

September 16th, 2021

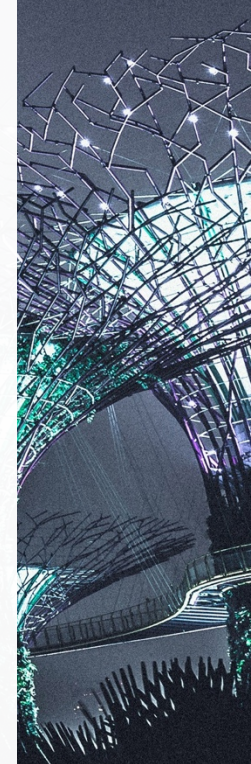
Rate Design and Net Metering Reform

Presentation to Vermont Public Utility Commission

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Outline

- Basics of Utility Ratemaking
- History and Future of the Electric System
- Rate Design Reform in Theory and Practice
- Four Net Metering Reform Examples

Challenges and Opportunities

- Rates and DER compensation in most jurisdictions do not reflect time- or location-varying costs
 - Older metering and billing systems could only handle simple data
 - Convention of postage stamp pricing historically ruled out location-varying prices
- DER adoption may be concentrated in certain economic and demographic sectors
 - Rate structure and program design may exclude business customers, low-income households, and renters
 - Federal tax credit policy is important

1 Basics of Utility Ratemaking



Why and How Do We Regulate Utilities?

- Public policy goals
 - Efficient competition and control of monopoly pricing
 - Reliable provision of service
 - Societal equity (e.g., universal access and affordability)
 - Economic development
 - Environmental and public health requirements
- Principles for setting utility rates
 - Effective recovery of revenue requirement
 - Customer understanding, acceptance, and bill stability
 - Equitable allocation of costs
 - Efficient forward-looking price signals

Simplified rate-making process

**Determine
revenue
requirement**

Net rate base
(Plant in service – depreciation reserve)

X

Rate of return

+

Depreciation expense
(Plant in service x depreciation rate)

+

Operating expense
(Fuel + purchased power + labor + labor overheads + supplies + services + income taxes)

+

Other taxes

=

\$ millions

**Allocate
costs among
customer
classes**

Residential

Commercial

Industrial

Street lighting

**Design
retail rates**

Dollars
per month

Cents
per kWh
peak

Cents
per kWh
off-peak

Dollars
per month

Cents
per kWh
peak

Cents
per kWh
off-peak

Dollars
per month

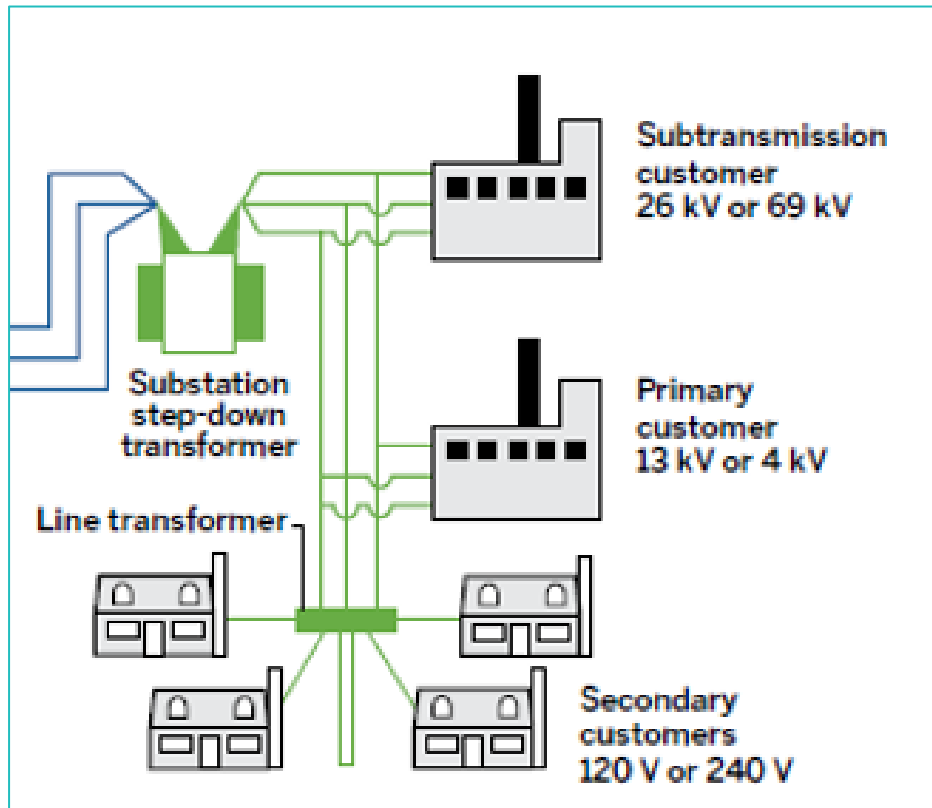
Cents
per kWh
peak

Cents
per kWh
off-peak

Dollars
per kW
monthly

Dollars
per light
per month

Determining Customer Classes



Types:

Residential

- Single-Family
- Multi-Family
- Heating?
- Other distinctions?

