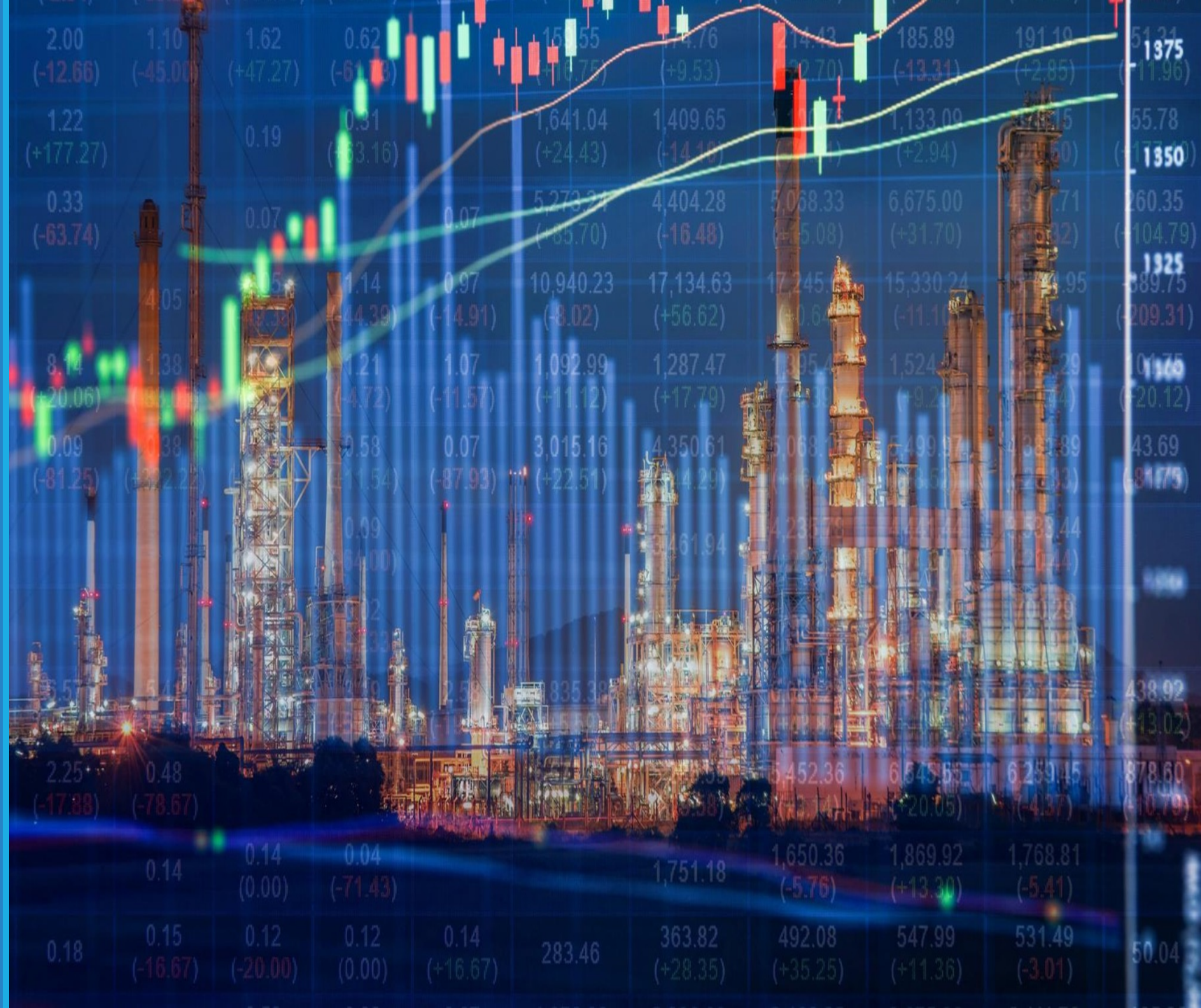
Energy Academy

Session #2: Energy Markets

Metropolitan Mayors Caucus | The Power Bureau

February 1, 2023



AGENDA

HOUSEKEEPING	▪ Course-related items
RESOURCES	▪ Readings ▪ Website of the Week
LECTURE	▪ Wholesale Energy Markets & Operations ▪ Retail Energy Markets & Operations
DISCUSSION	▪ Open

