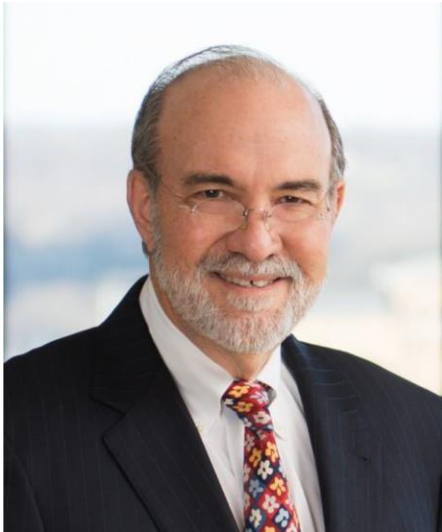


# Transactive Energy Tariffs: A New Path to Market for Microgrids



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# A Transactive Energy Tariff

- Provides local, real-time prices for demand response and energy export
- Protects the system by pricing congestion on the transmission and distribution system
- Reduces customer cost
  - Efficient use of generation, storage by shaping load
  - Reduces operation and maintenance cost
  - Uses lower cost local resources

# Tariff Elements

- Price
  - RTO wholesale price – energy bids plus congestion price
  - Distribution congestion cost/benefit
- Subscription – base energy allowance
- Interaction determines the customer result
- CalFUSE - Hard subscription with full recovery variable price credit
- MRC – Subscription is an option with wholesale price-based variable price

# Other Implementation Issues

- Timing – hourly or more frequent
- Calculation – day ahead or real-time
- Granularity – how deep in the distribution system
- More frequent and more granular allows better protection of distribution system
- Requirements – communication to customer controller and information from pricing level substations

# The CalFUSE Proposal

- California Energy Commission Load Management Standards

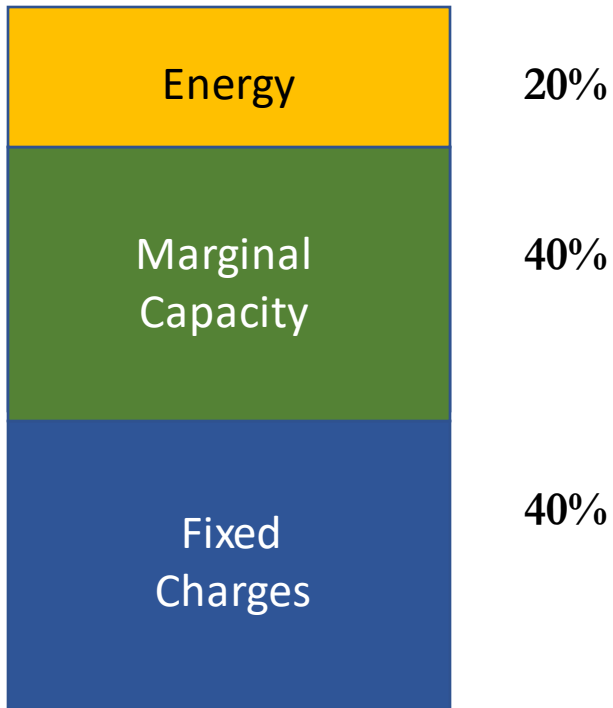
Total marginal cost shall be calculated as the sum of the marginal energy cost, the **marginal capacity cost (generation, transmission, and distribution)**, and any other appropriate time and location dependent marginal costs, including the **locational marginal cost of associated greenhouse gas emissions**, on a time interval of no more than one hour.

<https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-OIR-03>

- California Public Utility Commission staff white paper

<https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/demand-response-workshops/advanced-der---demand-flexibility-management/ed-white-paper---advanced-strategies-for-demand-flexibility-management.pdf>

