

RATE DESIGN FOR THE DISTRIBUTION EDGE

ELECTRICITY PRICING FOR A DISTRIBUTED RESOURCE FUTURE

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RATE DESIGN FOR THE DISTRIBUTION EDGE

August 2014 e-Lab publication “Rate Design for the Distribution Edge: Electricity Pricing for a Distributed Resource Future”

Summary

- Adding sophistication to rates can unleash innovation in DER products and services
- Default rate options can be more sophisticated with the ability for customers to opt-into more and less complicated rates
- DER solution providers can maintain a simple customer experience

TABLE 1: NEAR- AND LONGER-TERM EVOLUTIONARY RATE STRUCTURES

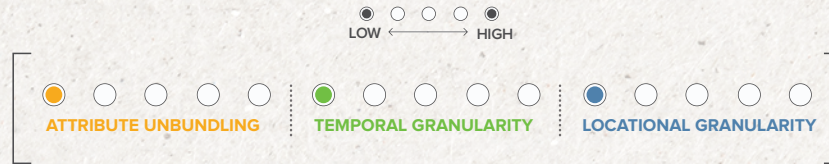
NEAR-TERM DEFAULT OR OPT-IN POSSIBILITIES	LONGER-TERM, MORE SOPHISTICATED POSSIBILITIES
Time-of-Use Pricing	Real-Time Pricing
Energy + Capacity Pricing (i.e., demand charges)	Attribute-Based Pricing
Distribution “Hot Spot” Credits	Distribution Locational Marginal Pricing



UNBUNDLING ALONG THREE SPECTRUMS CAN UNLEASH INNOVATIVE PRODUCTS AND SERVICES



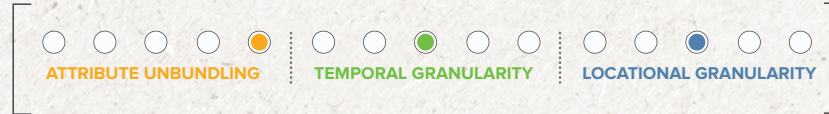
TODAY'S BUNDLED, VOLUMETRIC, BLOCK PRICING
 In the simplest system, prevalent today, there is no unbundling (i.e., fully bundled pricing) with no time- or location-based differentiation.



ENERGY + CAPACITY PRICING
 Breaking apart energy and capacity values begins to unbundle prices, but leaves many still bundled. Time- and location-based differentiation is still minimal.



ATTRIBUTE-BASED PRICING
 Attributed-based pricing more fully unbundles electricity prices, while doing so could also add time- and location-based sophistication.



TIME-OF-USE PRICING
 Relatively basic time-of-use pricing (e.g., off-peak, peak, critical peak) begins to add time-based differentiation, but could still allow attributes to remain fully bundled with no location-based differentiation.



REAL-TIME PRICING
 Real-time pricing, with prices dynamically varying by one-hour or sub-hour increments, adds much time-based sophistication, but could still allow attributes to remain fully bundled with no location-based differentiation.



DISTRIBUTION SYSTEM HOT SPOT PRICING
 Identifying distribution system "hot spots" begins to add location-based differentiation, but could still allow fully bundled attributes and little or no time-based differentiation.

