Best Practices in Tariff Design

Prepared By Ahmad Faruqui, Phil Hanser, and Neil Lessem

Cost of Service and Tariff Design Workshop
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THE Brattle GROUP

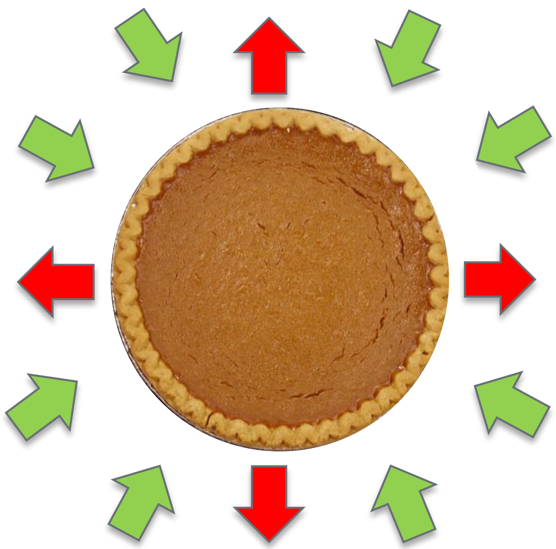
THE LANTAU GROUP
strategy & economic consulting

Agenda

1. How do we get utility tariffs?
2. Why does tariff design matter?
3. What are the principles of tariff design?
4. What tariff options are there?
5. How do we study the costs underlying tariffs?
6. What are the steps in the tariff design process?
7. How can customers get involved in tariff design?
8. Appendix A: The Bonbright Criteria
9. Appendix B: tariff Definitions and Descriptions

The tariff design process – as easy as pie!

Incentive Based Regulation	Cost Of Service Study	Tariff Design



How large is the pie?	*How do we slice the pie?*	*How should the slices be served?*

Tariffs are the means by which costs are assessed on customers

Unregulated Market

Competitive markets

- Competitive pressures set prices and quantities at efficient levels
- Socially optimal
  - If no externalities

Monopolies

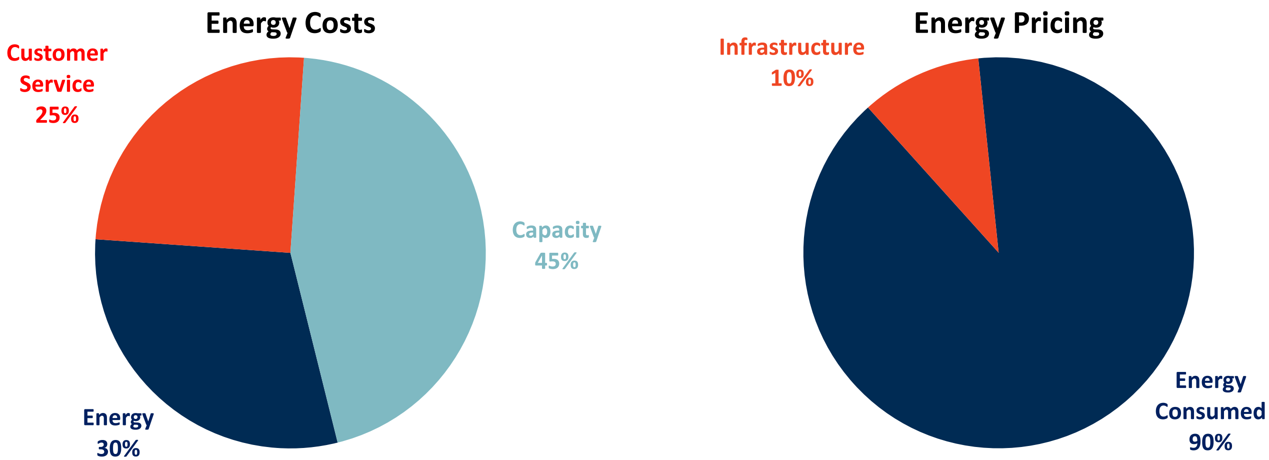
- Incentive to raise prices and restrict quantities to maximize profits
- Not socially optimal

Regulated Market

Monopolies

- Regulators set prices
- Prices are set to equal average costs.
  - Ensures producer recovers costs
  - Improves consumer welfare
- As a result, regulated monopoly tariffs are cost-based

Mismatching tariffs and the costs underlying those tariffs can cause several issues



An illustrative example from a US investor-owned utility

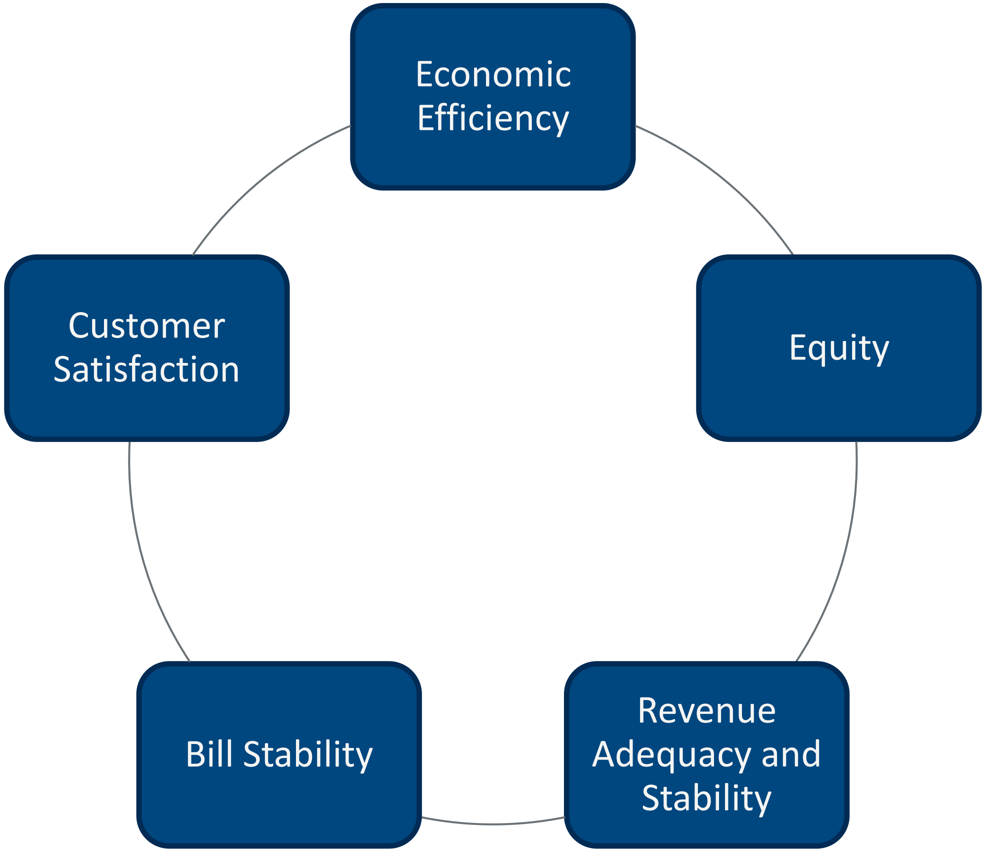
- Inefficient behaviors
- Non-optimal investments in long lasting durables
- Inadequate revenue recovery
- Increased risk and higher costs of capital
- Intra-class subsidies

Besides economic efficiency there are other reasons that tariffs matter

Customer	Utility	Society	Economy
Equitable (no subsidies)	Revenue Recovery		Efficient Behavior
	Minimize Risk/Costs (Cost of Capital)		Optimal investments

Professor Bonbright of Columbia University laid out 10 criteria for designing tariffs

Bonbright's criteria can be distilled into 5 Core Principles



Relating tariff Principles to Goals

Inside Goals	Customer Satisfaction	Revenue Adequacy and Stability	Bill Stability	Equity	Economic Efficiency
	Understandable	Revenue Recovery	Stable/ Predictable	Equitable (no subsidies)	Efficient Behavior
	Actionable	Minimize Risk			Optimal investments

Outside Goals	Protect vulnerable customers	Provide progressive transfers	Nurture infant industries?	Internalize externalities?

Prices should not be used to accomplish outside goals

Price act as a signal of value

- Cost reflective prices insure the efficient usage of resources

Outside goals are better instituted with direct subsidies

- For example Madison Gas and Electric waives the customer (fixed) charge for low income customers

Subsidies should be based on customer attributes not usage

- Can create perverse incentives to change usage patterns

May not effectively reach targeted group

- For example PG&E found that low income is not the same as low usage

There are many tariff options…

- Flat tariffs
- Two-Part Tariffs
- Inclining Block Rates (IBR)
- Declining Block Rates (DBR)
- Time-of-Use (TOU)
- Maximum Demand Charges
- Coincident Demand Charges
- Variable Peak Pricing (VPP)
- Critical Peak Pricing (CPP)
- Peak Time Rebates (PTR)
- Real-Time Pricing (RTP)
- Electric Vehicle tariffs
- Prepaid tariffs
- Flat Bill (akin to Netflix pricing)

To create cost based tariffs for each customer class you need to study the cost of serving them

Customer classes require different services from the utility

- Ability to instantaneously meet their energy needs at any moment
- Ability to continuously provide energy at all times of the day
- Customer service in managing energy, bills, outages, etc.

Different services have different costs

A Cost of Service (COS) study allocates costs to customer classes

- separated into costs varying with energy consumption, demand needs, and customers' requirements

There are two main types of Cost of Service study

- The vast majority of jurisdictions use **Embedded/Accounting COS** (*i.e.,* based on accounting book data and actual class load characteristics) for cost allocation

- **Marginal COS** is used for the development of time-of-use pricing, demand-side management, energy efficiency evaluation, and, in a small minority of jurisdictions, for actual cost allocation
  - Uses future incremental costs of serving customers

- Not an exact science – reasonable people can disagree

Cost of Service is based on costs over a "test year"

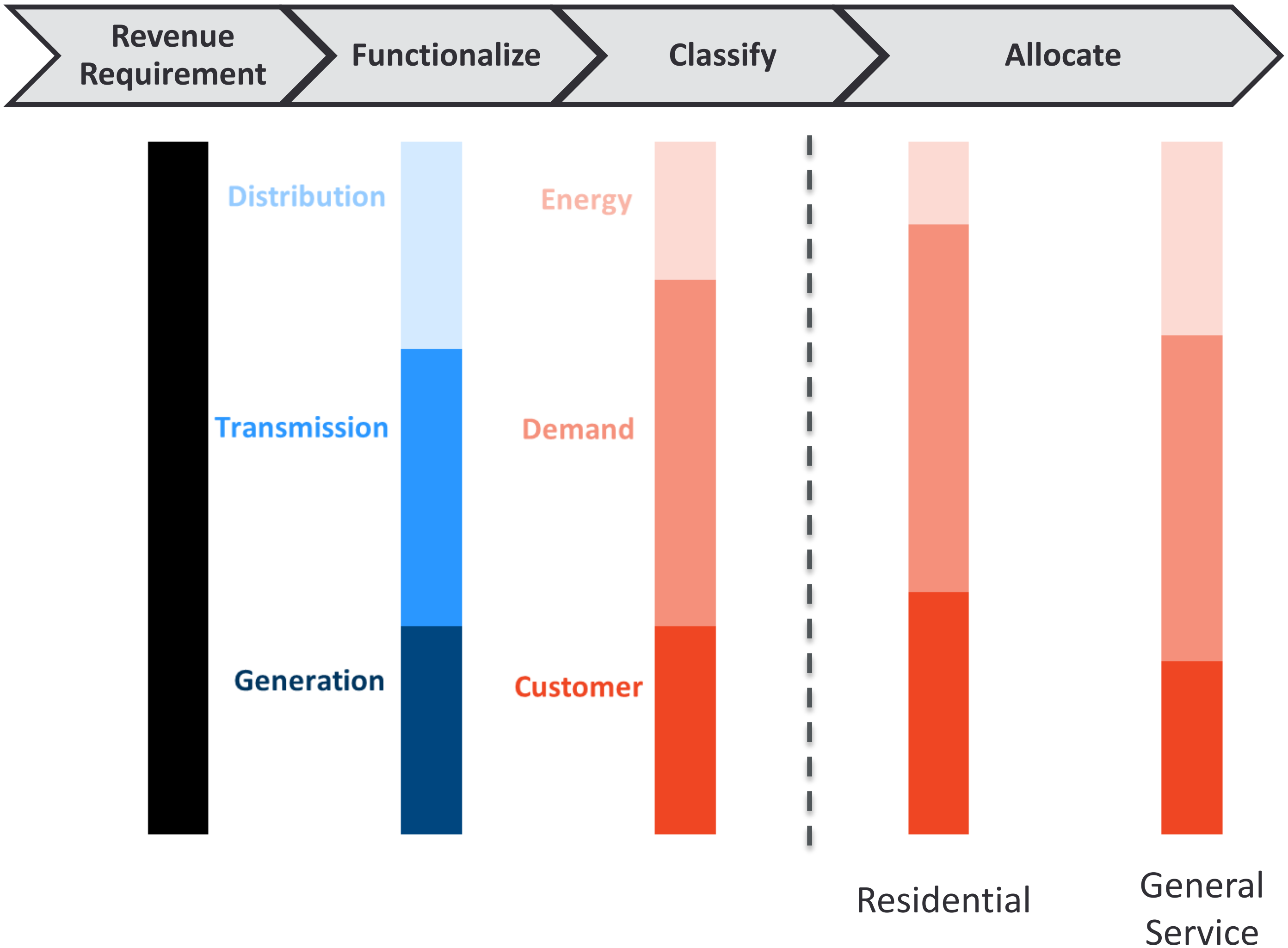
- A 12-month operating period used in tariff regulation to evaluate the utility's cost of service

- Several types of test years
  - **Historic Test Year:** costs and sales that actually occurred on the books during the test year, usually the most recent 12-month period ending on Dec. 31

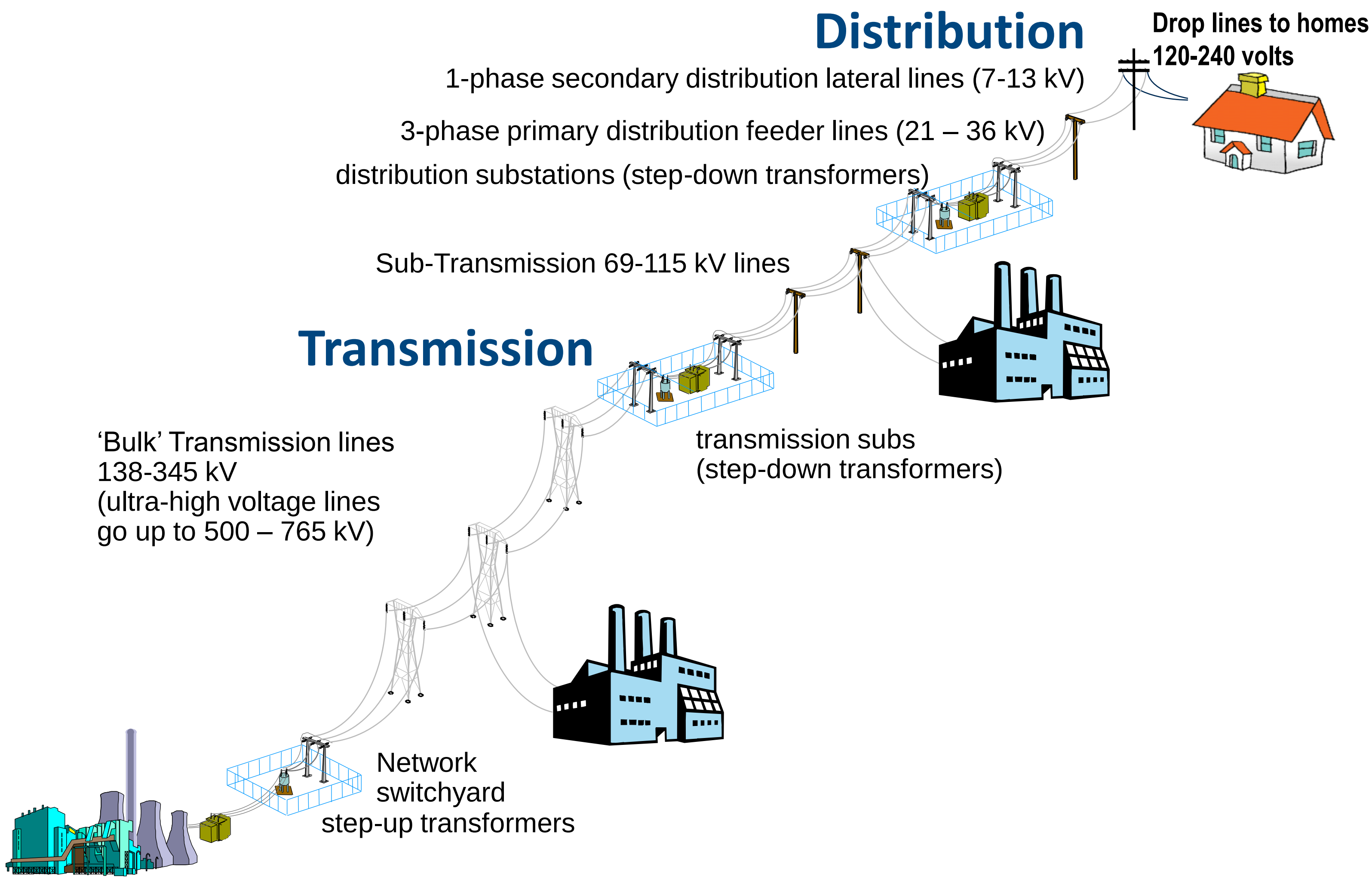
  - **Adjusted Historic Test Year:** adjust the actual book costs based on known and measurable changes

  - **Future (or forecasted) Test Year:** costs and sales are predicted based on forecasting techniques

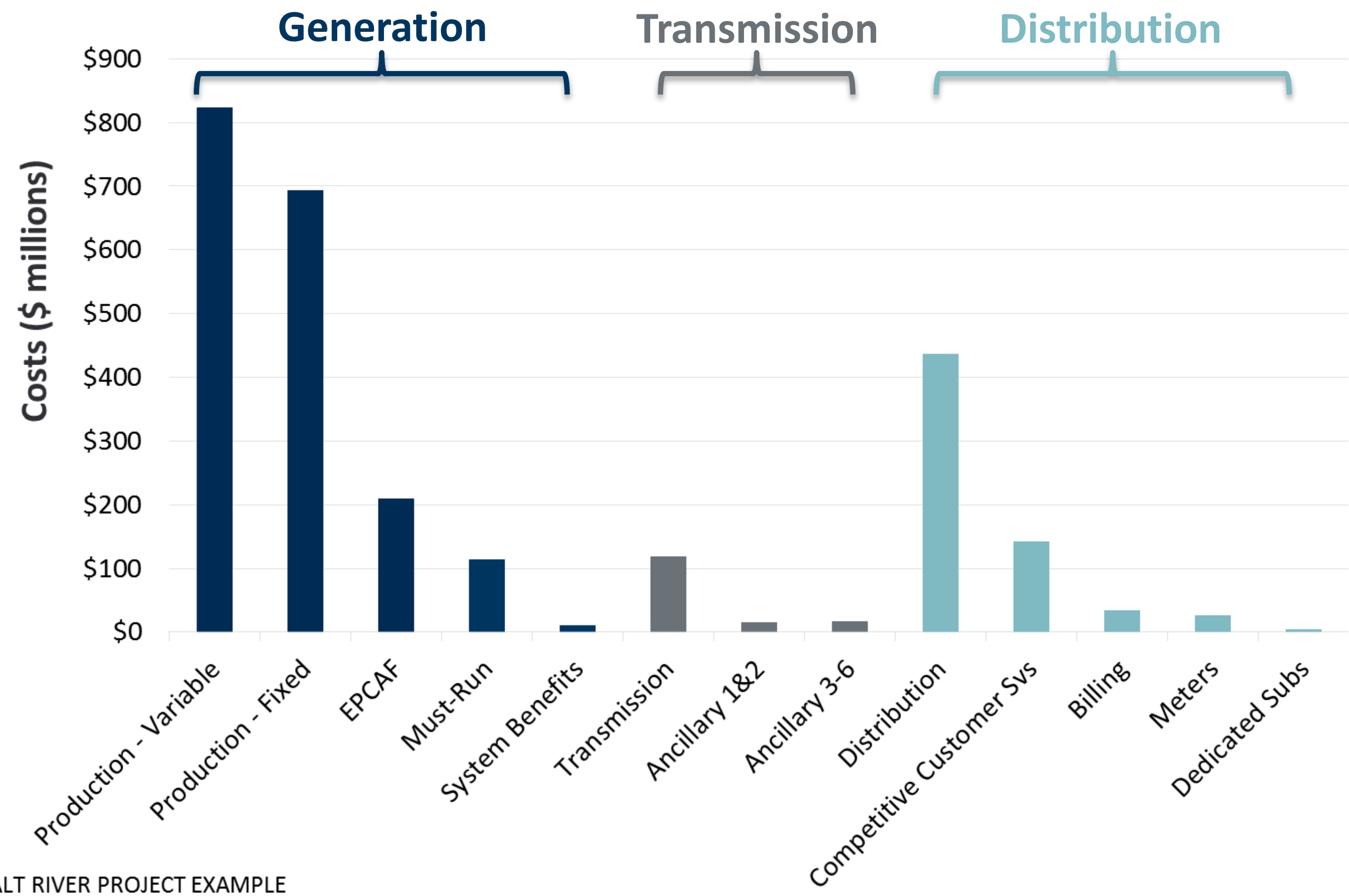
Cost of Service involves a number of steps to move from the utility's revenue requirement to cost allocation



Step 1: Functionalization

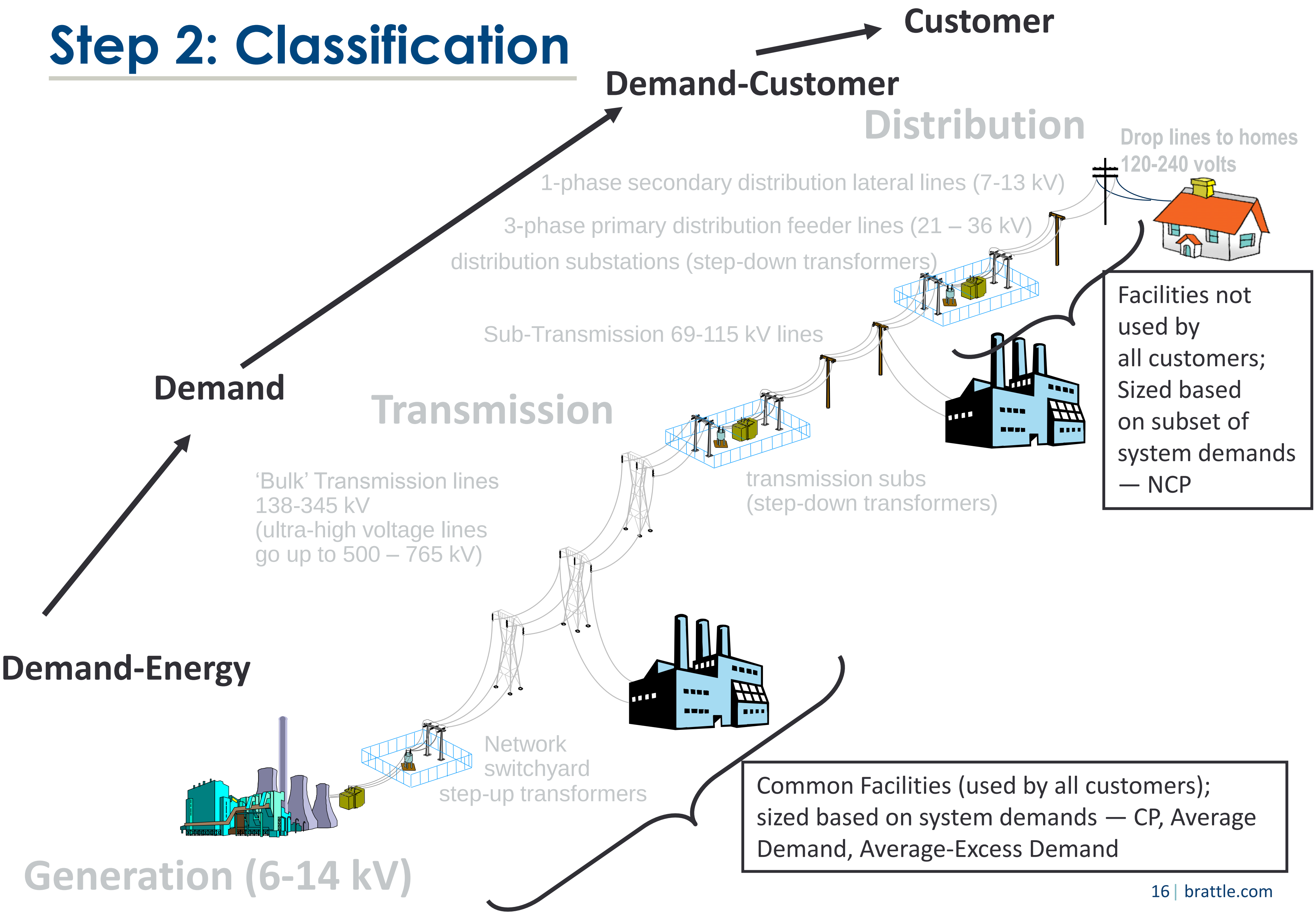


Step 1: Functionalization



SALT RIVER PROJECT EXAMPLE
Source: Unbundled Revenue Analysis in Support of Proposed Adjustments to SRP's Standard Electric Price Plans Effective with the April 2015 Billing Cycle
Note: EPCAF denotes SRP's Environmental Programs Cost Adjustment Factor

Step 2: Classification

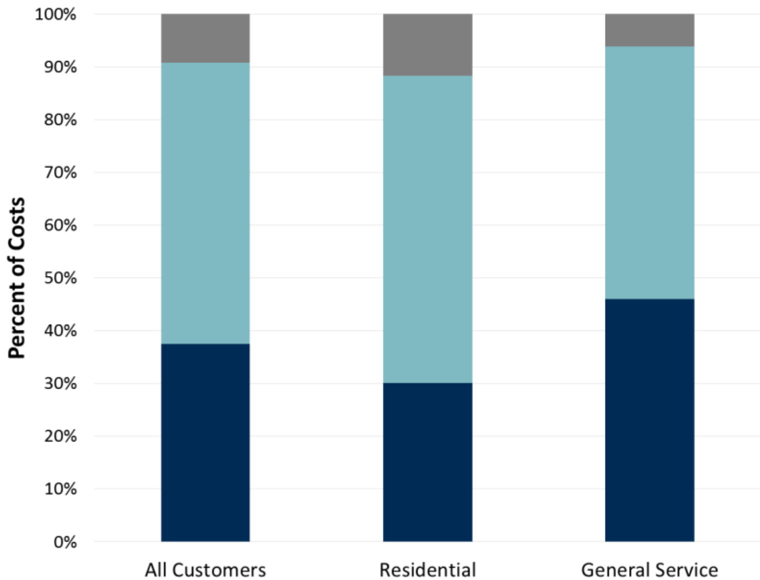


Step 2: Classification

Costs can vary based on energy consumption (kWh), demand (kW), or number of customers

Example of NV ENERGY

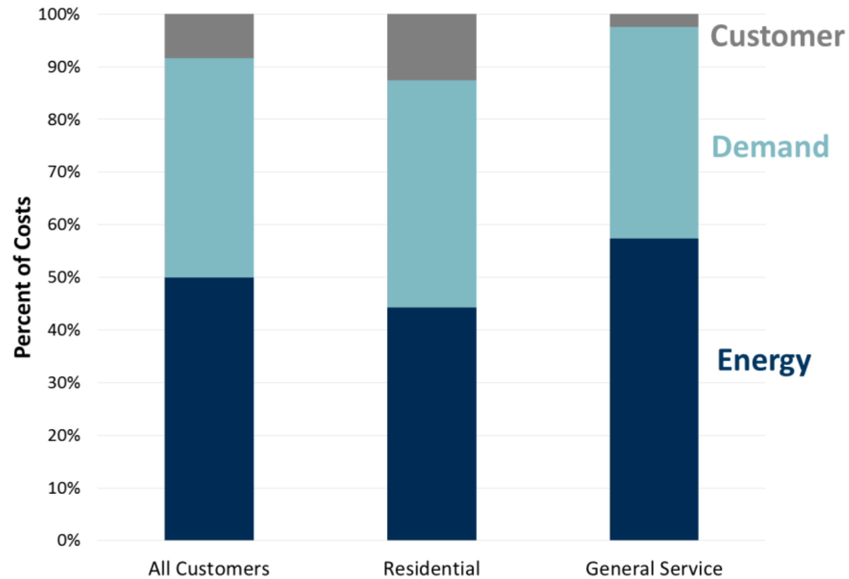
Marginal CoS



Source: NV Energy 2014 Rate Case, Testimony of Jeffrey Bohrman.

Example of APS

Embedded CoS



Source: Schedule G-4, APS 2011 Cost of Service study.

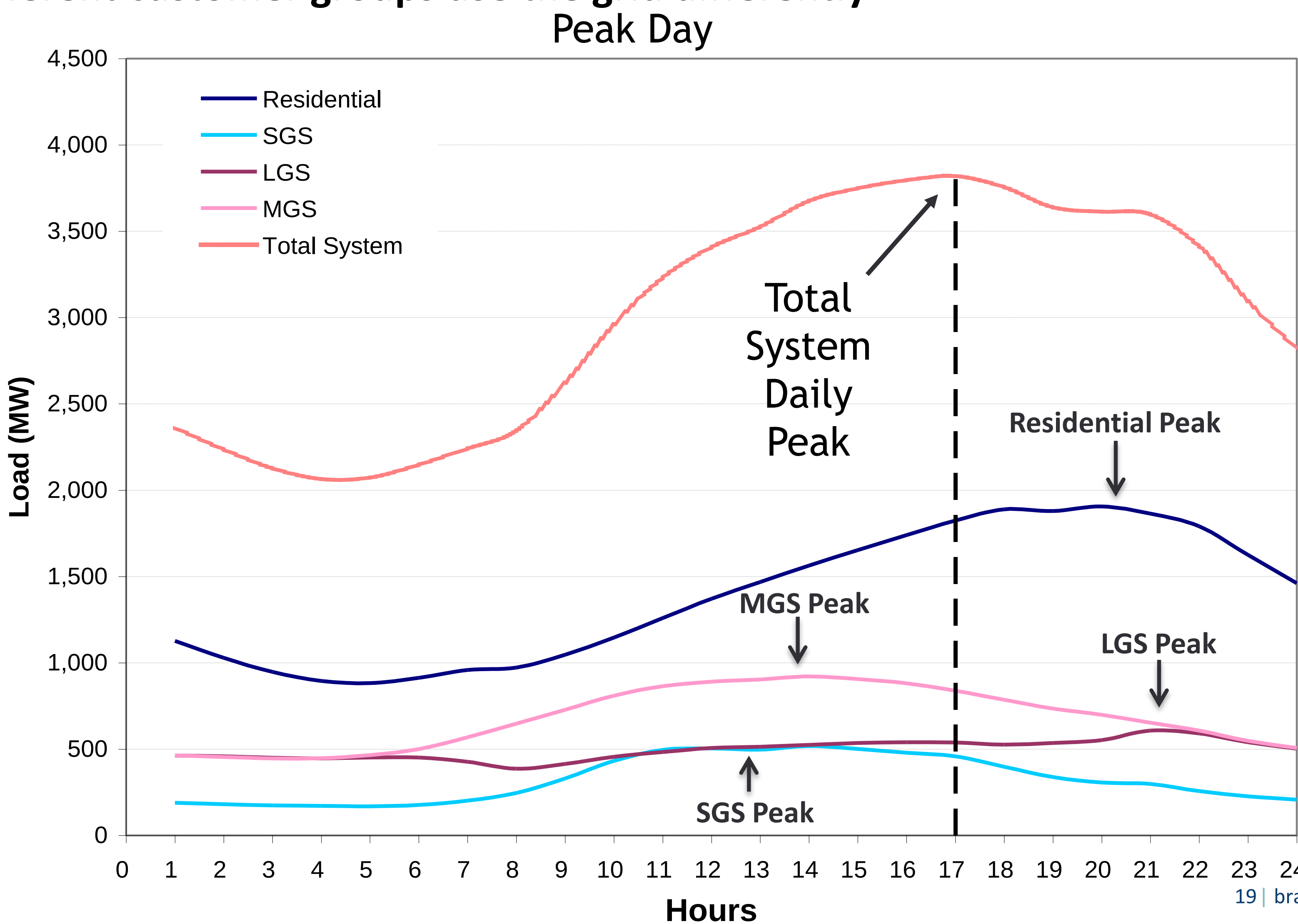
Step 3: Allocation

How should the rent of a two-bedroom house shared by a married couple and a single person be allocated?

