Economic Fundamentals of Electricity Rate Design for Commercial & Industrial Customers

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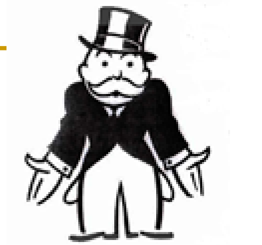
Four Fundamental Goals of Rate Design

- 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

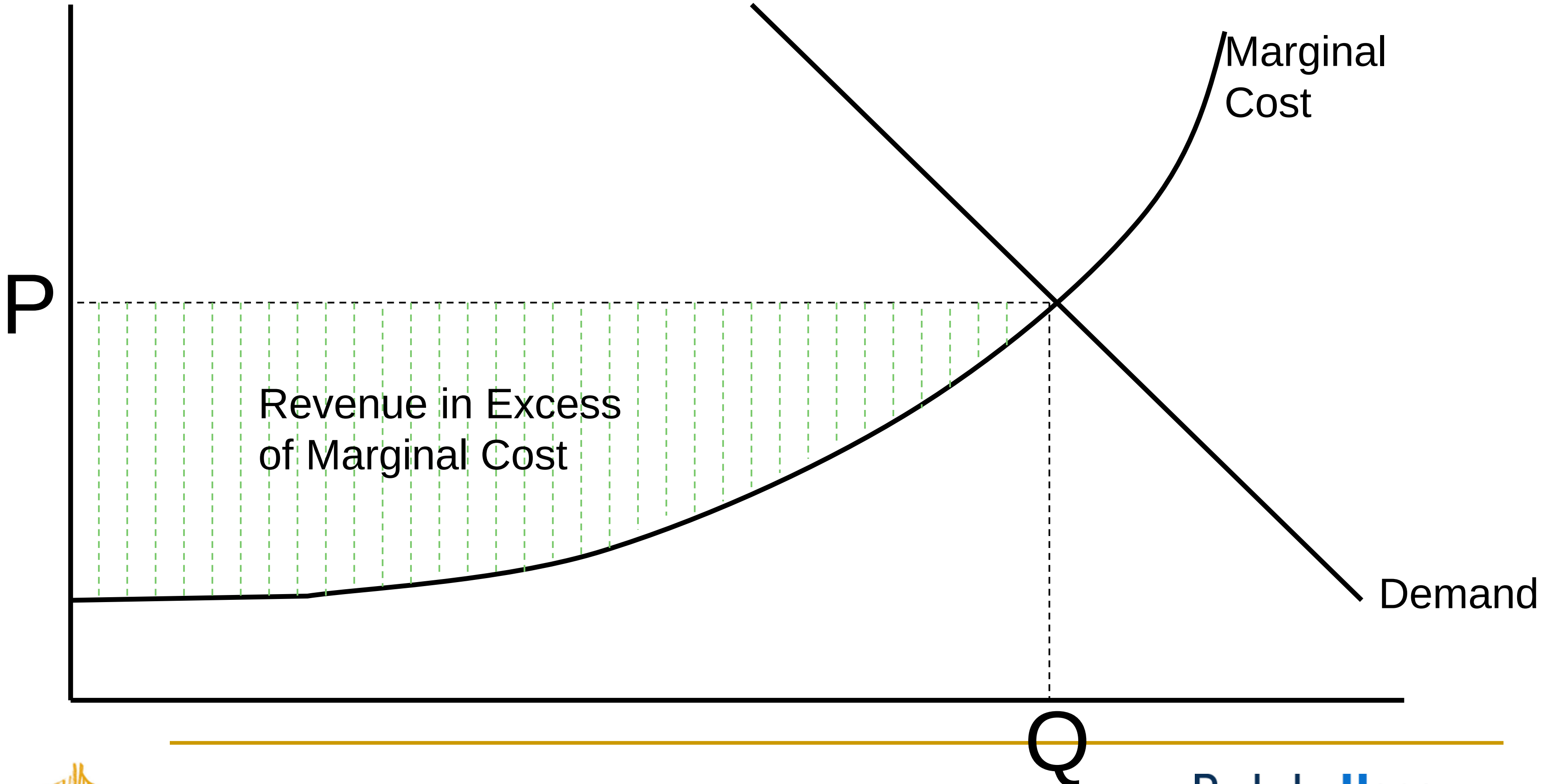
Which costs are part of marginal cost?