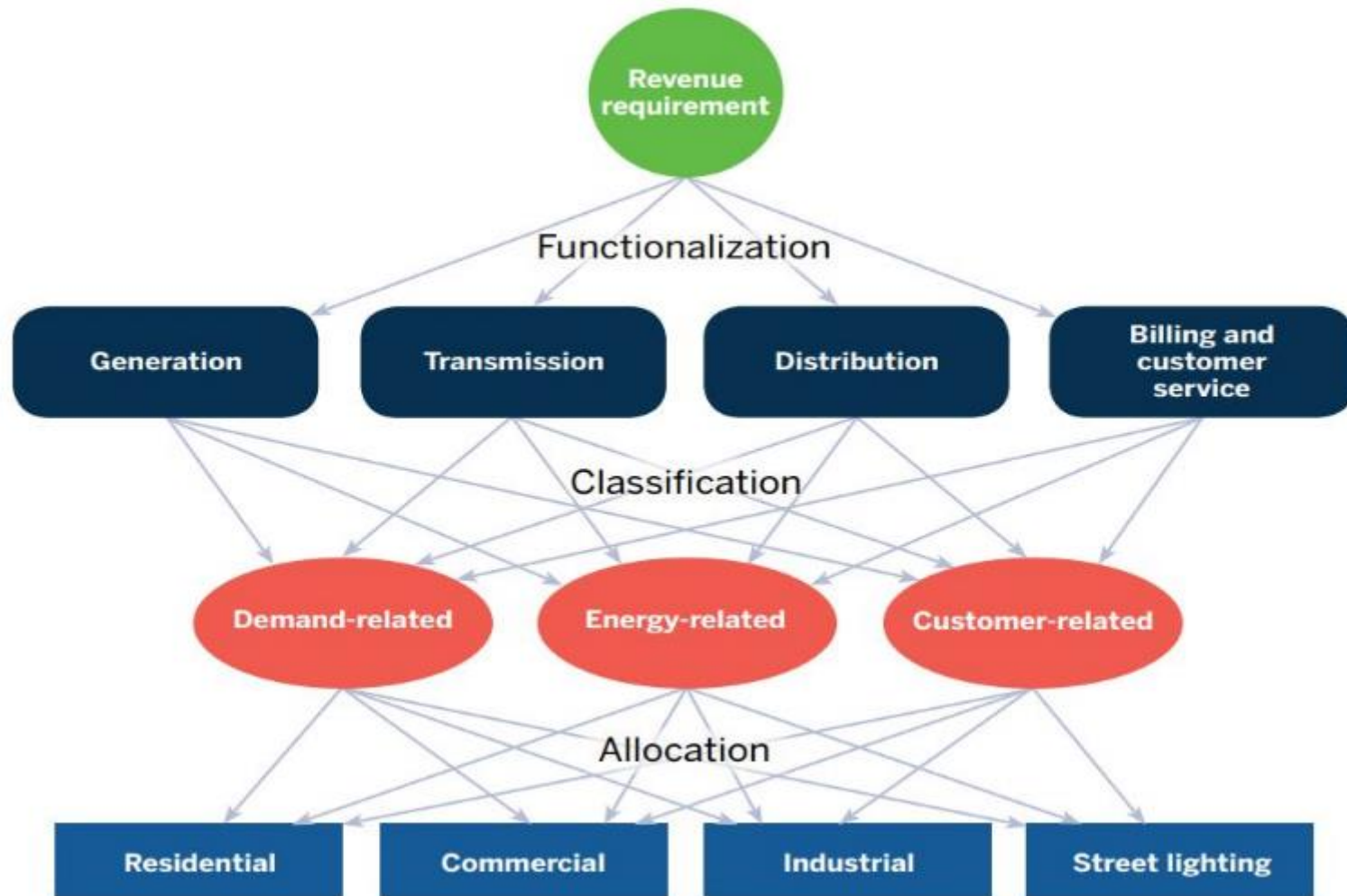
Commercial

Industrial

Irrigation

Street Lighting

Traditional Embedded Cost of Service Study (ECOSS) Process



Rate design should make the choices the customer makes to minimize their own bill

consistent with the choices they would make to minimize system costs.

Algorithm for Socially Efficient Price Signals

1. Start with short-run marginal costs where possible
2. Layer in long-run marginal costs
3. Add any unpriced externalities
4. End by allocating and pricing “residual” costs that must be recovered through rates