HOUSEKEEPING

ENERGY MARKETS: SUPPLY, DEMAND AND PRICES

Course Mechanics	**Website.** https://mayorscaucus.org/energy-academy/ **Schedule.** Invitations with link have been emailed to attendees. Each class offered on two (2) different dates
Readings and Website of the Week	**Description.** Each class will include links to external energy-related materials and resources including industry reports, white papers, and tools that the instructor has found to be valuable. **Purpose.** While these are not assignments, attendees are encouraged to examine the materials to acquire additional background and context for the classes.
Recommendations	Please feel free to share any ideas and recommendations for improvements to the course and its content!

RESOURCES

RESOURCES

Weekly Readings

US Annual Energy Outlook	**Link:** Annual Energy Outlook, 2022 **Source:** US Department of Energy, Energy Information Administration **Description:** Comprehensive outlook for energy supply, consumer demand, fuels, and other energy market elements in the US
State of the Markets Energy Primer	**Link:** FERC State of the Markets Energy Primer: A Handbook for Energy Market Basics **Source:** Federal Energy Regulatory Commission **Description:** Great background on energy markets in the US
World Energy Outlook, 2022	**Link:** World Energy Outlook, 2022 **Source:** International Energy Agency **Description:** Detailed information on energy trends and transitions in over 30 member and affiliate countries