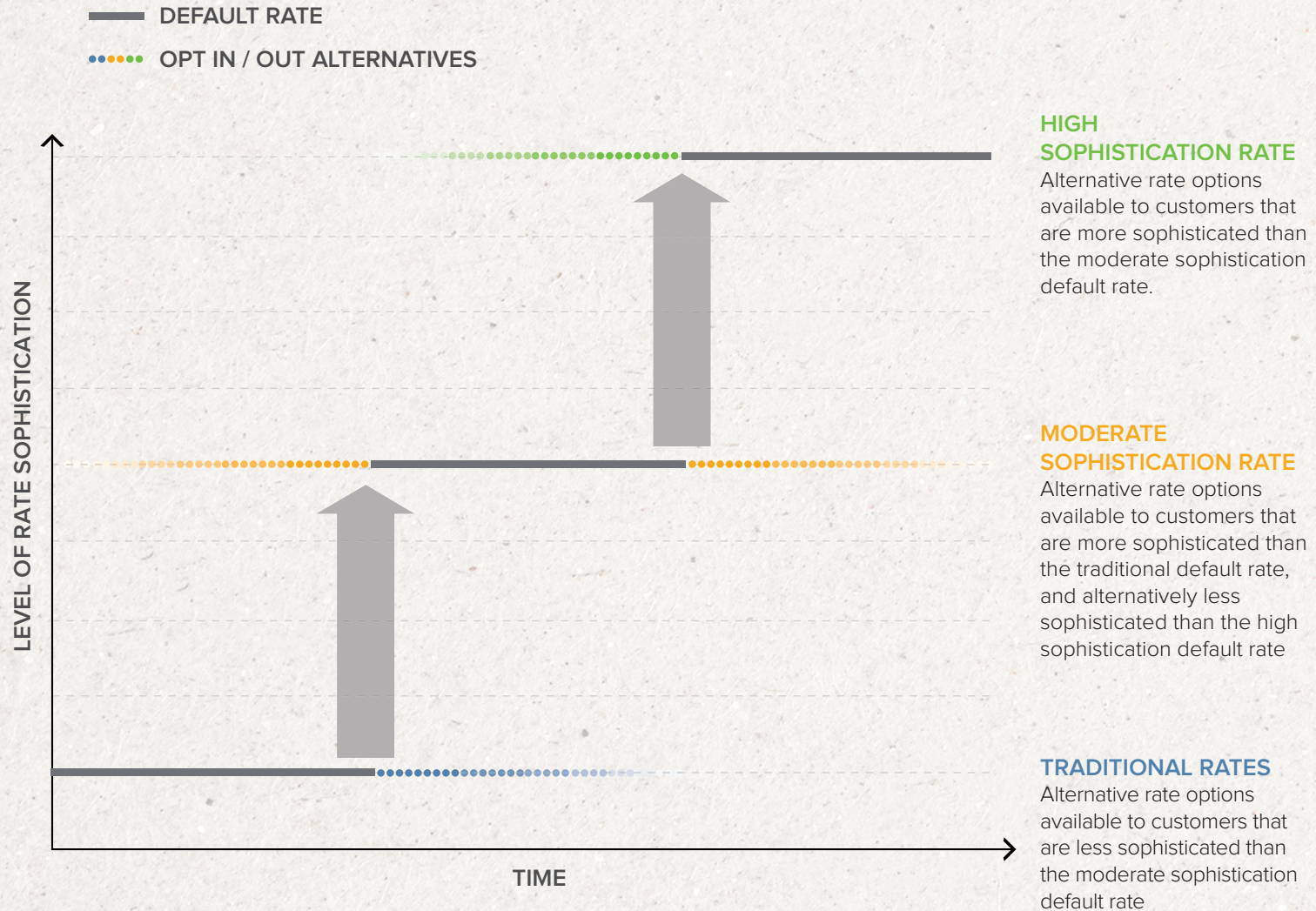


DISTRIBUTION LOCATIONAL MARGINAL PRICING
 Distribution LMP adds location-based sophistication, and in turn a high degree of temporal sophistication



Some of these solutions are achievable in the near term in many locations

AN APPROACH TO EVOLVE TOWARD MORE SOPHISTICATED RATES: DEFAULTS AND ALTERNATIVES



SOLUTION PROVIDERS CAN MAINTAIN A SIMPLE CUSTOMER EXPERIENCE AS RATES BECOME MORE SOPHISTICATED

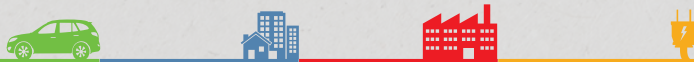


WHERE AND HOW COULD SOPHISTICATED RATES BE IMPLEMENTED AT SCALE?