History and Future of the Electric System



Brief History of U.S. Electric System

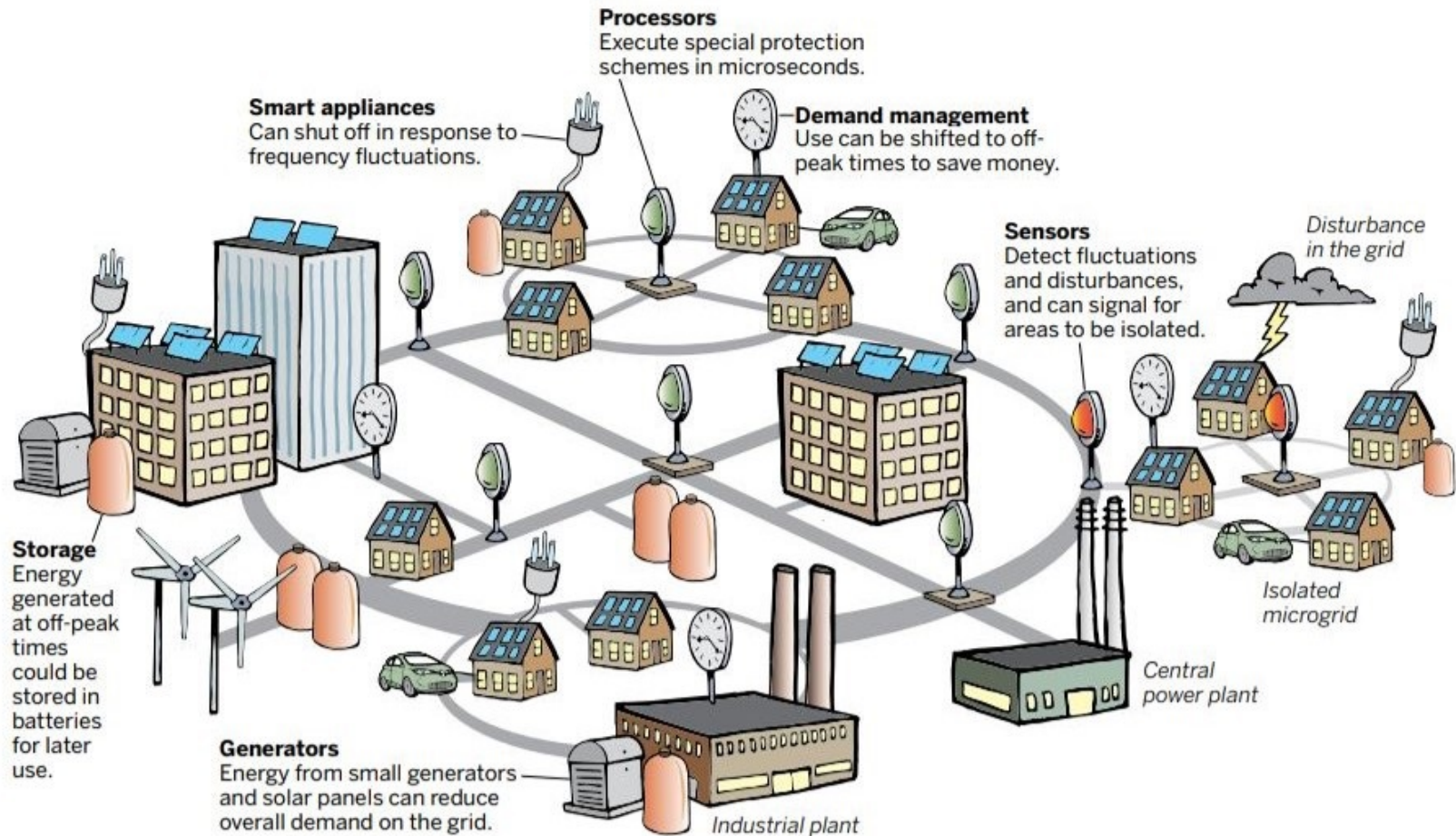
- Pre-1960
 - Combustion steam units, with significant hydro in some parts of the US
- 1960-1980
 - Emergence of nuclear power and combustion turbines
 - Oil crises and beginning of federal environmental regulation
- 1980-2000
 - PURPA implementation and then restructuring in many areas
 - Introduction of energy efficiency programs and demand-side resources
 - Emergence of combined cycle generation
- 2000-2020
 - Major increase in fossil gas extraction from hydraulic fracturing
 - Emergence of utility-scale wind and solar, distributed generation, advanced meters and smart grid

To Infinity and Beyond...

- Massive increases in computing power and data storage capabilities
- High penetrations of variable renewable resources change operation and economics of electric system
- Energy management technology becomes cheap and widespread
- Electrification of transportation and heating may increase load
- Continued cost declines for clean distributed generation and energy storage



