ENERGY SOLUTIONS CENTER

Energy Industry Fundamentals

Understanding Electric Rates & Billing

Eric Burgis, Energy Solutions Center

This unit is part of Energy Solutions Center's: Energy Industry Fundamentals Training Program

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Presentation Outline

- Rate Terminology
- Demand & Usage
- Deregulation
- Calculating Costs
- Resources

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Electric Rate Terminology and Bill Components

Typical Rate Schedules

- Residential & Small Commercial
  - Rate limited to small customers based entirely on energy consumption
- Commercial / Industrial Rate
  - Rates for large customers with both energy & demand charges
  - Customers large enough to warrant an energy & demand meter
- Time of Use
  - Rate where energy charges change depending on time of day (generally lower at night than during the day)

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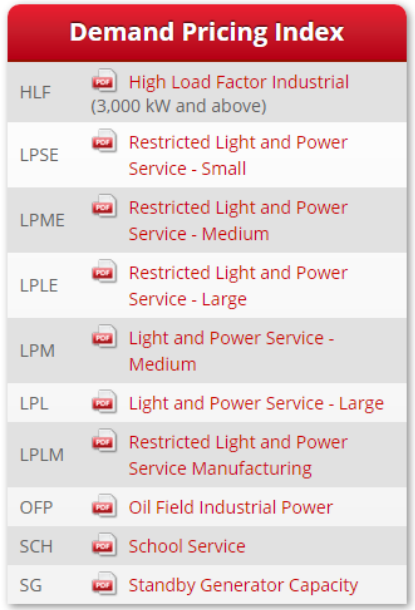
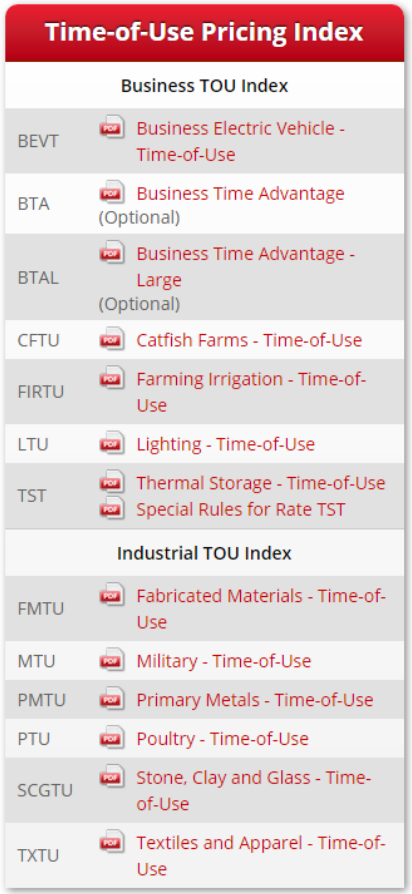
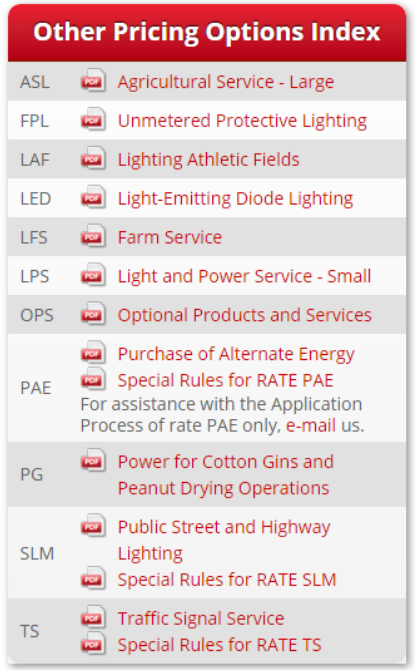
Customer Rate Choice - Example



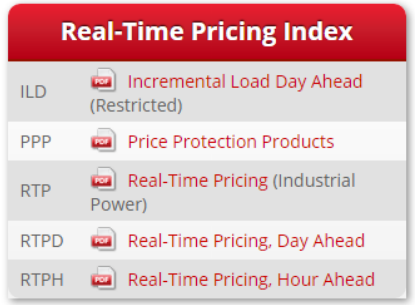
Demand Pricing Index	
HLF	High Load Factor Industrial (3,000 kW and above)
LPSE	Restricted Light and Power Service - Small
LPME	Restricted Light and Power Service - Medium
LPLE	Restricted Light and Power Service - Large
LPM	Light and Power Service - Medium
LPL	Light and Power Service - Large
LPLM	Restricted Light and Power Service Manufacturing
OFP	Oil Field Industrial Power
SCH	School Service
SG	Standby Generator Capacity



Time-of-Use Pricing Index	
Business TOU Index	
BEVT	Business Electric Vehicle - Time-of-Use
BTA	Business Time Advantage (Optional)
BTAL	Business Time Advantage - Large (Optional)
CFTU	Catfish Farms - Time-of-Use
FIRTU	Farming Irrigation - Time-of-Use
LTU	Lighting - Time-of-Use
TST	Thermal Storage - Time-of-Use Special Rules for Rate TST
Industrial TOU Index	
FMTU	Fabricated Materials - Time-of-Use
MTU	Military - Time-of-Use
PMTU	Primary Metals - Time-of-Use
PTU	Poultry - Time-of-Use
SCGTU	Stone, Clay and Glass - Time-of-Use
TXTU	Textiles and Apparel - Time-of-Use



Other Pricing Options Index	
ASL	Agricultural Service - Large
FPL	Unmetered Protective Lighting
LAF	Lighting Athletic Fields
LED	Light-Emitting Diode Lighting
LFS	Farm Service
LPS	Light and Power Service - Small
OPS	Optional Products and Services
PAE	Purchase of Alternate Energy Special Rules for RATE PAE For assistance with the Application Process of rate PAE only, e-mail us.
PG	Power for Cotton Gins and Peanut Drying Operations
SLM	Public Street and Highway Lighting Special Rules for RATE SLM
TS	Traffic Signal Service Special Rules for RATE TS



Real-Time Pricing Index	
ILD	Incremental Load Day Ahead (Restricted)
PPP	Price Protection Products
RTP	Real-Time Pricing (Industrial Power)
RTPD	Real-Time Pricing, Day Ahead
RTPH	Real-Time Pricing, Hour Ahead