- Possibilities for discussion:
 - Time-of-Use (SMUD)
 - Variable Pricing Plan (OG&E)
 - Energy + Demand (Black Hills Power)
 - Vehicle Grid Integration (SDG&E)
 - Real-time Pricing (E3 study)



APPENDIX



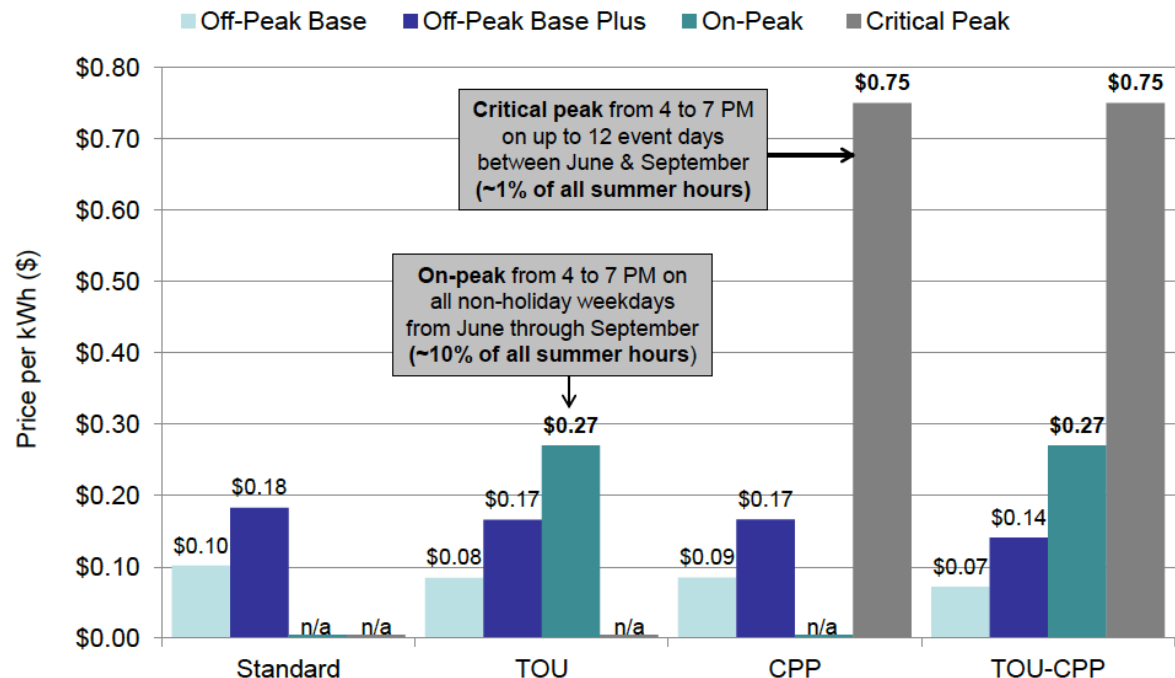
TOU OPTIONS: OVERVIEW

- A well-designed TOU rate offers customers the ability to be compensated for shifting load
 - Multiple time periods
 - Meaningful variation in prices
 - Across times of day
 - In comparison to the standard retail rate offering
 - TOU savings must be worth the investment of customer time and resources to achieve

TOU EXAMPLE: SACRAMENTO MUNICIPAL UTILITY DISTRICT

- SMUD offers three distinct time periods (with an additional critical peak period that can be called as needed)

Comparison of pricing plans

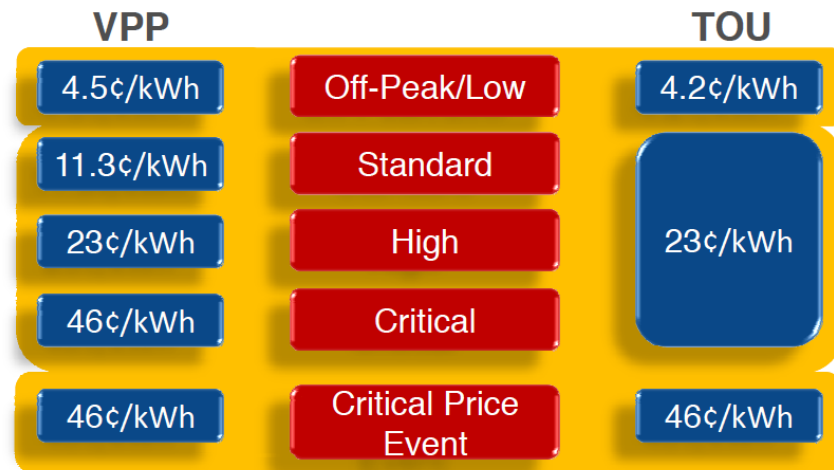


VPP EXAMPLE: OKLAHOMA GAS & ELECTRIC

- OG&E Smart Hours offers multiple time periods with significant price differential presents a compelling value proposition to customers to shift load
- Peak period is 2pm-7pm in summer.** Customers receive day ahead signal that sets the price point for the following day
 - Critical price events can be called with two hour advance notice and can last for up to eight hours and are applicable all year