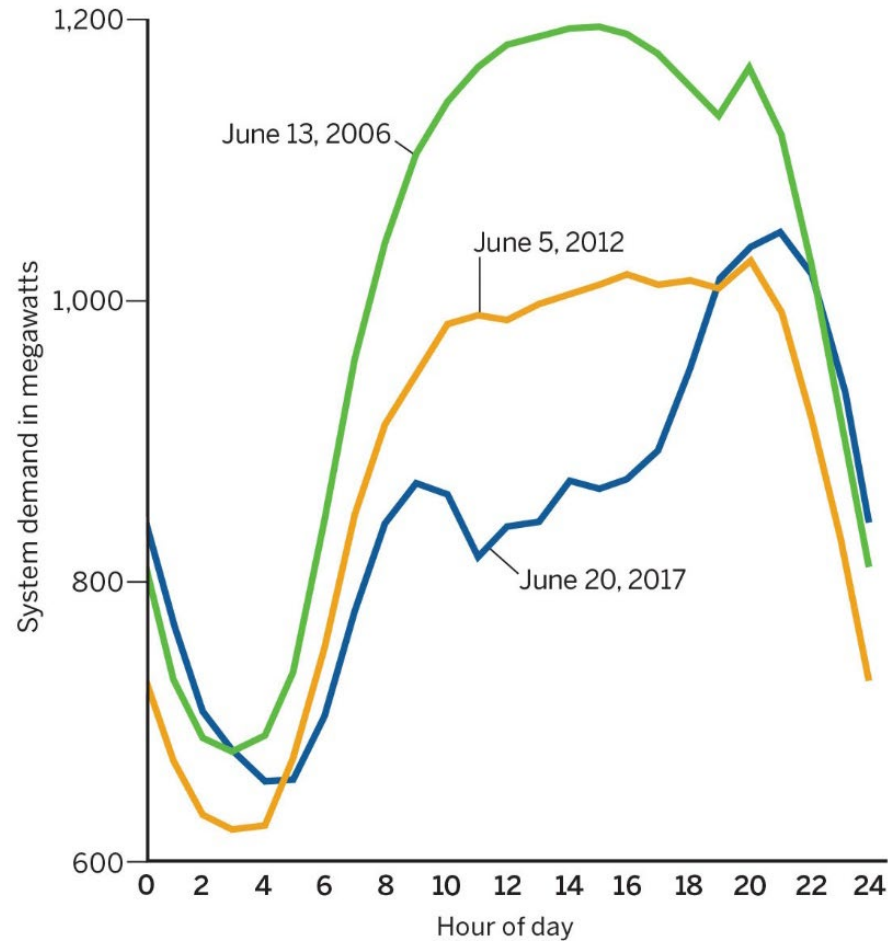
Illustrative modern electric system



Source: Adapted from U.S. Department of Energy. (2015). *United States Electricity Industry Primer*

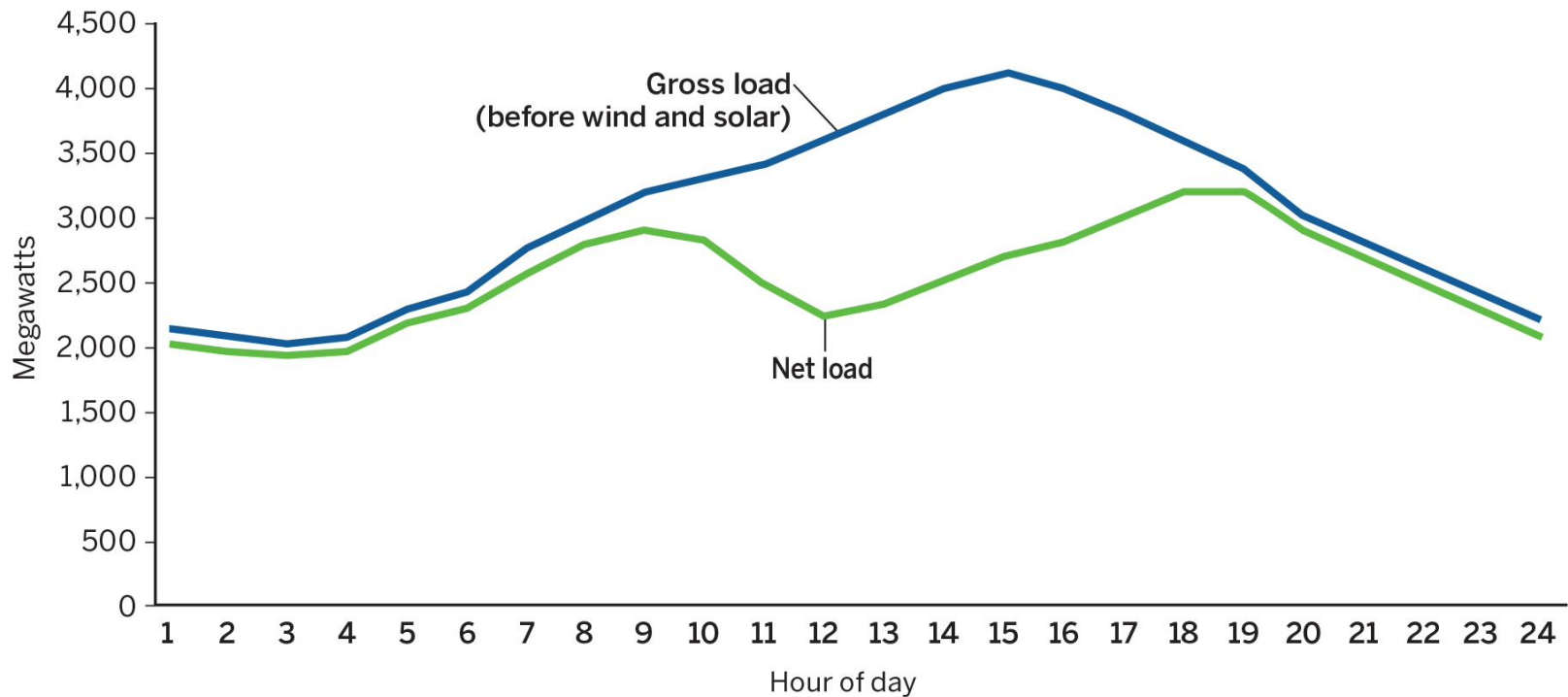
Decarbonized and decentralized!