# Base Tariff Structure



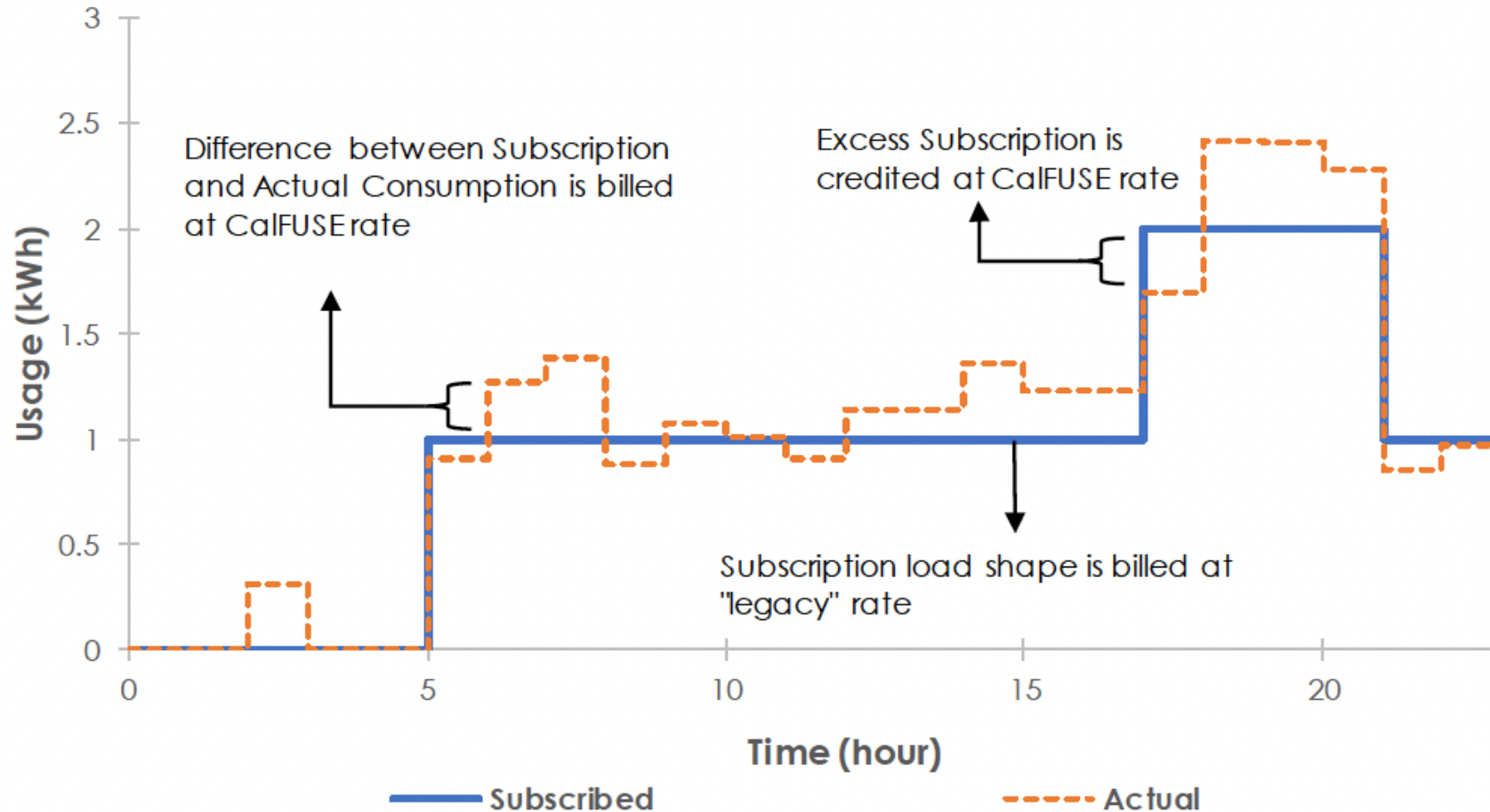
- CalFUSE – Create an incentive rate by redistributing the top two categories to different hours
- MRC – Keep bottom two categories unchanged but use actual wholesale prices for the energy component

# Subscriptions

- Customer's typical load shape is treated as baseline
  - Tariff for baseline use is a standard, flat, full cost recovery tariff
  - Only deviations from the baseline pay or are paid the TE rate
- Is it a prepurchase or an option?
- Need adjustment for changes in load
- Problems with ratcheting down
- Interaction with fixed charges under AB 205
- Deviations from subscription reward folks who reduce usage but hurt folks who have an unavoidable need for power
- Should different load shapes have different prices?