- 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

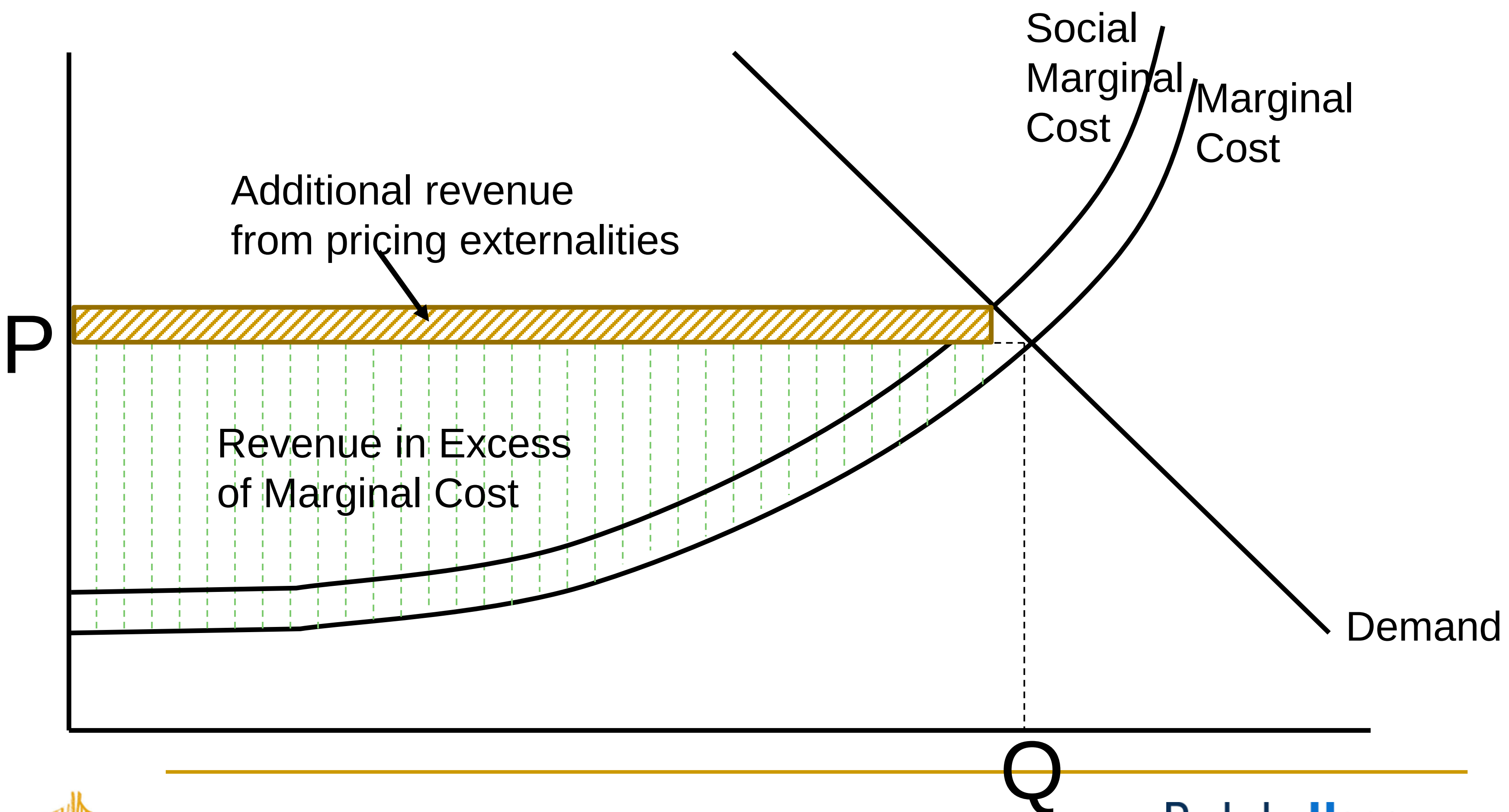
Which other costs are part of marginal cost?

- 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



More so if externalities are not paid by utility, but still priced in electricity



Addressing bill/revenue volatility under SRSMC pricing

- SRSMC 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 SRSMC
  - 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:

-- Severin Borenstein, “Effective and Equitable Adoption of Opt-In Residential Dynamic Electricity Pricing,” *Review of Industrial Organization*, March 2013, 42(2).

-- Severin Borenstein and James Bushnell, “The U.S. Electricity Industry After 20 Years of Restructuring”, Annual Review of Economics, 2015, 7

-- Severin Borenstein, "Customer Risk from Real-Time Retail Electricity Pricing: Bill Volatility and Hedgability," The Energy Journal, 28(2), 2007.