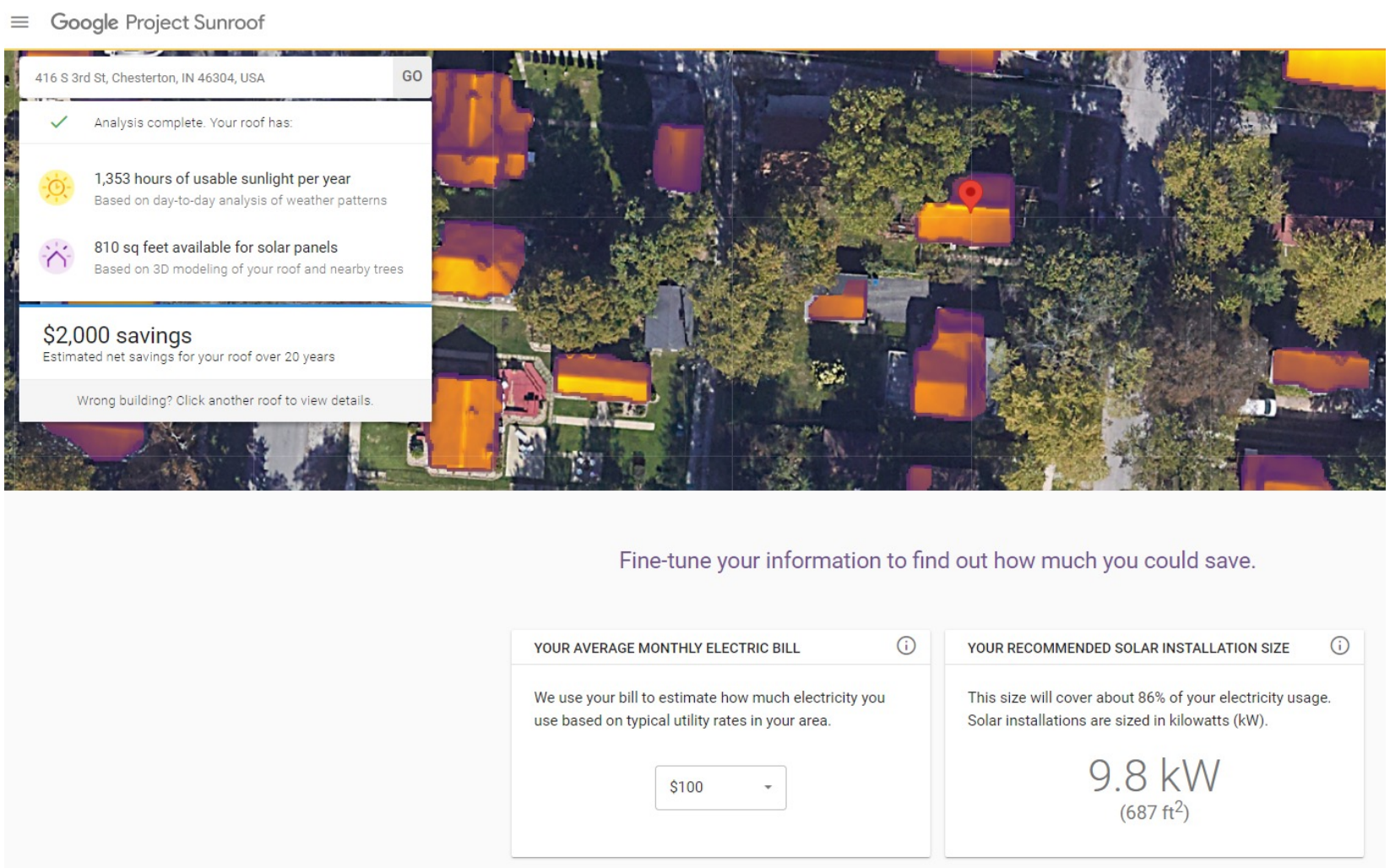
RESOURCES

Weekly Readings

Website of the Week

- Google Project Sunroof
- “Project Sunroof puts Google's expansive data in mapping and computing resources to use, helping calculate the best solar plan for you.”
- Enter a street address and Google calculates a solar array that can be accommodated on rooftop space, the approximate cost of the array, and the level of annual energy generation.
- An effective tool to answer basic questions and build interest in solar

Google Project Sunroof



LECTURE

ENERGY MARKETS

CONTEXT

- Wholesale Markets

Wholesale = Sale of Energy from Generators to Resellers (utilities, marketers, etc.)