# Subscription Operation\*

\* Chart from CPUC Staff White Paper on Demand Flexibility





# Calculation Issues

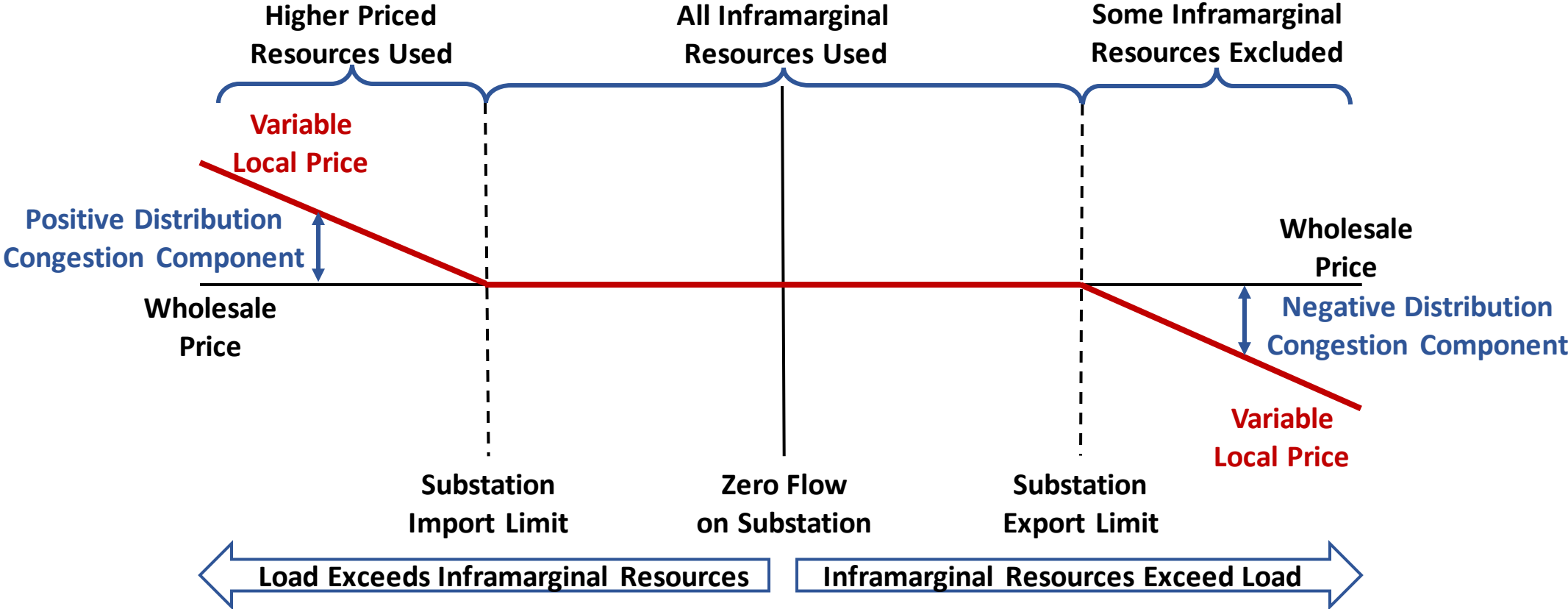
- CalFUSE requires at least hourly
- PGE is suggesting calculating prices day ahead
- More effective market pricing and system protection requires current pricing on shorter intervals
  - Functions like a market without requiring advance bids
- Communications cost
  - Communication to customers means one time installation
  - Can use web, cable, radio frequency or smart meters
  - More frequent pricing doesn't substantially increase cost
  - Going lower in the substation chain requires more communication

# Marginal Cost Price

- Wholesale energy price
  - Based on generator and storage resource bids to inject energy
  - Transmission constrained least-cost dispatch of system resources
  - When constraint prevents using external resources, price is set by lowest cost resource behind the constraint
  - Difference between system low price and actual price behind the constraint is the congestion cost (always positive)
- Distribution congestion price
  - Should work the same as wholesale congestion price
  - Not bids but price responses (can be positive or negative)

# Distribution Congestion Price

## Effect of Local Resource / Load Imbalance on Local Variable Price



# Marginal Capacity Prices

- CalFUSE marginal capacity is a long-term variable cost
  - High grid stress points drive investment need
- Congestion cost is a marginal cost of (lack of) transmission
- Distribution congestion price should be a marginal cost (or value) of local generation or demand reduction driven by the constraints on the distribution system
- Constraints can be remedied by new “wires” (such as larger substations) or export resources (non-wires alternatives)

# Marginal GHG Prices

- Carbon doesn't have a marginal cost for time of emission
- Highest usage periods use dirtiest generation – aggregate emissions are higher than the same MWh at level usage
- California has cap and trade under AB 32
  - Dirtier generators already pay a higher carbon price per MWh
  - Market bids reflect this marginal cost which is captured in price
- Small generators aren't covered
  - Consider imposing market carbon price on small generators
  - Include back-up generators

# Demand Response v. Export

- Cal Fuse – Demand response gets a credit
- MRC
  - Demand response means no no option price
  - Export and demand response get paid wholesale energy price
- The export price by itself won't support investment
  - Uncertain price for an uncertain amount of hours
- Need capacity payment supported by hours commitment
  - Can use TE Price for actual energy when run

# Implementation

- Utility, Community Choice Aggregation (CCA), Virtual Power Plant (VPP), Distribution System Operator (DSO)
- Utility or DSO directly prices distribution congestion
- CCA or VPP must go through aggregator to RTO/ISO
  - FERC Order 2222
  - Ability to sell at retail
- All different types must face the same disaggregated distribution congestion charge (benefit)
  - Aggregator faces different prices for different locations

# Questions?



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*“The economy is a subset of the ecology.”*