- What drives rent costs? (*i.e.,* what are the cost drivers?)
  - Married couple argues it's the number of bedrooms
  - Single person argues it's the total size of the house and yard required to accommodate three household members
- Cost drivers help in choice of appropriate allocation methods
  - Married couple says use "relative number of bedrooms" method (50% of rent goes to married couple and 50% of rent goes to single person)
  - Single person says use "relative number of people" method (67% of rent goes to married couple and 33% of rent goes to single person)

Step 3: Allocation

Different customer groups use the grid differently



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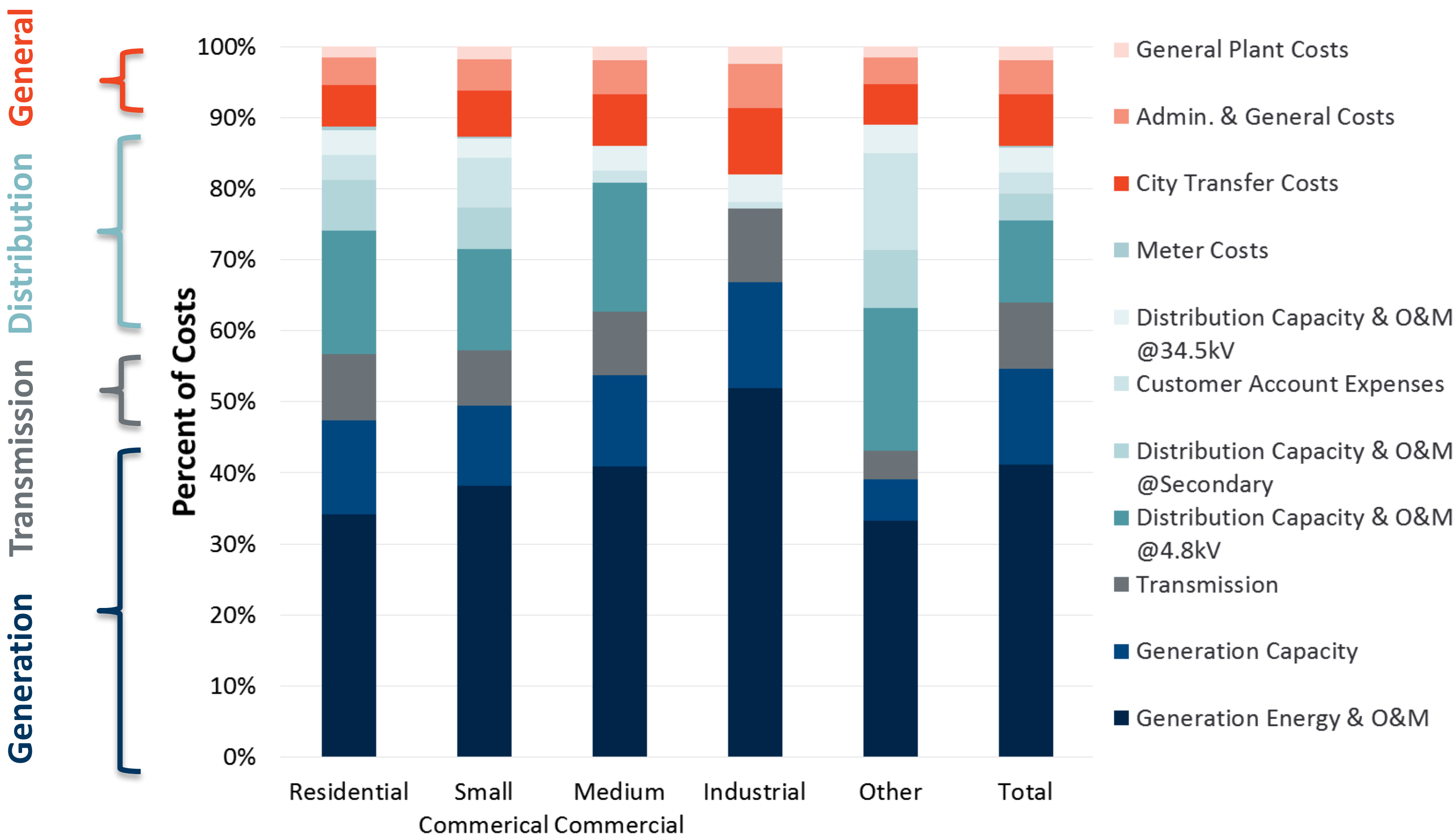


LOS ANGELES DEPT. OF WATER AND POWER EXAMPLE

Source: 2014 Power Service Cost of Service Study, Los Angeles Department of Water and Power

Once costs are allocated, tariffs are designed to recover costs for the utility

There can be a tension between being cost reflective and being easy to understand

- Different classes have different abilities to understand and manage their energy use

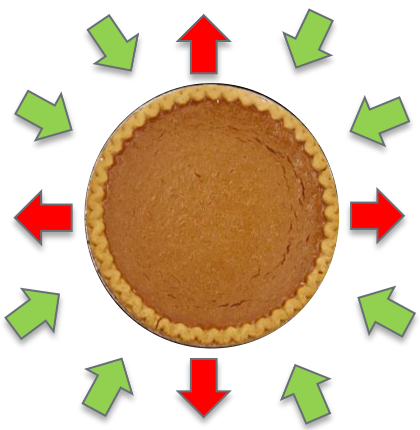
Tariff options will depend on the underlying meter technology

- The costs and benefits of more complex meter technologies vary by customer class

Tariff options may reflect other societal constraints

How can customers influence tariff design?

Incentive Based Regulation



What assumptions are driving costs?
- *Load growth scenarios*
- *Projected costs*
- *Non-energy goals*
- *Cost of capital*

Cost Of Service Study

- *Are costs correctly functionalized and classified?*
- *Are cost drivers driving costs?*
- *Are projected load forecasts correct?*

Tariff Design

- *Do tariffs create bill risks for certain customers?*
- *Are tariffs understandable and actionable?*

Conclusion/Discussion

Good tariff design is needed to create a robust and sustainable grid

- Distortions in price are not economically sustainable

Tariffs are ultimately set by government

BUT customers can give feedback in the process

- Tariff design and cost of service is not an exact science
- But there are parameters guiding discussion
  - Cost of Service is calculated in a robust and accepted framework
  - Principles of good tariff design reflect the societal goals from multiple perspectives
  - Cost-causation is a common thread

Presenter Information

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Ahmad Faruqui is an internationally recognized expert on rate design. He has testified or appeared before regulatory bodies, governmental agencies, and legislatures in the US and abroad. The venues have included Alberta, Arizona, Australia, California, the District of Columbia, Connecticut, Illinois, Indiana, Maryland, Michigan, Minnesota, New Mexico, Oklahoma, Ontario and Saudi Arabia. Ahmad's academic, consulting and research activities have spanned four decades, during which time he has advised more than 125 clients in 34 states, the District of Columbia, and eleven countries. He has made the case for cost-based rates at conferences, seminars and workshops on six continents. His work has been cited in The Economist, Forbes, Fortune, National Geographic, The New York Times, The Times (London) and the Washington Post. He has appeared on Fox Business News and NPR. He has authored, co-authored or co-edited more than 150 articles, editorials, papers and books on various aspects of efficient energy use. He holds a doctorate in economics from the University of California at Davis, where he was a Regents Fellow, a master's in agricultural economics from the same university, and baccalaureate and master's degrees from the University of Karachi, Pakistan, both with the highest honors.

Presenter Information

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Mr. Hanser assists clients in issues ranging from utility industry structure and market power and associated regulatory questions, to specific operational and strategic issues, such as transmission pricing, generation planning, and tariff strategies. He also has expertise in fuels procurement, environmental issues, forecasting, marketing and demand-side management, and other complex management and financial matters.

Over his thirty years in the industry, Mr. Hanser has appeared as an expert witness before the Federal Energy Regulatory Commission (FERC), the California Energy Commission (CEC), the New Mexico Public Service Commission (NMPSC), the Public Service Commission of Wisconsin (PSCW), the Vermont Public Service Board (VPSB), the Public Utilities Commission of Nevada (PUCN), the Connecticut Siting Commission, the Pennsylvania Department of Environmental Protection, and before arbitration panels and in federal and state courts. He has also presented before the National Association of Regulatory Utility Commission (NARUC) and the New York State Energy Research and Development Authority (NYSERDA). He served six years on the American Statistical Association's Advisory Committee to the Energy Information Administration (EIA).

Prior to joining The Brattle Group, Mr. Hanser held teaching positions at the University of the Pacific, University of California at Davis, and Columbia University, and served as a guest lecturer at the Massachusetts Institute of Technology, Stanford University, and the University of Chicago. He has also served as the manager of the Demand-Side Management Program at the Electric Power Research Institute (EPRI). He has been published widely in leading industry and economic journals.

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Dr. Lessem assists utilities, policymakers and technology firms across North America, Asia, the Middle East and Australia on rate design, energy policy, innovative pricing, experimental design, technology adoption and policy impact measurement. He has broader expertise in energy, applied microeconomics, environmental economics, and behavioral economics. In his graduate studies, Dr. Lessem conducted extensive research examining consumer adoption of environmentally-friendly products and conservation behaviors, utilizing both field experiments and utility data.

Dr. Lessem holds a Ph.D. and M.A. in Economics from the University of California, Los Angeles and a B.Bus.Sc in Economics and History from the University of Cape Town (South Africa), where he graduated with top honors.

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7. **Appendix A: The Bonbright Criteria**
8. Appendix B: Tariff Definitions and Descriptions

Professor Bonbright of Columbia University laid out 10 criteria for designing tariffs that encapsulate many of these ideas

1. Effectiveness in yielding total revenue requirements under the fair-return standard without any socially undesirable expansion of the rate base or socially undesirable level of product quality and safety

2. Revenue stability and predictability, with a minimum of unexpected changes that are seriously adverse to utility companies

3. Stability and predictability of the tariffs themselves, with a minimum of unexpected changes that are seriously adverse to utility customers and that are intended to provide historical continuity

4. Static efficiency, i.e., discouraging wasteful use of electricity in the aggregate as well as by time of use

5. Reflect all present and future private and social costs in the provision of electricity (i.e., the internalization of all externalities)

The Bonbright criteria

6. Fairness in the allocation of costs among customers so that equals are treated equally

7. Avoidance of undue discrimination in tariff relationships so as to be, if possible, compensatory (free of subsidies)

8. Dynamic efficiency in promoting innovation and responding to changing demand-supply patterns

9. Simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application

10. Freedom from controversies as to proper interpretation

Deriving the 5 Core Principles

10 Bonbright Principles

1. Effectiveness in yielding total revenue requirements under the fair-return standard without any socially undesirable expansion of the rate base or socially undesirable level of product quality and safety.
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5 Core Principles

- Economic efficiency
- Equity
- Revenue adequacy and stability
- Bill stability
- Customer satisfaction

The 5 Core Principles

1. **Economic efficiency**: the price of electricity should convey to the customer the cost of producing it, ensuring that resources consumed in the production and delivery of electricity are not wasted. If the price is set equal to the incremental cost of providing a kWh, customers who value the kWh more than the cost of producing it will use it and customers who value it less will not.
2. **Equity**: no customer should unintentionally subsidize another customer. A classic example of the violation of this principle occurs under purely volumetric pricing where there is no price differentiation by time of day. Since customers have different load profiles, "peaky" customers, who use more electricity when it is most expensive, are subsidized by less "peaky" customers who overpay for cheap off-peak electricity.
3. **Revenue adequacy and stability**: tariffs should recover the authorized revenues of the utility and should promote revenue stability. Theoretically, all tariff designs can be implemented to be revenue neutral within a class, but this would require perfect foresight of the future. Changing technologies and customer behaviors make load forecasting more difficult and increase the risk of the utility either under-recovering or over-recovering costs when tariffs are not cost reflective.

The 5 Core Principles

1. **Bill stability:** customer bills should be stable and predictable. tariffs that are not cost reflective will tend to be less stable over time, since both costs and loads are changing over time. For example, if fixed infrastructure costs are spread over a certain number of kWh's and the number of kWh's halves between rate cases, then the price per kWh will double when tariffs are revised, even though there has been no change in the underlying infrastructure cost of the utility.
2. **Customer satisfaction:** tariffs should enhance customer satisfaction. For a tariff to work as planned, customers need "buy in" to the tariff. Because most residential customers devote relatively little time to reading their electric bills, tariffs need to be relatively simple to understand and simple to respond to. Giving tariff choices to customers can also help enhance customer satisfaction, since risk tolerances for price volatility versus stability vary across customers.

