Economic Fundamentals of Electricity Rate Design for Commercial & Industrial Customers

Severin Borenstein
E.T. Grether Professor of Business & Public Policy
Haas School of Business and Energy Institute at Haas University of California, Berkeley
Four Fundamental Goals of Rate Design

- Economic Efficiency of Consumption: encouraging additional usage when -- and only when -- it is valued more than the full additional cost to society
- Equity: distributing costs among customers in a way that is consistent with societal views of fairness
- Ensuring Access: creating rates that ensure that all members of society are able to consume quantities necessary for basic needs
- Cost Recovery: allowing suppliers to recover costs, including the opportunity cost of capital
Why is there a Cost Recovery Problem?

Because rate design affects the other concerns:

- **Economic Efficiency** – prices that deviate from full social marginal cost create deadweight loss, i.e., reduce the total wealth created in the economy

- **Equity** – particularly the sense that fairness suggests large-quantity consumers should pay more towards recovering a revenue shortfall than small-quantity consumers

- **Ensuring Access** – with concern about a widening income inequality, desire to assure that low-income households can afford basic necessities such as energy

As supply and energy efficiency options grow

- Increased pressure on tariff policy from econ efficiency effects
- Volumetric sales decline, making existing tariffs less sustainable
Why we care about efficient pricing?: setting price equal to short-run social marginal cost

- Departures from efficient pricing cause behavior that reduces economic value creation.

- Price greater than short-run social marginal cost discourages consumption that creates value.
  - If SRSMC = $0.10, but utility charges P = $0.22, discourages consumption that creates value.
    - Raises cost of charging an electric vehicle relative to gasoline.
    - Or discourages outdoor lighting that improves safety.
  - P > SRSMC during belly of duck exacerbates over-generation.

- Price below SRSMC encourages overuse.
  - Setting P below SRSMC encourages insufficient energy efficiency and wasteful use.
Why efficient pricing is now more important than ever: technology

Path 1: Technology tightly integrates individual energy users with their regional grid
- Two-way communication between users and wholesale market operators.
- Massively distributed responses to changes in wholesale market conditions.
- Responses largely automated through home automation of thermostats and management systems

Path 2: Technology and policy encourages customers to strategically use/drop the grid: *regulatory arbitrage*
- DERs and DSM respond to prices that don’t reflect true system marginal costs, raising overall system costs
- E.G., using data analytics and storage to reduce customer demand charges when those charges don’t reflect real costs
So, start from setting volumetric price to reflect social marginal cost

- **Social** => includes costs of externalities whether or not the utility has to pay those costs
  - If utility doesn’t have to pay, pricing externalities is still efficient, and it raises additional revenue

- **Short-run Marginal Cost** =>
  - Short-run MC, *i.e.*, true incremental cost at that moment
    - electricity price is time-varying
  - Does not include costs that are sunk or fixed at that time
  - But does include anything that requires adjustment if more electricity is provided during a given time interval

- Efficient consumption incentives aren’t the only goal, but are a starting point for tradeoffs
Which costs are part of marginal cost?

- **Generation**
  - Incremental fuel, variable operation & maintenance costs of the supplier of the marginal MWh
  - Scarcity cost (loss of value) if another customer must forgo a MWh of consumption – a capacity constraint
  - Cost of bringing additional reserves online, if required
  - **NOT** the cost of funding additional capacity in the future, or of past capacity investments
    - Examples with short run over-capacity or under-capacity
    - These cost must still be covered, but they are not short-run MC
Which other costs are part of marginal cost?

- **Transmission & Distribution**
  - Line losses and Variable O&M (e.g., transformer wear)
    - *Marginal* line losses are much higher than *average* line losses
  - Grid stability costs (e.g., voltage support, reactive power)
  - Scarcity costs if at capacity

- **Retailing, Billing, Customer Support**
  - Very little or no marginal cost
Efficient pricing will generate revenue towards fixed and sunk costs

![Graph showing demand and marginal cost](image-url)
More so if externalities are not paid by utility, but still priced in electricity.

![Graph showing demand, marginal cost, social marginal cost, and additional revenue from pricing externalities.](image-url)
Addressing bill/revenue volatility under SRSMMC pricing

- SRSMMC is much more volatile than most customers are used to – hr to hr and year to year
- Creates more bill volatility for customers and revenue volatility for utility than is desired
- “Pre-purchase” (hedge) contracts address this concern in other industries
  - Specify fixed quantity at fixed price
  - Standard contract in fuels, metals, and other commodities
  - Departures from fixed quantity are still priced at volatile SRSMMC
  - Greatly reduces bill/revenue volatility while maintaining efficient price incentives
But for most utilities, efficient pricing will still yield revenue shortfall

- Because much of distribution costs are fixed relative to quantity of electricity consumed
- Because utility revenue covers many other costs that are not marginal
  - Low-income, DG and EE programs. Expensive past contracts.
- Because reduced quantity means lower MC

- Plus declining demand due to DG and EE makes the revenue shortfall greater
  - Because price is set above MC, so decline in quantity reduces net revenue
Options for Recovering Revenue Above Efficient Time-Varying Pricing

- Average Cost Pricing
  - Recover additional revenue from fixed volumetric adder
  - Recover additional revenue from multiplicative volumetric adder

- Fixed Charge (independent of quantity consumed)
  - Uniform to cover billing/metering
  - Variable by attributes of customer line drop
  - Variable by distribution capacity “reserved”

- Demand Charges
  - Traditional definition: customer non-coincident peak usage
  - New usage: customer non-coincident peak usage during peak period
Fixed Charges

- Very attractive on efficiency grounds because very low elasticity of connection in response
  - Though not zero: shared connections to avoid fixed charge

- But real issues of equity
  - Should corner store’s fixed charge be the same as Apple’s?
    - Could even impact entry/exit of small firms
  - Distinction on usage or service level means it’s not a fixed charge

- In residential, concern about impact on low-income consumers

- Claim that “Fixed costs should be recovered with fixed charges” is not grounded in economics
Demand Charges

- Old “demand charge” – non-coincident peak -- had only cost basis in customer’s service level
  - Why not charge directly for service level?

- New “demand charge” -- for customer peak usage during peak period
  - Still not capacity/scarcity cost causation as dynamic pricing

- Even peak-period demand charge fails to address actual level of system stress
Differences between demand charges and dynamic pricing

- Demand charges do not reflect variation in marginal cost (except in “last mile” of distribution)
  - Don’t target the hour(s) of highest cost supply

- Demand charges create a more stable revenue stream than simply setting price equal to short-run social marginal cost
  - Low demand year => SRSMC create revenue shortfall
  - But hedge contracts will also create revenue stability
Conclusion

- There is no perfect answer to meeting the revenue shortfall from efficient pricing
- Efficient pricing isn’t the only goal
  - Equity
  - Ensuring access
  - Revenue adequacy and low revenue/bill volatility
- The challenge is to maintain as efficient consumption incentives as possible while also addressing other policy goals
Thank You

- This presentation is based substantially on Severin Borenstein, “The Economics of Fixed Cost Recovery by Utilities”, *The Electricity Journal*, 2016 part of Lawrence Berkeley National Laboratory’s Future Electric Utility Regulation series funded by the U.S. Department of Energy.

Some other related research:

