efficient pricing will still yield revenue shortfall

- Because much of transmission and distribution costs are fixed relative to quantity of electricity consumed
- Because utility revenue covers many other costs that are not marginal
  - Low-income subsidies, DG and EE programs, expensive past contracts
- Because declining demand due to DG and EE makes the revenue shortfall greater
  - Lowers SMC
  - *Because* price is set above MC, decline in quantity reduces net revenue even more

Electricity price pays for many things beyond electricity and many electricity costs that are not marginal

Rules and rates

You may be eligible for a lower rate. To learn more about optional rates or view a complete list of rules and rates, visit www.pge.com or call 1-800-743-5000.

If you believe there is an error on your bill, please call 1-800-743-5000 to speak with a representative. If you are not satisfied with our response, contact the California Public Utilities Commission (CPUC), Consumer Affairs Branch, 505 Van Ness Avenue, San Francisco, CA 94102, 1-800-649-7570 or 415-703-2032 (TDD/TTY).

To avoid having service turned off while you wait for a CPUC decision, enclose a deposit check (payable to the CPUC) for the disputed amount and a description of the dispute. The CPUC will only accept deposits for matters that relate directly to billing accuracy. If it is not possible for you to pay your deposit, you must advise the CPUC. PG&E can not turn off your service for nonpayment while it is under review by the CPUC, however, you must continue to pay your current charges to keep your service turned on.

If you are not able to pay your bill, call PG&E to discuss how we can help. You may qualify for reduced rates under PG&E's CARE program or other special programs and agencies may be available to assist you. You may qualify for PG&E's Energy Savings Assistance Program which is an energy efficiency program for income-qualified residential customers.

Important definitions

Rotating outage blocks are subject to change without advance notice due to operational conditions.

Tier *	% of Baseline
1	0% – 100%
2	> 100%

** Doesn't apply to EV & ETOUA/B*

Tier 1 / Baseline allowance: Some residential rates are given a Tier 1 / Baseline allowance - a CPUC approved percentage of average customer usage during summer and winter months. Your Tier 1 / Baseline allowance provides for basic needs at an affordable price and encourages conservation. Your allowance is assigned based on the climate where you live, the season and your heat source. As you use more energy, you pay more for usage.

High Usage: A state-mandated charge for energy consumption that exceeds four times the total Baseline Allowance (Tier 1). This charge does not apply to customers on a Time-of-Use rate.

DWR bond charge: Recovers the cost of bonds issued by the Department of Water Resources (DWR) to purchase power to serve electric customers during the California energy crisis. DWR bond charges are collected on behalf of DWR and do not belong to PG&E.

Power Charge Indifference Adjustment (PCIA): Ensures that non-exempt customers under PG&E's GT and ECR rate schedules or who purchase electricity (generation) from non-PG&E suppliers pay their share of generation costs.

Gas Public Purpose Program (PPP) Surcharge. Used to fund state-mandated gas assistance programs for low-income customers, energy efficiency programs, and public-interest research and development.

Visit www.pge.com/billexplanation for more definitions. To view most recent bill inserts including legal or mandated notices, visit www.pge.com/billinserts.

Your Electric Charges Breakdown	
Conservation Incentive	-$5.74
Generation	36.50
Transmission	11.77
Distribution	36.59
Electric Public Purpose Programs	6.39
Nuclear Decommissioning	0.63
DWR Bond Charge	2.34
Competition Transition Charges (CTC)	0.55
Taxes and Other	0.12
Total Electric Charges	**$89.15**

Options for recovering revenue above efficient time-varying pricing

- Average Cost Pricing
  - Recover all additional revenue from flat volumetric adder
- Tiered Pricing
  - Increasing-block or Decreasing-block pricing
- Fixed Charge (independent of quantity consumed)
- Demand Charges
  - Traditional definition: customer non-coincident peak usage
  - New usage: customer non-coincident usage during peak period
- Government Budget

- Combination of approaches

How does retail competition change retail rate setting challenges?

- Less than many people think
- Retail competition covers procurement of generation, possibly billing and customer service. Not transmission and distribution. Not most public purpose programs.
- Generation makes up less than 50% of retail price in many U.S. markets, much less in California.

Conclusion

- Technology is improving customer metering and responsiveness, which can improve efficiency
  - The sloppy ratemaking of the past depended on customers not being responsive
- Technology advances also increase the opportunity for inefficient "regulatory arbitrage", so increase the importance of cost-based pricing
- Intermittent renewables increase the volatility of social marginal cost, increase the value of cost-based pricing
- But, even efficient pricing at social marginal cost is likely to leave a revenue shortfall due to large fixed costs
- No easy solution to covering revenue shortfall
  - Some approaches are more vulnerable to regulatory arbitrage (eg, demand charges) than others (eg, fixed charges)
  - Very different equity implications
- Retail competition doesn't change the rate setting challenge

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