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More detail and discussion is available in this appendix for ten tariff options

- Critical Peak Pricing (CPP)
- Maximum Demand Charges
- Coincident Demand Charges
- Electric Vehicle (EV) tariffs
- Peak Time Rebates (PTR)
- Prepaid tariffs
- Real-Time Pricing
- Time-of-Use (TOU)
- Variable Peak Pricing (VPP)
- Inclining Block Rates (IBR)

Critical peak pricing addresses system peaks

Participating customers pay higher prices during the few days when wholesale prices are highest or when the power grid is severely stressed

- E.g., during peak times on 15 days during the season of the system peak, prices may exceed $1/kWh. In return, participants receive a discount on the standard price during the other hours to keep the utility's total annual revenue constant

Pros:

- CPP provides a strong price signal and has produced some of the highest observed peak reductions among participants

Cons:

- Some customers consider CPP tariffs to be more intrusive than TOU tariffs because customers are contacted when critical events are called
- Political acceptance is sometimes low due to the relatively high peak price
- Some utilities have expressed concern that they will under-collect revenue

Demand charges incentivize customers to consider their electric demand

Demand charges are based on a customer's maximum demand (kW) during a certain window

- The customer's demand could be measured to be coincident with the distribution system peak, be based on the individual customer's maximum demand regardless of time of occurrence, or it could be based on a combination of the two.
- Individual maximum demand generally measures each customer's contribution to the costs of local distribution capacity
- Maximum coincident demand measures each customer's contribution to the system peak costs – transmission, generation capacity and parts of the distributions system
- For residential and small commercial customers, advanced metering infrastructure will allow demand charges to be offered without incremental metering costs

Electric vehicle tariffs address the needs of a growing market

Electric vehicle tariffs may apply to the entire home or just the vehicle

Enabling technology can improve the effectiveness of the tariff

- For example, a smart charger may allow the car to charge only during off-peak hours

SDG&E recently sponsored a study on the responsiveness of electric vehicle customers to TOU tariffs

Inclining block rates are usually applied to residential customers

IBRs involve increasing prices in each tier of electricity consumption

- The simplest IBR has two tiers
  - Provides simplicity for customer
  - Provides simplicity for utility

- A three-tiered tariff is another approach
  - Provides more customers with a conservation incentive
  - Still fairly easy to explain

- Today's IBRs include as many as five tiers
  - Most granular reflection of increasing costs
  - In theory, the concept could be extended to a "straight line"

Inclining block rates may face a tradeoff between policy goals and reflecting costs

Pros:

- Inexpensive to implement
  - Does not require smart meters
- Can encourage energy conservation
- Can improve the economics of other efficiency technologies
- Can be customer-friendly and universally deployed
- A "lifeline" allocation in the first tier can benefit low income customers
- Alternatively, the first tier can represent the share of class usage that is met with baseload generation

Cons:

- tariff design may be subjective in choosing the number of tiers and cutoffs between the tiers
- tariff design may require tradeoffs between policy goals and reflecting costs
- Can result in cross-subsidies
- Can introduce complexity for customers with many tiers
- In medium and large C&I segments, an IBR could encourage low load factor responses resulting in poor utilization of resources

Peak time rebates pay customers for load reductions

Instead of charging a higher tariff during critical events, participants are paid for load reductions (estimated relative to a forecast of what the customer otherwise would have consumed)

There is no tariff discount during non-event hours

No customer gets a higher bill

PTRs often appeal to regulators but may be subject to inaccurate baseline calculations

Pros:

- Provide a level of bill protection that is not embedded in these other tariffs
- Are often more acceptable to regulators and policymakers

Cons:

- Require calculation of each customer's baseline usage
- One study estimated that as much as 40 percent of a utility's total rebate payment would be due to the inaccuracies of estimating individual customer baselines
- Do not convey the true time-varying cost of providing electricity and do not provide the price signal necessary to encourage adoption of plug-in electric vehicles or rooftop solar systems
- Customers may artificially inflate their baseline energy usage to receive a higher rebate payment

Prepaid tariffs are available at many small utilities all over the United States

Electric utilities offer prepay options in over 30 U.S. states, mostly in the southeast

While prepay has been most common among rural cooperatives and municipal utilities, Georgia Power is one of the first IOUs to launch a full-scale prepay option

Prepaid tariffs can achieve utility savings and conservation benefits

Commonly cited benefits of prepaid tariffs include:

- Assistance for customers
  - Assistance with budgeting
  - Management of personal finances
  - Improvement in customer relations
  - Reduction in costs associated with delinquent accounts
- Energy conservation
  - Customer notifications about usage and remaining balances help keep energy use top-of-mind
  - Some prepay programs have cited conservation effects of 5 to 14 percent

However, prepaid tariffs are primarily a financing mechanism and could complement other demand-side tariffs

Real-time pricing is cost-based but may pose challenges for customers

Participants in RTP programs pay for energy at a tariff that is linked to the hourly market price for electricity

- Depending on customer class, participants are made aware of hourly prices on either a day-ahead or hour-ahead basis
- Typically, only the largest customers in specific regions face hourly prices
- There are two utilities in the U.S. that offer RTP to residential customers: Ameren and Commonwealth Edison

Pros:

- Provide the most granularity in conveying accurate hourly price signals to customers
- Provide a dynamic price signal that responds to changing market conditions

Cons:

- Without automating technologies, it is difficult for customers to respond to prices on an hourly basis

Time-of-use tariffs can achieve energy and demand savings

Divide the day into time periods and make the peak period as short as possible

- E.g., a peak period might be defined as the period from 2PM to 6PM on weekdays, with the remaining hours being off-peak. Prices would be higher during the peak period, reflecting the higher cost of supplying energy during that period

Pros:

- There is certainty as to what the tariffs will be and when they will occur
- TOU tariffs encourage permanent load shifting away from peak hours
- TOU tariffs also could be used to encourage adoption of plug-in electric vehicles, solar photovoltaic systems, and distributed energy storage technologies

Cons:

- TOU tariffs are not very useful for addressing specific events on the grid and integrating variable renewable energy resources

Variable peak pricing are a more complex version of CPP

VPP tariffs are similar to CPP tariffs except that the window of critical peak hours is not fixed and the critical peak price varies in real time

Pros:

- More flexible than CPP
- More accurate in reflecting system costs than CPP

Cons:

- Customers may dislike the uncertainty and/or complexity of a VPP tariff relative to a CPP tariff
- Customers may find VPP tariffs even more intrusive than CPP tariffs