Evolution of “duck” curve in Hawaii

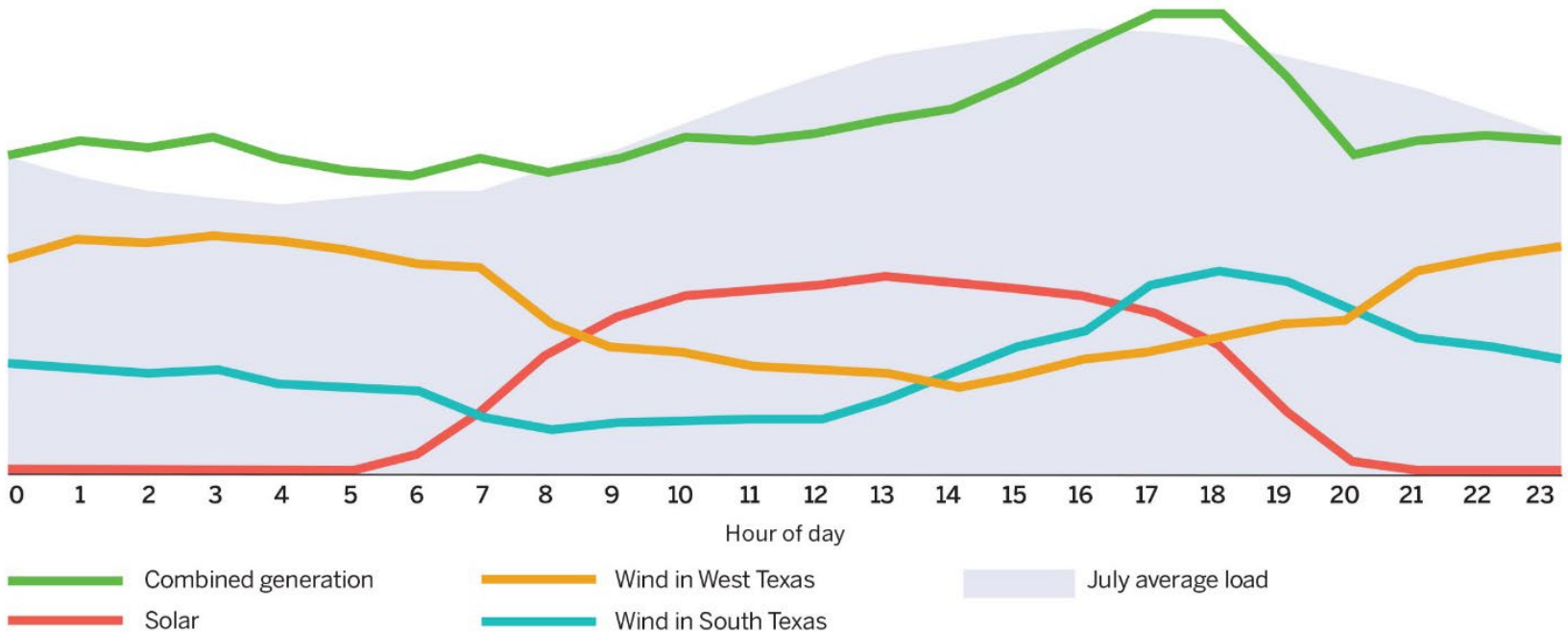


Data source: Federal Energy Regulatory Commission. Form No. 714
— Annual Balancing Authority Area and Planning Area Report

Net versus gross load



Overall resource mix matters!



Sources: Adapted from Slusarewicz, J., and Cohan, D. (2018). *Assessing Solar and Wind Complementarity in Texas* [Licensed under <http://creativecommons.org/licenses/by/4.0>]. Load data from Electric Reliability Council of Texas. (2019). *2018 ERCOT Hourly Load Data*