39 Different Electric rates in this example makes it hard for customers to understand

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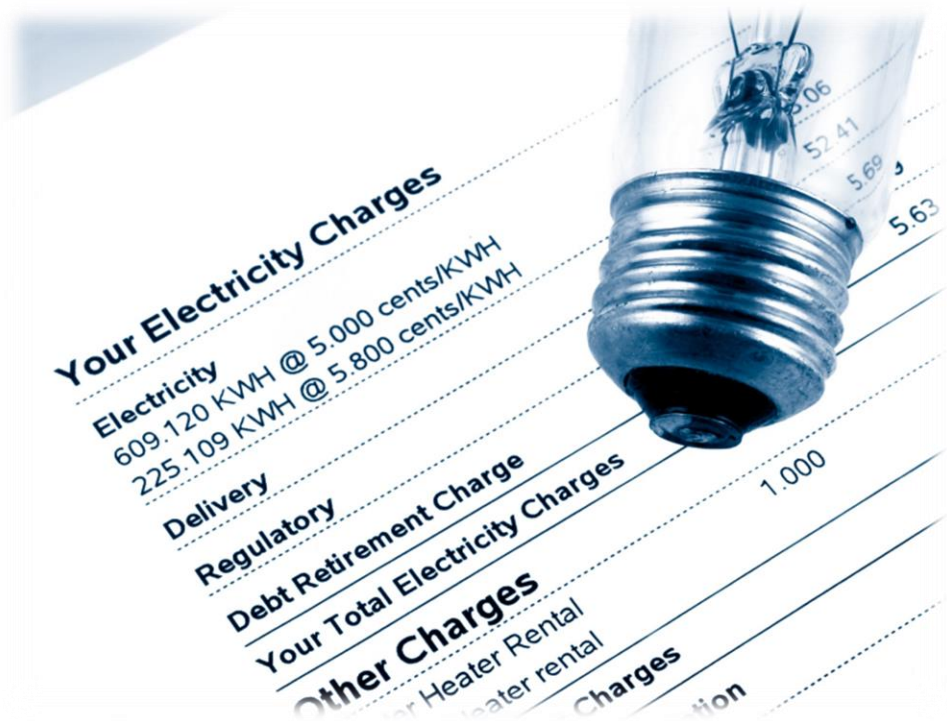
Primary Electric Bill Components

- Service Charge
- Demand Charge
- Usage Charge



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Definitions – Service Charge

- **Service Charge:** This is also referred to as a meter charge and is a fixed cost that each customer pays each month and in theory covers the electric utility's fixed and administrative cost to serve their customers

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Definitions - Demand

- **Demand Charge:** Demand is the rate at which a customer draws power. Demand is usually set at the highest level of demand drawn by the customer during some set time period. The Demand Charge basically represents the charge to the customer for generation and transmission facilities to provide that level of service.
- *Example: Ten 100 Watt light bulbs will draw 1000 Watts or 1 kilo Watt (1 kW)*

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Definitions - Usage

- **Usage Charge:** This is for the quantity of power consumed. If we leave Ten 100 Watt light bulbs, on for 1 hour, then they will consume 1kW x 1 hr or 1 kWh
- The Usage Charge represents the variable cost of the actual energy provided to the customer

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Let’s Take a Deeper Look at Demand and Usage Charges

Demand Charge

- Demand relates to capacity or flow rate – electric utilities reserve space on the lines for the customer based on their Peak Demand requirement
- Demand changes monthly, or based on a 15 or 30-minute time intervals
  - Peak demand is usually set in the Summer due to cooling
- Hours of Use = Usage/Demand
  - Higher Demand means Lower Hours
  - Lower Hours means higher Electric Usage rates
- Cheapest power is for high usage low demand such as 24-hour operation

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Registered vs. Billed Demand

- Registered Demand or (Measured Demand)
  - Highest average demand viewed in typically 15 or 30-minute intervals during a given month
- Billed Demand
  - This may be higher than the actual demand registered for the month due to ratchet penalties or Power Factor issues

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Ratchet Penalties

This is when the Billing Demand is adjusted upward above the current monthly measured demand

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Ratchet Charge Example

Power Example:

- Rate PLS-5 (<30kW) & Rate PLM-5 (30-500kW)
  - Summer June through September
    - Billed Demand = the highest of:
      - The actual Monthly Demand or
      - **95% of a preceding Summer Month or**
      - 60 % of the highest Winter Month
  - Winter October through May
    - Billed Demand = highest of:
      - **95% of the highest Summer Month**
      - 60% of the highest Winter month, including current month
- On this rate, customers typically pay 95% of the worst Summer Demand all year long.