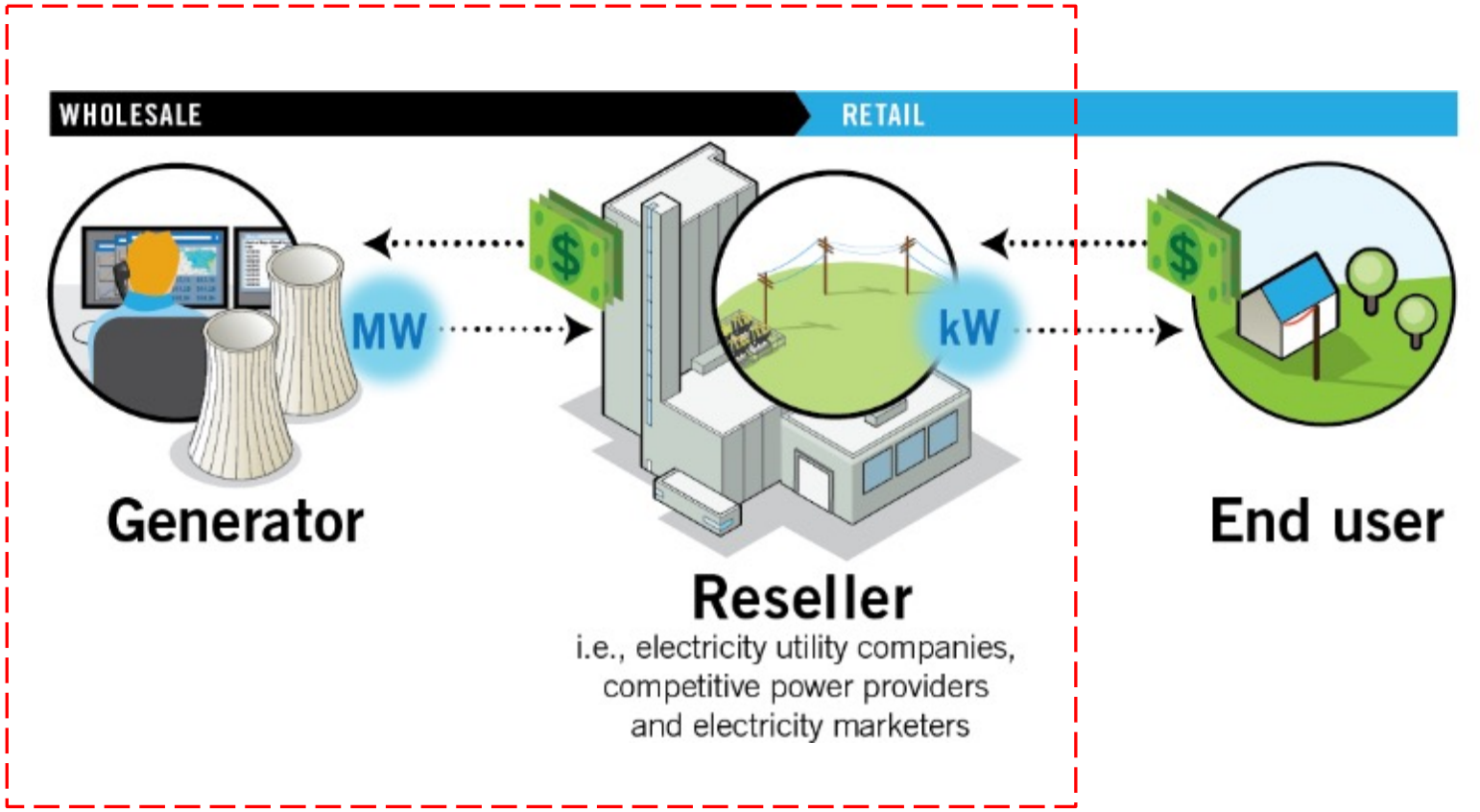


Image Credit: PJM

ENERGY MARKETS

CONTEXT

- Wholesale Markets
- Retail Markets

Retail = Sale of Energy to Consumers (Industrial, Commercial, Residential)

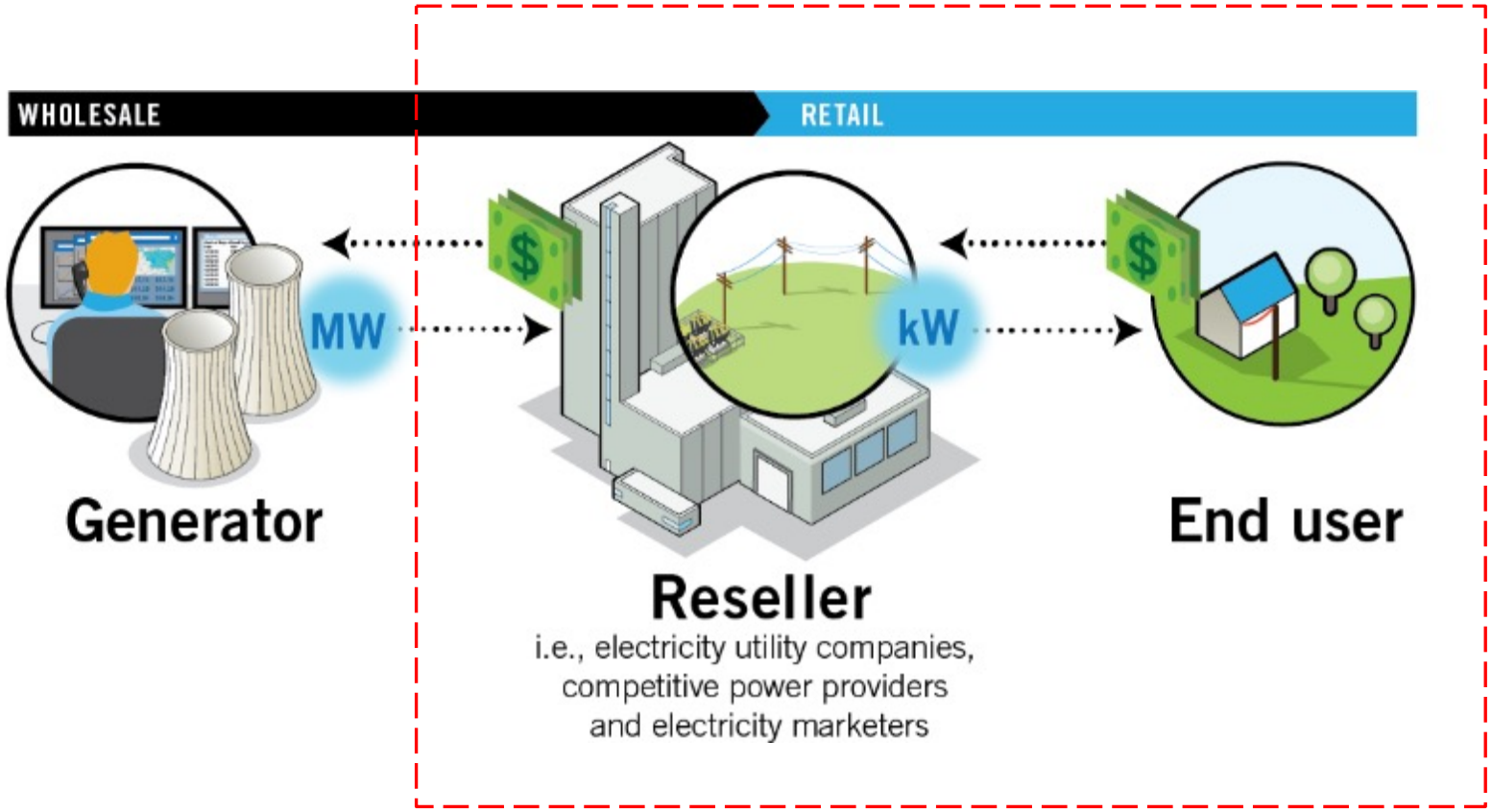


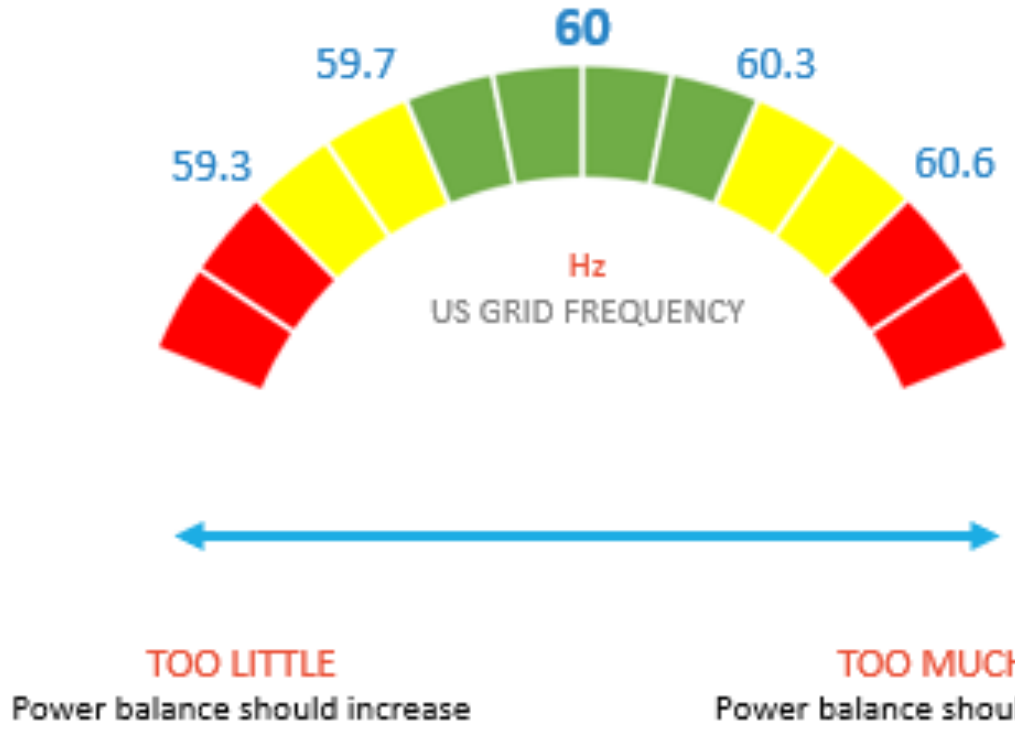
Image Credit: PJM

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability

Grid frequency must remain within narrow