3 Rate Design Reform in Theory and Practice



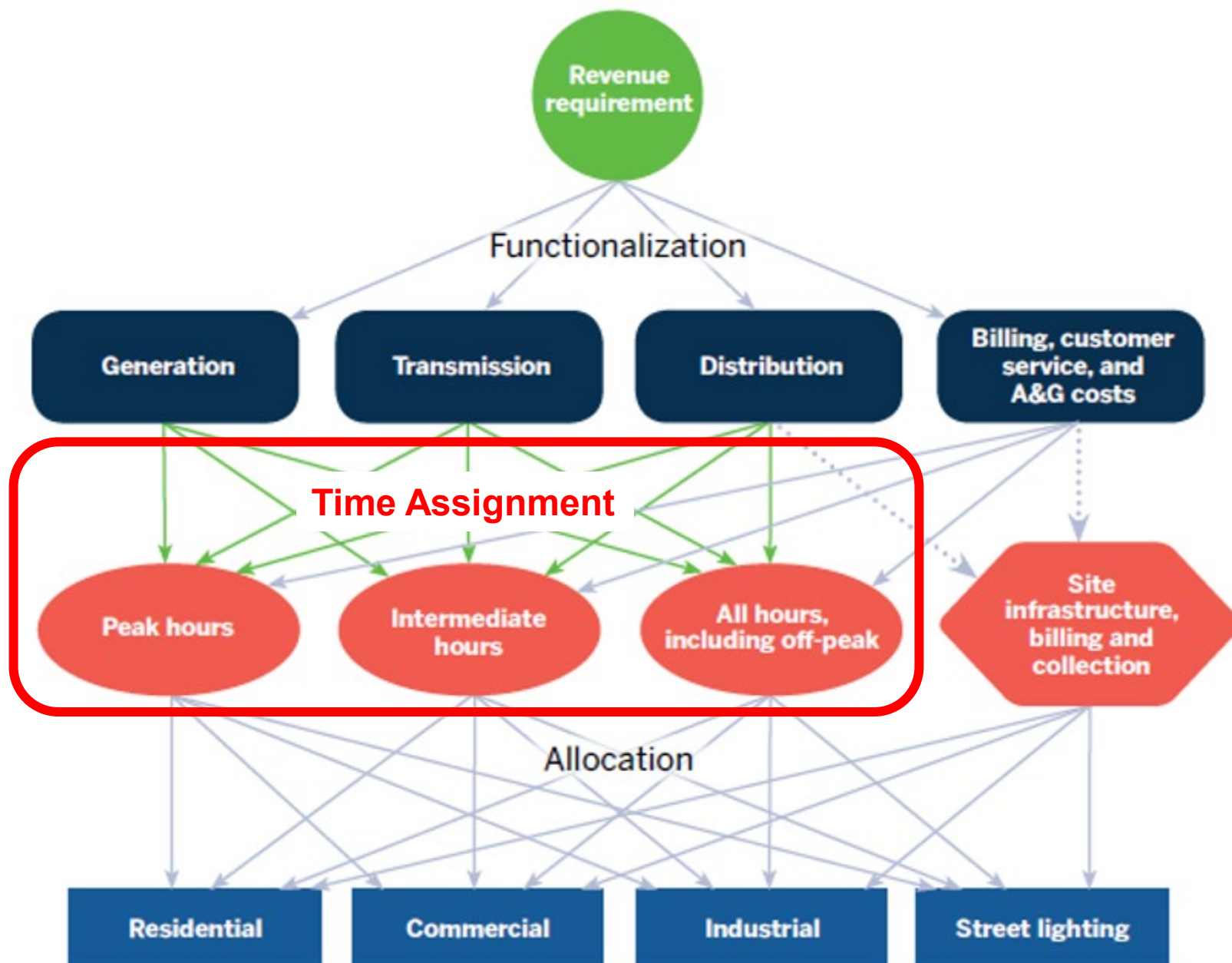
Key principles in focus

- Cost allocation and pricing tied more closely to marginal costs should reduce misallocation of revenue burdens
 - Even in an embedded cost framework
- Costs follow benefits is fair principle for equitable cost allocation
 - Particularly if marginal-cost-based prices recover insufficient revenue
- Customer understanding can be helped with education, gradualism and supportive companion programs