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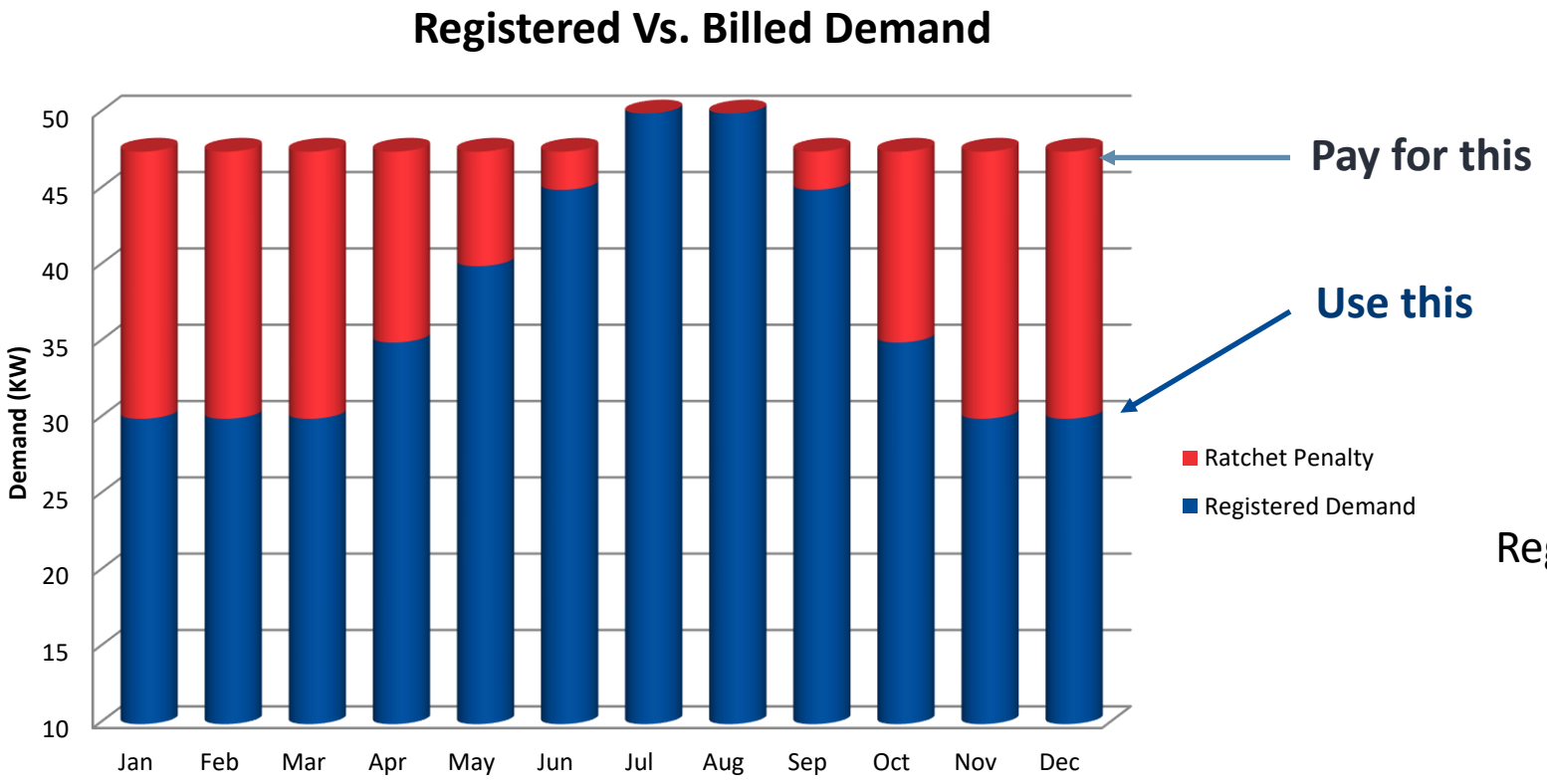
Ratchet Penalties

Example of a customer that peaks at 50 KW July and August and then Winter registered demand is 30KW



Registered Demand cost = $3,060 / Yr

Billed Demand cost = $3,910/ Yr

Ratchet Penalty = $850 / Yr

(Assumes GP Demand rate of $6.80/KW)

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Usage Charges

- The usage charges are typically in a block or step fashion where the unit cost of the energy is reduced as the quantity of electricity consumed increases.
- Most electric utilities do this in either 2 or 3 blocks which are broken up either by KWHs or Hours

METER NUMBER	METER READING PREVIOUS	PRESENT	NUMBER OF DAYS	METER CONSTANT	METERED USAGE		METERED DEMAND	RATE CODE	
8559	9949	731 E	31		782.00	KWH		D	
LAST BILL AMOUNT							133.21		
PAYMENTS THROUGH							133.21CR		
BALANCE FORWARD									$.00
CURRENT CHARGES ELECTRIC SERVICE									
DELIVERY SERVICES RESIDENTIAL									
Delivery Charge – 1st 500 KWH				**500 KWH**	**x**	**$.0698**		**34.90**	
Delivery Charge – Over 500 KWH				**282 KWH**	**x**	**$.0550**		**15.51**	
TAXES & SURCHARGES									
System Benefits Chg				782.00 KWH	x	$.00301		2.35	
Consumption Tax				782.00 KWH	x	$.00055		.43	
TOTAL CURRENT EL CHARGES									$43.43
CURRENT CHARGES SUPPLIER SVC EL				SERVICE PERIOD		9/30/05-10/31/05			
Transition Fixed				782.00 KWH	x	$.05531		43.25	
TOTAL CURRENT SS CHARGES									$43.25

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Usage Charge Example

- **Usage less than 200 Hours** use block rates
  - First 25 kWh included in base Charge
  - Next 2,975 kWh = $.093079 / KWh
  - Next 7,000 kWh = $.087624 / kWh
  - Over 10,000 kWh = $.076243 / kWh

The greater the usage, the less the cost

- **Usage over 200 Hours** uses steps with lower rates
- For each step: 200-400 hrs = $.009, 401-600 hrs = $.0088, greater than 600 hrs = $.0076/kWh. (Usage over 200 hrs is less than a penny a kWh)

Hours = Usage (kWh) / Demand (kW)
The greatest # of hours is 744/month (31 days*24 hrs)

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Power and Light
Small, PLS-5 rate

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Demand's Effect on Usage Charges

- Often missed in an energy analysis is the effect that demand has on the total bill which can be significant and can increase the savings potential for an analysis.
  - Example: GP Rate PLS-5, Winter Month, registered demand = 30 KW, electric usage = 9,000 KWH, Summer peak demand was 50 KW.
    - If **billed on Registered Demand** the hours = 9,000/30 = 300 Hours
      - First 200 hours = 200* 30 = 6,000 KWH
        - 2975 KWH * .$093079 = $277
        - 6000 KWH – 3000 = 3000 KWH * $.087624 = $262
      - Next 100 hours = 3,000 KWH * $.009502 = $29
      - Total Energy Charge = $14.75 (base) + $277 + $262 + 29 **= ~ $ 583**
    - If **billed on Billed Demand** the hours = 9,000/47.5KW(ratchet)= 189 Hours
      - Total hours are under 200
        - 2975 KWH * .$093079 = $277
        - 9000 KWH – 3000 = 6000 KWH * $.087624 = $526
      - Total Energy Charge = $14.75 (base) + $277 + $526 **= ~ $ 818**

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Full Effect of Penalty

- Assumptions: Winter Month, 30 KW Demand, 9,000 KWH usage and peak Summer was 50 KW.
- Energy Charge if based on Registered Demand
  - Usage = $583, Demand = 30KW*$6.8 = $204, Total = $787
- Energy Charge based on Billed Demand
  - Usage = $818, Demand = 47.5KW*$6.8 = $323, Total = $1141

- Usage premium = 29%
- Demand premium = 37%
- **Overall Energy Charge Penalty was 31%** (Winter)

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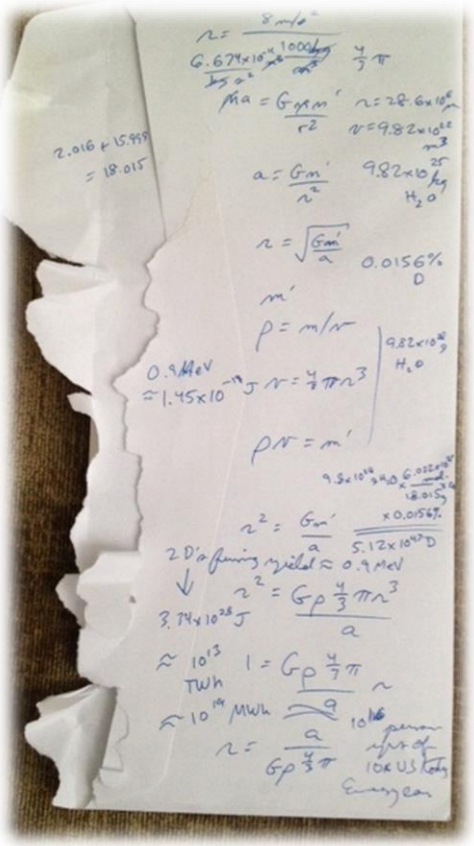
Word of Caution

Do the calculation, don’t use the back of envelope average approach or you’ll miss savings opportunities for your customer



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Consumption & Demand Relationship

- If a facilities electric load were constant over all hours in a month, the **Load Factor** would be 1.0

$$\textbf{Load Factor} = \frac{\textbf{Energy Consumption}}{\textbf{(Peak Demand x Hours/Billing Period)}}$$

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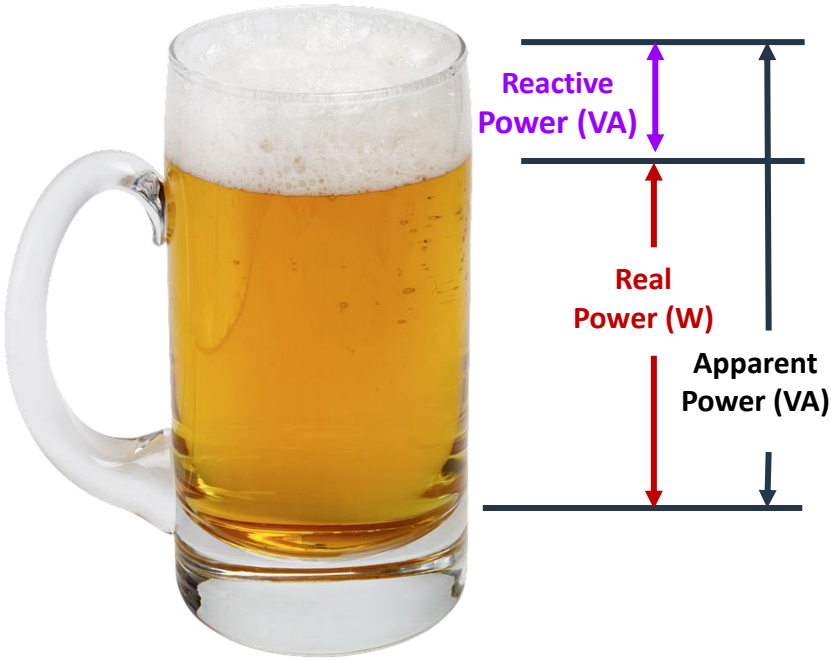
Power Factor

- Power factor is defined by the industry as the power input in watts divided by the product of the input voltage and input current (measured in amps)
- The power factor of an electrical system is a number between 0 and 1 – the ratio of the real power flowing to the load to the apparent power in the circuit



Power Factor is the ratio of beer (W) to beer + foam (VA). As the foam increases and beer decreases, the PF is reduced. This beer looks like it has Power Factor of .9

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Load Factor

- Calculation
  - Effective Full Load Hours (EFLH) =[Total Usage (kWh) / Registered Demand (kW)]
  - Load Factor = [EFLH / (#days/month X 24 hr/day)]
    - Monthly load factor varies
  - Example
    - Customer used 9,000 kWh with a registered demand of 30kW in a Winter month containing 30 days
      - EFLH = 9,000 kWh / 30 kW = 300 EFLH
      - Load Factor = 300 hours / (30 days x 24 hr/day) = 300 hours / 720 hours = .416 = 42% Monthly load factor
  - 75% to 80% is considered a good Load Factor

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Load Factor & Demand Charge Effect

- Some electric rates set the demand charge based on the Load Factor (L.F. described later)
- A higher demand charge has the net effect of increasing the total cost of electricity
- Example
  - Demand charge is $10/kW / Month
  - Assume 30 days/month = 720 hours per month
  - A Load factor of 25% is equivalent to 180 hr…cont.

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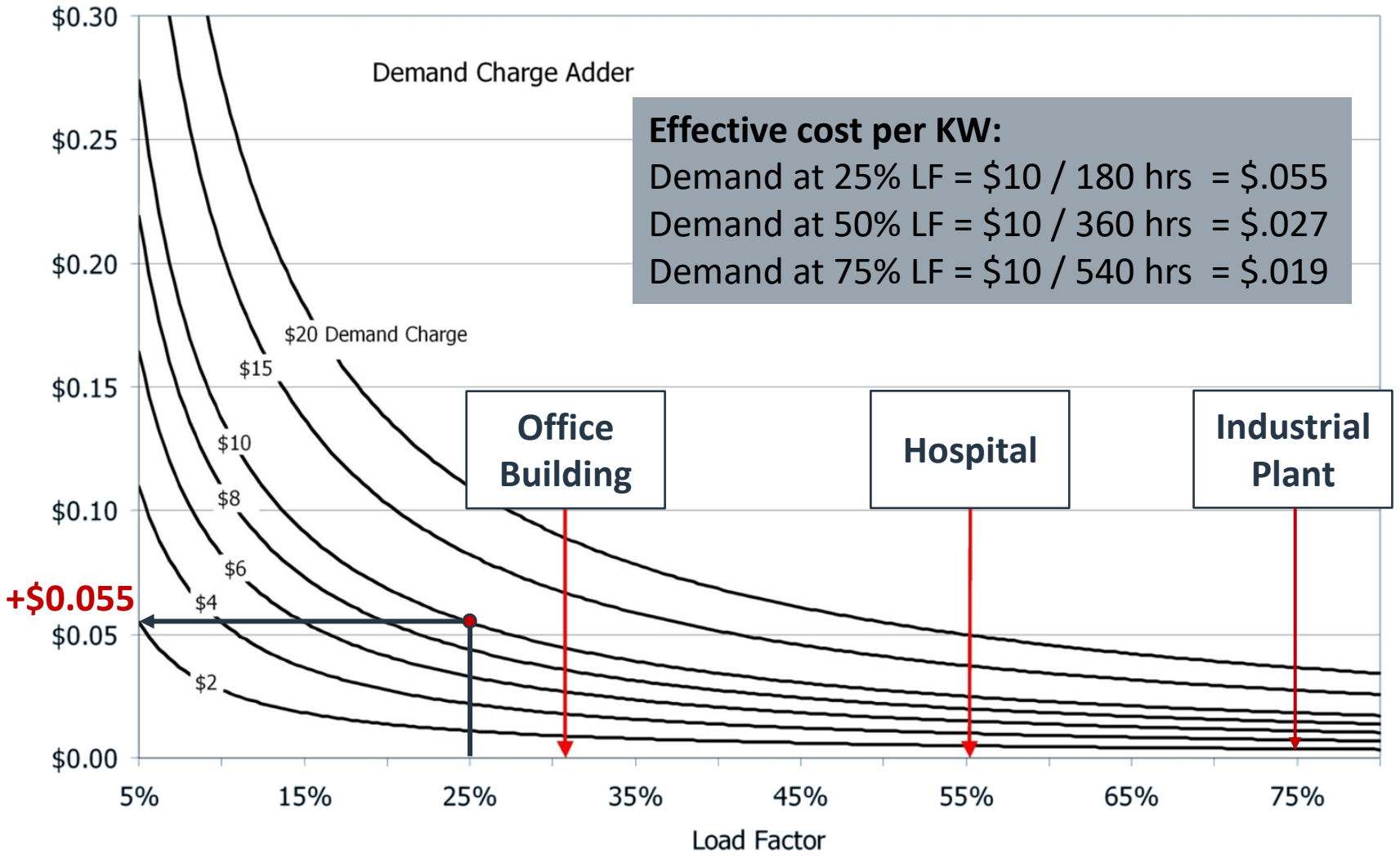
Demand Charge Impact



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Misc. Adjustments

- Time of Use Adjustments
- Other Adjustments
- Stranded Costs

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On Peak / Off Peak

- Peak Hours
  - Each electric company defines peak hours differently: Peak hours are typically weekdays during working hours when electric demands are at their highest
  - Some electric utilities have different Summer and Winter peak periods
  - The Demand billing component will be set typically during peak hours
  - Holidays may be included or excluded from Peak Hours

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On Peak / Off Peak Example 1

Ameren Illinois Company
d/b/a Ameren Illinois
Electric Service Schedule Ill. C. C. No. 1

Ill. C. C. No. 1
1st Revised Sheet No. 3.009
(Canceling Original Sheet No. 3.009)

CUSTOMER TERMS AND CONDITIONS

Non-Residential
Non-Residential means those Customers not eligible for Residential service.

Off-Peak
Off-Peak means all hours other than those included in the On-Peak period.

On-Peak
On-Peak means the hours from 10 A.M. until 10 P.M. Central Prevailing Time (CPT), Monday through Friday except New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day or if one of the preceding holidays occurs on a Sunday, the Monday immediately following the holiday.

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On Peak / Off Peak Rate Example 2

- GP Schedule TOU-EO-4
- Base Charge $40.75 per month
- On Peak / Off Peak adjustments
  - On-Peak is 2PM – 7PM June through September
    - On-Peak Usage $.149/kWh
    - Off-Peak Usage $.067/kWh
  - Off-Peak is all other times plus October through May
    - Usage 1st 1500 kWh $.067308
    - Usage over 1500 kWh $.025698
- Demand from $4.27 for 30-40 kW, $8.44/kW for 40-50kW and skyrockets to **$25.64/kW** for over 50kW

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On Peak / Off Peak Rate Example 2

- On-peak hours are 6:00 a.m. to 10:00 p.m. during periods of the year when Eastern Standard Time is in effect, and 9:00 a.m. to 10:00 p.m. when Eastern Daylight Savings time is in effect, Monday through Friday, including holidays falling on weekdays. All other hours are off-peak hours.
- The availability of Off-Peak Service is subject to agreement in writing between the Company and the Customer. There shall be an additional charge per month for such service as shown on Tariff Leaf No. 47. The Company reserves the right to restrict the amount of off-peak power available to any individual Customer and to restrict the total amount of off-peak power available on its system.

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Other Adjustments & Fees – Example 1

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

B.P.U.N.J. No. 15 ELECTRIC

Second Revised Sheet No. 2
Superseding
First Revised Sheet No. 2

TABLE OF CONTENTS

Most electric tariffs include some sort of adjustments to the rates

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Other Adjustments – Example 2

- Fuel Cost Recovery, FCR-20
  - Varies. $.038239/kWh for Secondary Distribution customers
- Franchise fee, FF-1
  - 2.9106% Inside the city
  - 1.0532% Outside the city
- Environmental Compliance Cost Recovery, ECCR-1
  - 6.1246 % of Base Bill
- Local Tax adjustment, LT-1
- Other taxes or fees

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Debt Retirement Charge

- Debt Retirement Charge (**Stranded Costs**) – a fixed cost of $/kWh to pay down the cost of the existing generation stations that were divested
- Charge is in $ per kWh

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Stranded Cost Example

Oncor Electric Delivery Company LLC
FERC Electric Tariff, Twelfth Revised Volume No. 1

Original Sheet No. 34

TARIFF FOR TRANSMISSION SERVICE
TO, FROM AND OVER CERTAIN INTERCONNECTIONS

2.21 Stranded Cost Recovery

Company may seek to recover stranded costs from the transmission service customer pursuant to this TFO Tariff in accordance with the terms, conditions and procedures set forth in FERC Order No. 888. However, Company must separately file any specific proposed stranded cost charge pursuant to 18 CFR §35.26 or successor regulation.

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Electric Deregulation – (Unbundled Bill)

De-Regulation

- Allows companies to generate electricity & sell in the open market
- Transmission and Distribution (T&D) will be regulated by the Federal Energy Regulatory Commission) FERC and owned by the Local Distribution Companies (LDCs)
- Encourage new power producers to enter the market through more efficient generation of electricity
- Ultimate goal is to achieve lower generated supply prices through a “free market”

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Independent System Operators (ISO)

- Manages fair market practices to the power grid system
- Matches pricing through supply and demand
- Maintains authority to direct energy in response to emergencies
- Indicates hourly pricing based on system requirements


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North American Independent Service Operators (ISO)

https://isorto.org/#about-section

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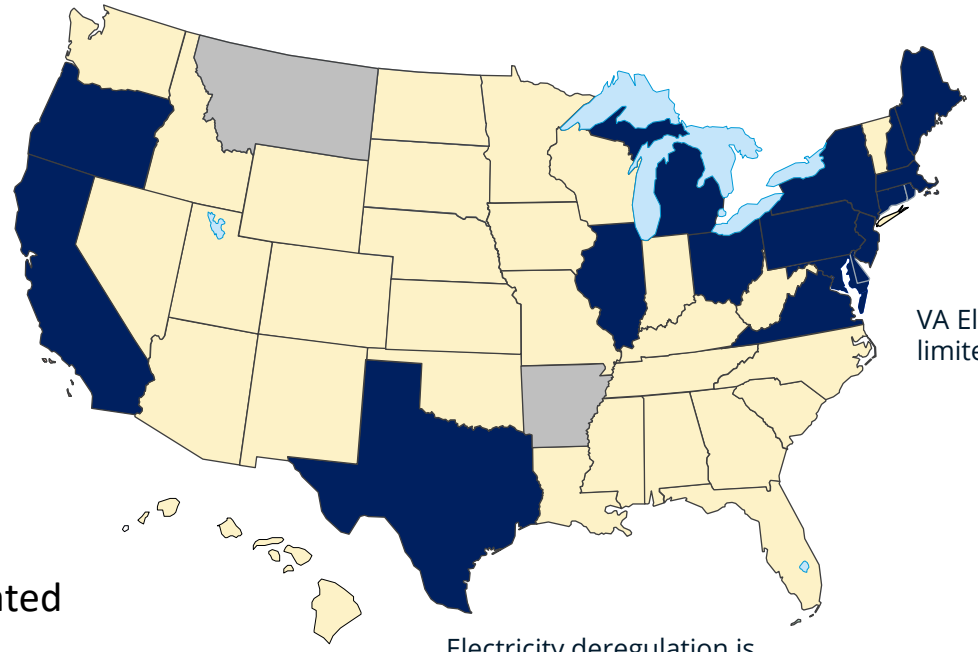
Electric Deregulation Map

California's electric choice works on a very limited lottery system called DirectAcccess



VA Electric Choice programs are limited for residential consumers

Electricity deregulation is available to 85% of Texans.

Electric Deregulated

Suspended

Years = Year deregulated

As of 2023: https://www.electricchoice.com/map-deregulated-energy-markets/

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Typical Structure Electrical Energy Business
Conventional Electric System Layout

Electric Generation (Regulated)

Electric Transmission Lines

Electric Distribution System

End-Use Customer

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Typical Structure Electrical Energy Business
Deregulated Electric System Layout

Merchant Electric Plant

Independent Power Provider

ISO Independent System Operator

Regulated Distribution Systems

End-Use Customers

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Typical Structure
Electrical Energy Business Structure

Marketer

Merchant Electric Plants

Independent System Operator

Regulated Distribution Systems

End-Use Customers

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De-Regulated Tariff Example 1

Ameren Illinois Company
d/b/a Ameren Illinois
Electric Service Schedule Ill. C. C. No. 1

Ill. C. C. No. 1
1st Revised Sheet No. 3.004
(Canceling Original Sheet No. 3.004)

CUSTOMER TERMS AND CONDITIONS

1. Bundled Power and Energy

A Customer may purchase power and energy from the Company pursuant to Rider BGS, RTP or HSS. Service under Rider BGS represents a continuation of bundled service in accordance with Section 16-103 (220 ILCS 5/16-103) of the Illinois Public Utilities Act. Service under Rider RTP or HSS represents a continuation of bundled service for Customers that elect to purchase power and energy at prices that reflect Real-Time Pricing. The Company shall deliver the power and energy purchased by the Customer in accordance with this Schedule.

2. Unbundled Power and Energy

A Customer may arrange to purchase power and energy from a Retail Electric Supplier (RES) or as a Customer Self-Manager (CSM). The Company shall deliver the power and energy to the Customer in accordance with this Schedule. CSM or Customer's RES must designate a Transmission Service Agent (TSA) to act on Customer's behalf, and the TSA must arrange for sufficient Transmission Service to accommodate Customer's load.

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De-Regulated Tariff Example 2

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

B.P.U.N.J. No. 15 ELECTRIC

Second Revised Sheet No. 2
Superseding
First Revised Sheet No. 2

TABLE OF CONTENTS

14. THIRD PARTY SUPPLIER SERVICE PROVISIONS

14.1. **Third Party Supplier Electric Supply:** Customers served on any of the applicable rate schedules of this Tariff for Electric Service and who desire to purchase their electric supply of capacity, transmission, and energy, hereinafter referenced as electric supply, from a Third Party Supplier (TPS) must provide appropriate authorization as required by the TPS. Customers who are not enrolled with a TPS will continue to receive Basic Generation Service electric supply.

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Wholesale Market Pricing

- Wholesale Market Pricing is the supply portion of the customer's bill – not the delivery component
- The cost of the energy supplied through generation
- LDCs can purchase this supply from various power producers on the open market
- Pricing can be on long term supply contracts
- Pricing can be based on an negotiated and/or quoted prices from an ISO

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Bundled Utility Company Pricing

- "Bundled" customers are billed by the LDC
  - Can be an average hourly supply price paid by the LDC
  - Typically, LDC will "bundle" in the delivery charge
- Delivery service remains a regulated monopoly with regulated prices

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"It's in there"

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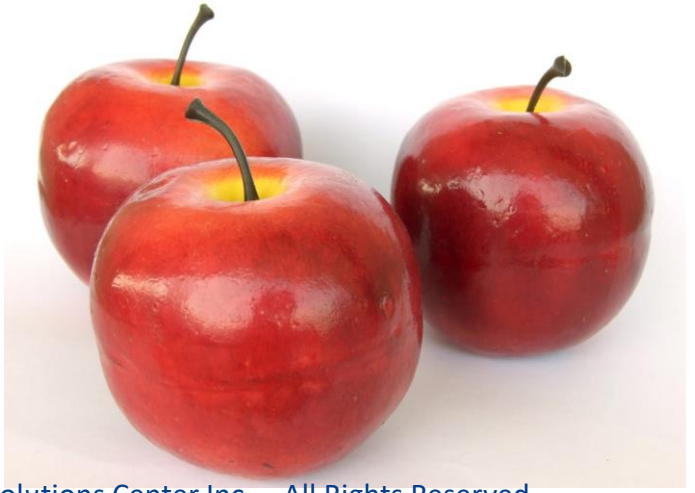
Unbundled Retail Access

- "Commodity" provided by competitive electric energy suppliers
  - Can be contracted – long-term based on hedge pricing
- Customer pays the LDC delivery charges
  - May pay for delivery through the electric energy supplier



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Distribution / Delivery Charge

- The costs of transporting electricity from the local distribution company to the end-user
- The distribution charge is a fee that you will pay to your local utility for the costs they incur while transporting and delivering energy to you. This may include charges for emergency services, maintenance, meter reading and repairs also.

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Calculating Electric Costs

ESC's CHP Payback Tool

Combined Heat & Power (CHP) Simple Payback Analysis Tool

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This tool provides a simple payback calculation for various CHP technologies based off the size and energy rates. The calculations use average pricing, efficiencies, & maintenance costs provided in the CHP Technology Catalogs available from the Combined Heat and Power partnership of the EPA.

The results produced by use of this tool are intended solely as a preliminary evaluation of a potential CHP installation. For a more detailed and exact evaluation you should seek the assistance of a qualified engineering firm with input from the appropriate manufacturers of power generation equipment.

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Analysis Assumptions




CHP Technology	Reciprocating Engine	Micro Turbine	Gas Turbine	Fuel Cell
Typical Size Range	75 kW - 10 MW	30 kW - 200 kW	.5 MW - 40 MW	1kW - 400 kW
Average Installed cost ($/kW)	$ 1,130 - $ 2,210	$ 2,440 - $ 2,970	$ 972 - $ 3,324	$ 6,310 - $ 9,100
Total Average CHP System Efficiency	74 - 79.0%	63.8 - 71.2%	66.3 - 72.1%	65.0 - 81.0%
Gas Input (MMBTU/Hr)	1.2 - 43.79	0.422 - 3.165	18.5 - 368.8	0.1 - 1.9
O&M Cost ($/kWH)	$ 0.009 - $ 0.022	$ 0.012 - $ 0.025	$ 0.0042 - $ 0.011	$ 0.033 - $0.038
Notes:	Less than a 75KW Engine is considered Micro-CHP	Can package multiple Micro turbines to reach 2 MW	Size starts at 1000KW	PEM: 1KW to 200 KW, PAFC: 250KW-400KW

www.understandingchp.com

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Understand Customers Buying System

- Purchasing bundled package from LDC
  - What rate tariff (residential, commercial, industrial)
  - Any special riders
  - Bundled or unbundled services
  - Separate T&D contract
  - Type of metering
  - Any applicable taxes
- Contracted rate through Marketer

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Other Rates:

Net metering
Standby Rates
Excess Power

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Net Metering

- When CHP is used primarily for heating, you will often find times that more electricity is being generated than is being used by the home or business
- Net metering allows the consumer to spin the meter backwards and put power back on the grid at times when more power is being produced than consumed
- This usually means excess power is being sold back to the electric utility at retail rates versus wholesale

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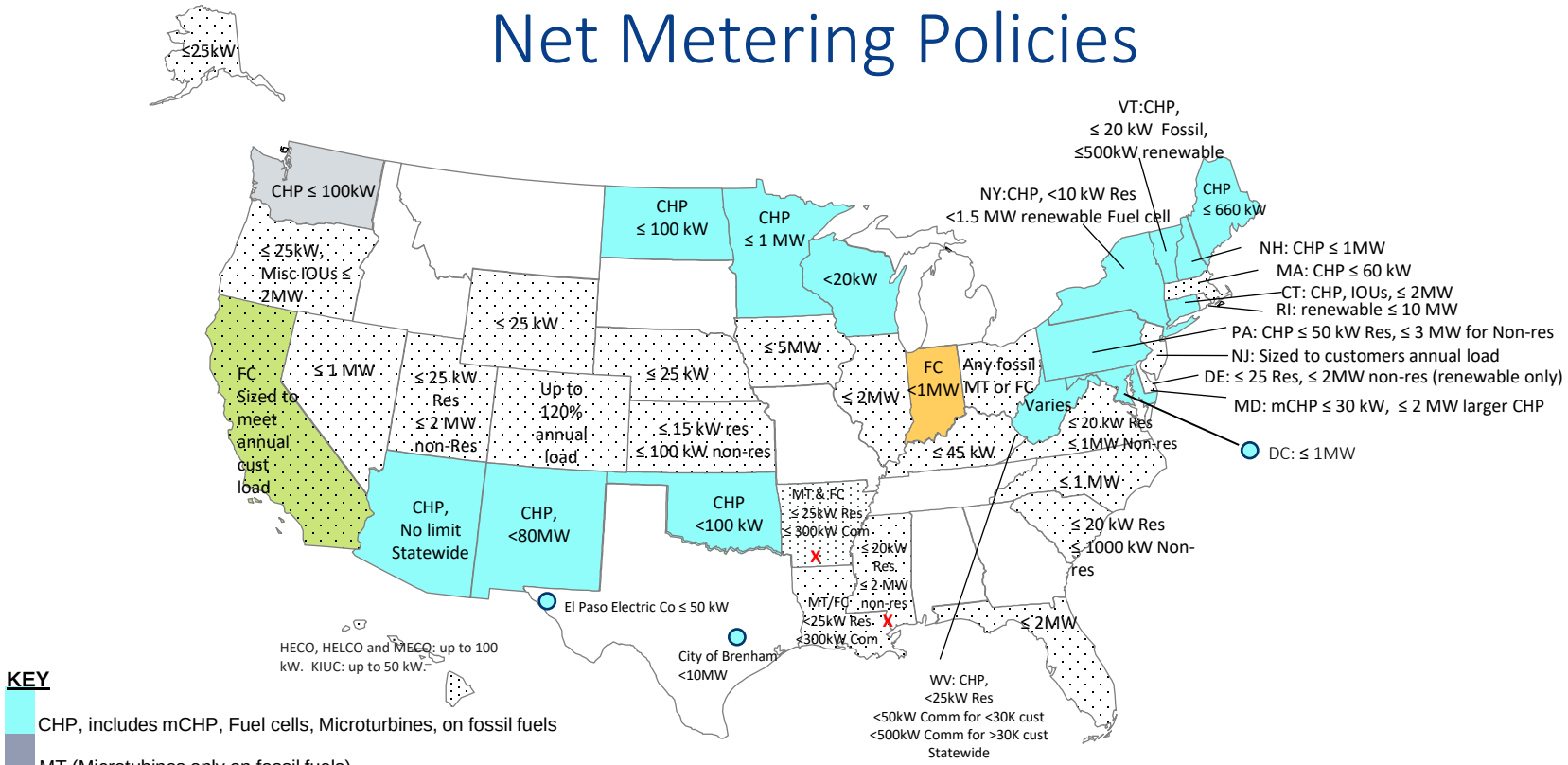
States Allowing Net Metering for CHP

Net Metering Policies



Note that some states have policies for fuel cells or microturbines only, and some list max capacities that are smaller than commercially available technologies. Small X's show these locations on the map.

https://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database

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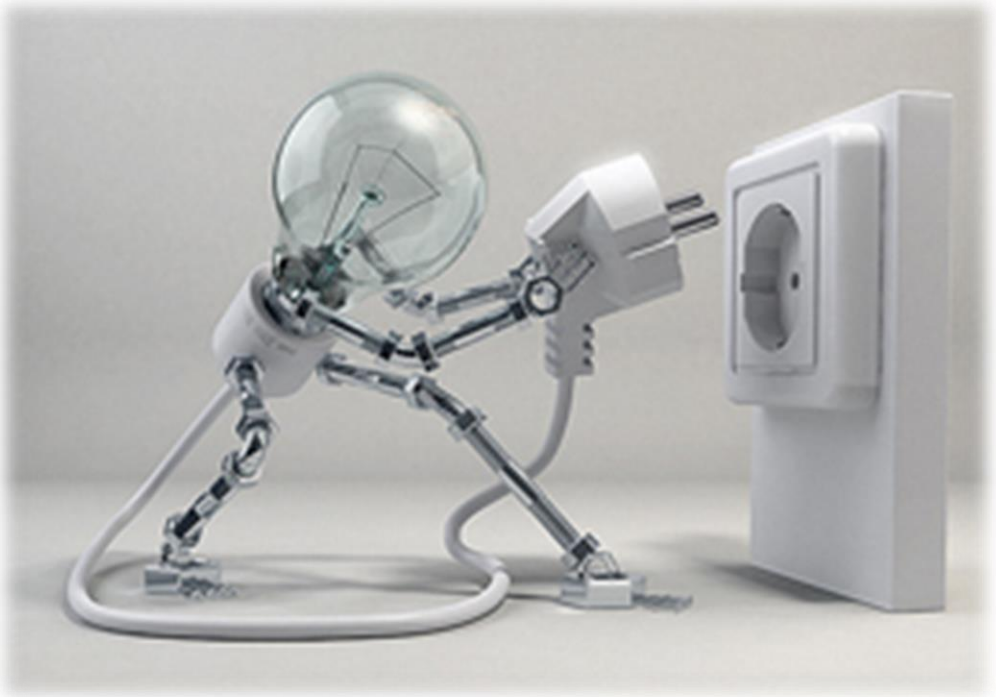
Standby Rates

- Most onsite generators stay connected to the grid and contract with the utility company for electricity in the event that the onsite generator experiences an outage (scheduled or emergency)

- For this backup service, utilities charge customers standby rates (also called backup rates, partial requirements, and other terms)



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Standby Rates Typically Include

- **A capacity reservation charge** (a charge to compensate the utility for the capacity that the utility must have available to serve a customer during an unscheduled outage of the customer's own generation unit)
- **Capacity and energy charges** for the actual electricity supplied to a customer during an unscheduled outage of the customer's own generation unit
- **A maintenance capacity charge** for the capacity supplied by the utility during a scheduled outage of the customer's own generation unit
- **Facility charges** to compensate the utility for any dedicated distribution costs

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Excess Power

- Sizing the CHP system to the thermal load in facilities with large thermal needs, such as industrial facilities, can result in more electricity generated than can be used on site.
- Excess power sales may provide a revenue stream for a CHP project, possibly enabling the project to go forward, and help achieve state energy goals.
- Three types of programs can provide for excess power sales from CHP systems:
  - Programs based on state implementation of the Federal Public Utility Regulatory Policies Act (PURPA)
  - Feed-in Tariffs (FITs) and variations
  - Competitive procurement processes

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Thank You

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