Pilot Variable Pricing Plan and TOU Plans

Study Design: Price Plans



Standard Rate Plan*



Summer (June-Sept.)	Winter (Nov.-Apr.)	Shoulder (May, Oct.)
First 1,400 kWh = \$0.05	First 600 kWh = \$0.05	All kWh = \$0.05
Additional = \$0.06	Additional = \$0.01	* \$/kWh rounded to two decimals

ENERGY + DEMAND EXAMPLE: BLACK HILLS POWER

- Black Hills Power proposed to require all residential DG customers to take service under the available Optional Residential Demand Service
- The proposal was withdrawn Sept. 2014

Standard Service*

Customer Charge	Energy Charge
\$10.00/month	\$0.10/kWh

Optional Residential Demand Service*

Customer Charge	Energy Charge	Demand Charge
\$14.00/month	\$0.02/kWh	\$9.75/kW

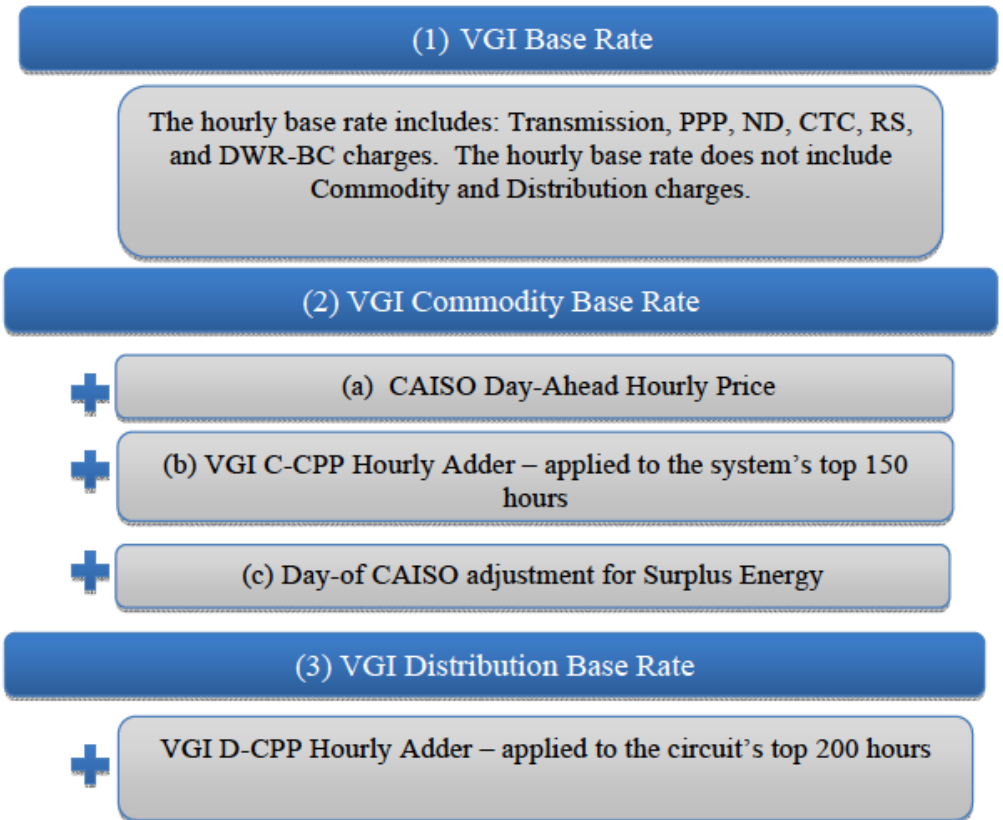
* \$/kWh rounded to two decimals

VEHICLE-GRID INTEGRATION: SDG&E

- Customers can set price ceiling for charging, minimum charging requirements and participate in demand response based on market prices
- Prices delivered to customers via mobile app and web