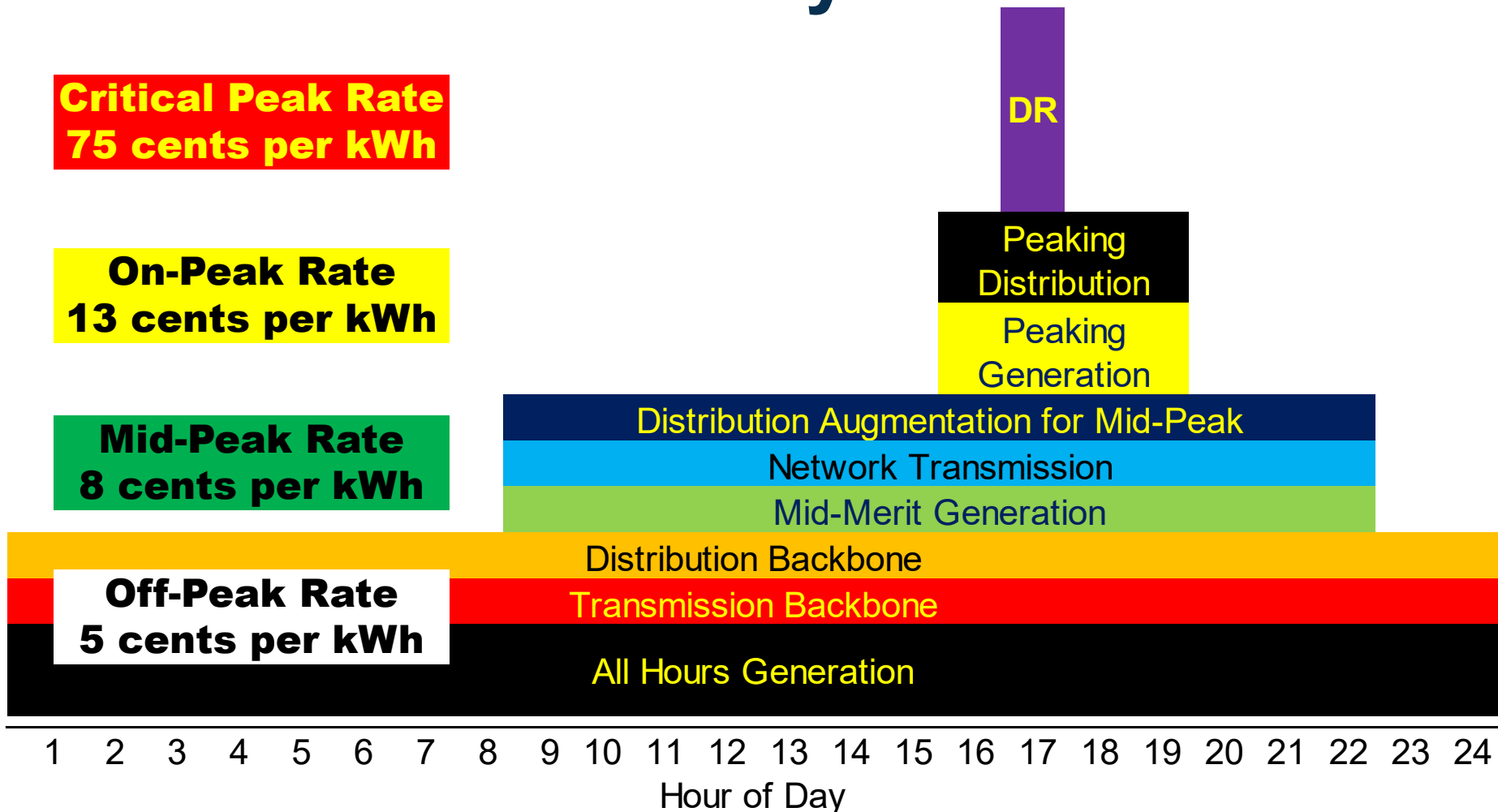
Cost causation

- Shared electric system costs are driven by collective patterns of customer usage
- Lower load diversity at customer end of distribution system
 - E.g., service drops, secondary lines and line transformers
- Billing and customer service costs may vary by type of customer
- Administrative and general costs are driven by size of the business
- Public policy programs reflect a mix of motivations
 - Electric system benefits
 - Broader societal goals

Modern embedded cost of service study flowchart



Build a Cost-Based TOU Rate for Shared Elements of System



Smart Rate Design for Today

	Residential	Medium C&I
Customer charge (\$/mo.)	Multifamily: \$7 Small single-family: \$10 Large single-family: \$15	\$100
Site infrastructure (\$/kW)	N/A	\$2
Off-peak (cents/kWh)	12 cents	10 cents
Mid-peak (cents/kWh)	18 cents	16 cents
On-peak (cents/kWh)	25 cents	24 cents
Critical peak (cents/kWh)	75 cents (peak-time rebate)	75 cents

Volumetric components reflect both import charges and export credits, which should be netted by TOU period

Rate Design Reforms in Practice

- Moving entire residential customer class to time-varying rates
 - Fort Collins (CO) municipal utility
 - California
 - Michigan
 - Maryland
- Opt-in residential TVR is now fairly common
- Best practices for C&I rates has been SMUD
 - Time-varying energy rates
 - Modest site infrastructure demand charge
 - Summer month demand charge

Fort Collins time-of-day rate

Customer Charge(\$/month)	\$8.59	
	Summer	Non-Summer
Off-Peak (cents/kWh)	7.19	7.19
On-Peak (cents/kWh)	26.24	22.42
Tier Charge (over 700 kWh)	+ 2.46 cents / kWh	



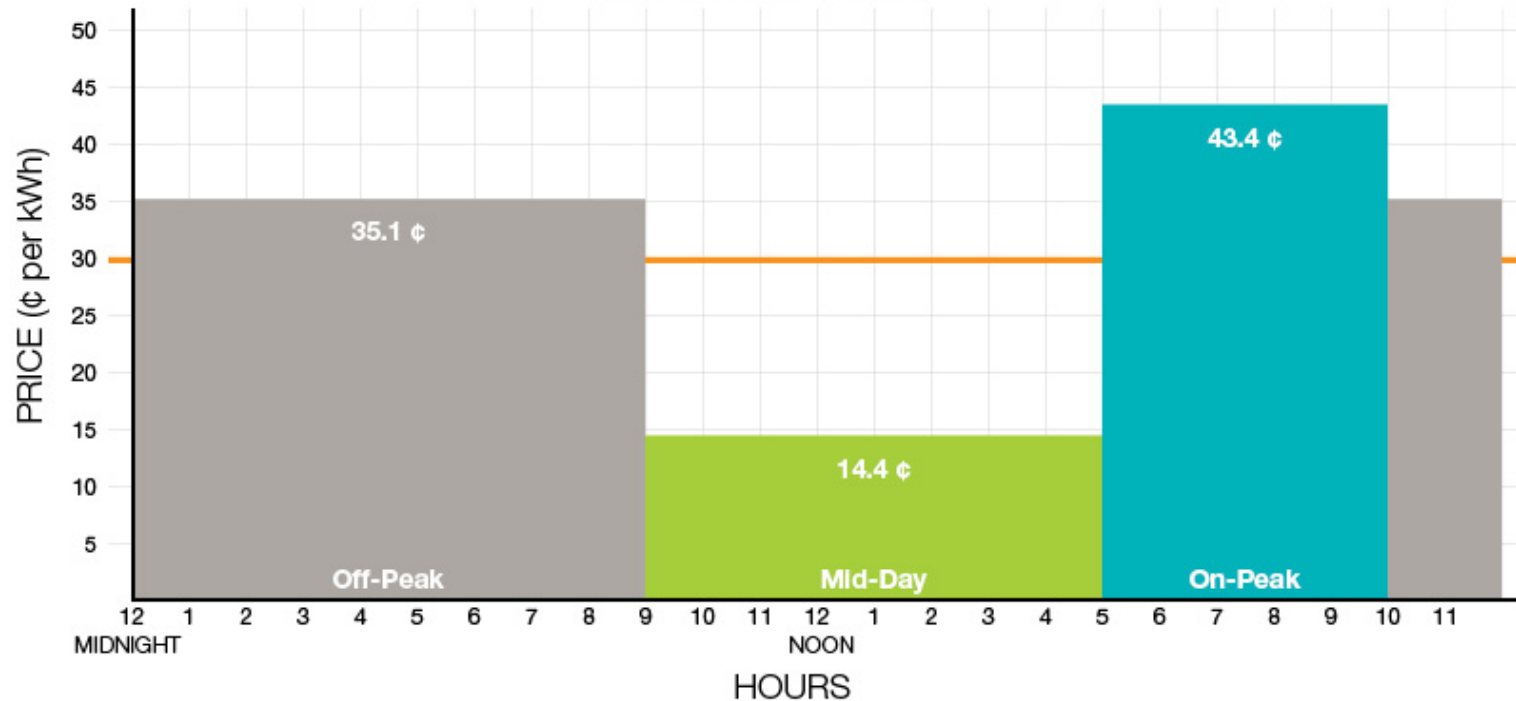
Oklahoma Gas & Electric Variable Peak Pricing

Customer Charge (\$/month)	\$13.00
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Off-Peak (cents/kWh)	3.27
On-Peak (cents/kWh)	
Low	3.27
Standard	7.70
High	18.40
Critical	38.00

Hawaiian Electric Optional TOU Rate

Interim Time-of-Use Rates*
(For illustrative purposes only)



*Illustration reflects September 2021 O'ahu electric rates with applicable surcharges.

Source: <https://www.hawaiielectric.com/products-and-services/save-energy-and-money/time-of-use-program>

TOU netting under HI TOU rates

Rate Element	Rate	Unit	Time Period	Load	Generation	Net	Billed Amount
Customer Charge	11.50	\$/Month					\$ 11.50
Off-Peak	0.144	\$/kWh	9 AM to 5 PM	195.3	477	-281.7	\$ (40.56)
Mid-Peak	0.351	\$/kWh	All Other Times	198.6	42	156.6	\$ 54.97
On-Peak	0.434	\$/kWh	5 to 10 PM	140.1	15	125.1	\$ 54.29
Total				534	534	0	\$ 80.20

Four Net Metering Reform Examples



Background on CA NEM 2.0

- Significant residential solar adoption levels in the 2000s and early 2010s
 - Inclining block rate design, tax credits, many sunny regions
 - Self-generation incentive program phased out solar PV
- By mid-2010s, net system peak shifted from afternoon to late afternoon or early evening
- Transition for all residential customers from inclining block rates to TOU rates
- New legislation led to CPUC NEM 2.0 decision in January 2016

CA NEM 2.0 Reforms

- Modest one-time interconnection charge
- Small minimum bill
- Requirement for NEM customers to be on TOU rate
 - Gradual transition from “legacy” TOU rates to newer designs
- Non-bypassable charges billed based on all imports from distribution grid
 - Cannot be offset by credits

Background on Duke Energy Settlement in NC/SC

- South Carolina
 - Energy Freedom Act passed in 2019 included framework for net metering reforms
- North Carolina
 - HB 589 (“Competitive Energy Solutions for NC”) passed in 2017 included solar rebates
 - Paired with interconnection queue reforms

Rate Structure in Duke Energy Settlement in NC/SC

- Minimum bill of \$30
- Time-of-use and critical peak pricing
- Rollover at an avoided cost rate
- Special treatment for non-bypassable charges
- Monthly grid access fee for facilities >15 kW

Background on Value of Solar in MN

- 2013 legislation required value of solar credit for community solar gardens and allowed adoption for residential rooftop PV as well
- Consideration of several value streams required by statute but considerable debate around methods

Structure of MN Value of Solar Credit

- Annual calculation expressed in \$/kWh levelized over 25 years
 - Locked in for projects qualified in given year
- Key components
 - Avoided fuel cost
 - Avoided O&M
 - Avoided generation and reserve capacity
 - Avoided T&D capacity
 - Avoided environmental cost
- Requires transfer of RECs

Background on New York VDER Tariff

- Part of broader “Reforming the Energy Vision” initiative
 - Desire for transactive energy system and smarter pricing
- NYSERDA provides separate incentives to wide range of projects, as well as additional assistance for LMI projects
- Community solar program on the verge of taking off in 2016
- REV benefit-cost framework established separately

NY VDER tariff

- Value stack credit structure applies to larger C&I projects and community DG
- Credit is the sum of:
 - An hourly wholesale energy rate
 - A generation capacity value
 - Pricing structure depends on technology
 - A delivery value credit
 - General credit and location-specific value in constrained areas
 - An environmental value credit based on social cost of carbon
 - Only for eligible technologies in exchange for RECs
 - For community DG, “market transition credit” has transitioned to “community credit”

4 Conclusion and Resources



Key Takeaways

- More efficient pricing is possible
 - How complex can rates get without confusing customers or risking significant adverse bill impacts?
- Enabling stand-alone distributed generation and remote/virtual crediting is key for access
 - Are rates efficient and fair enough to expand programs and tariff access?
- A more complex regulatory system may be necessary
 - How do you manage administrative costs to regulators, utilities, and other stakeholders?

Resources from RAP

- [Electric Cost Allocation for a New Era: A Manual](#)
- [Smart Rate Design for a Smart Future](#)
- [Demand Charges: What are They Good For?](#)
- [Smart Non-Residential Rate Design](#)
- [Electricity Regulation in the U.S.: A Guide](#)

About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org



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