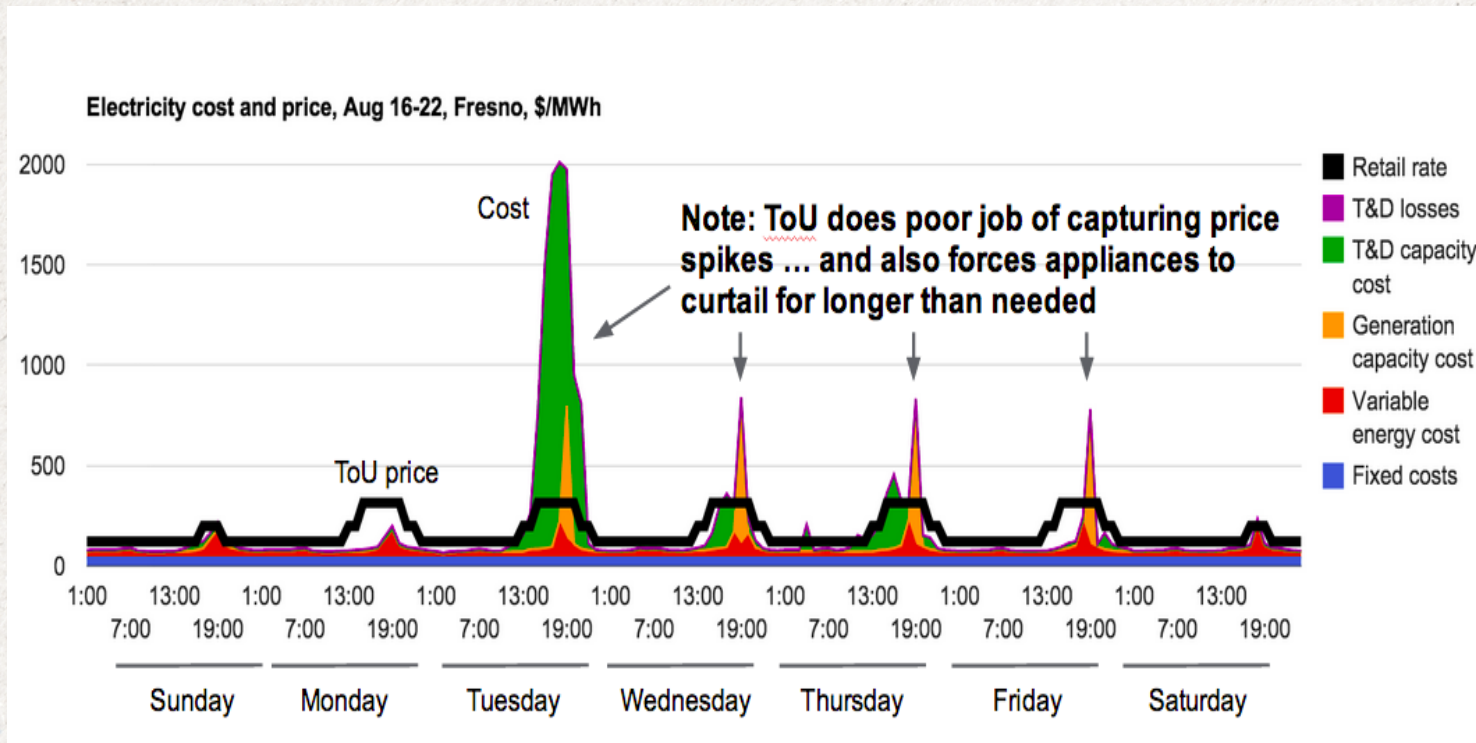
VGI = vehicle grid integration
C-CPP = commodity critical peak pricing
D-CPP = distribution critical peak pricing
CAISO = California Independent System Operator
PPP = public purpose programs
ND = nuclear decommissioning
CTC = competition transmission charges
RS = reliability services
DWR-BC = Dept. of Water Resources bond charge

Diagram CF-1: Proposed VGI Pilot Rate



All rates are \$/kWh

REAL-TIME PRICING OPPORTUNITIES



- E3 California study shows:
 - TOU rates may reflect the average cost of service but it misses the peaks and valleys of actual utility avoided costs
 - The more volatile the real-time cost of electricity the more value comes from distributed control strategies