ranges to ensure system reliability

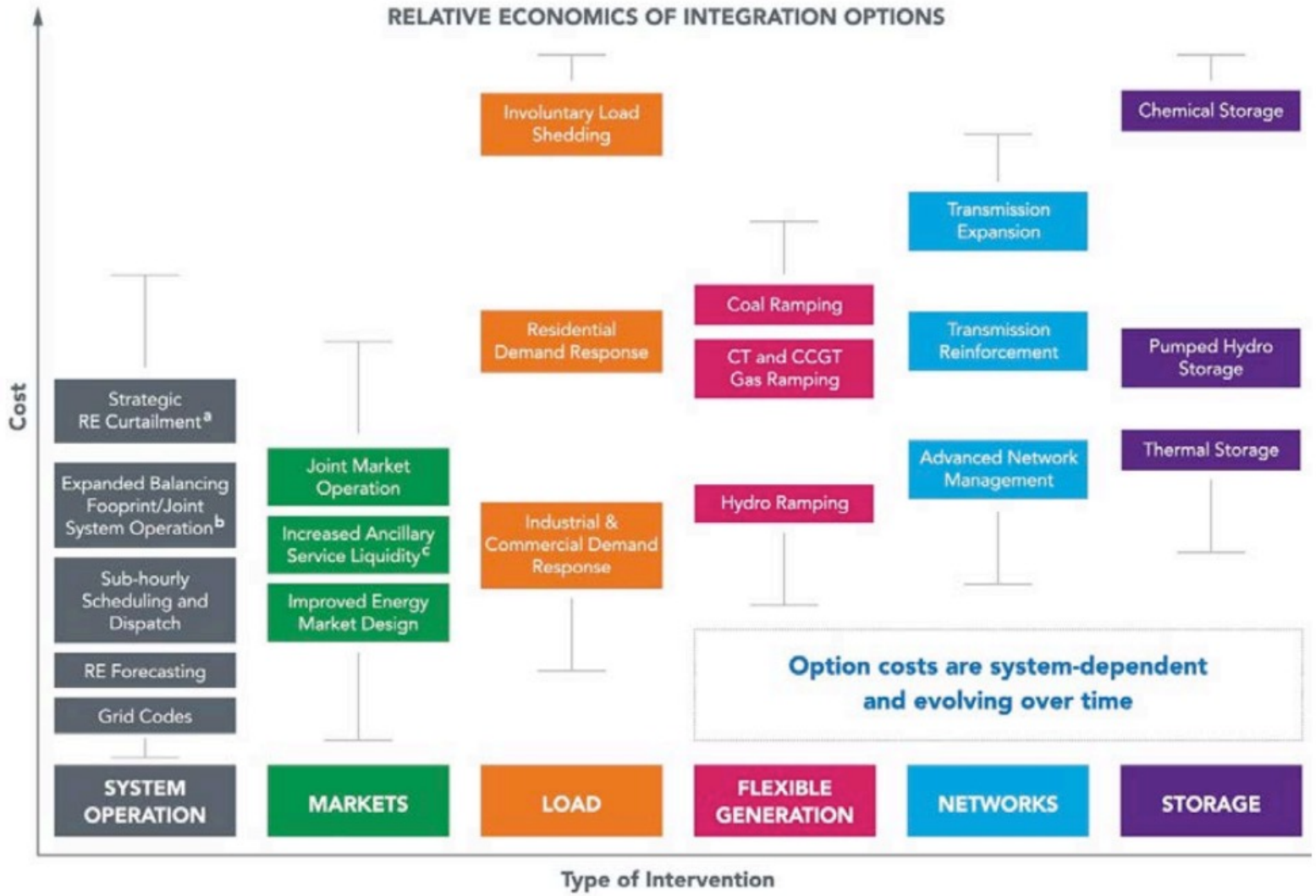


WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches

Wholesale markets have a variety of approaches to manage reliability



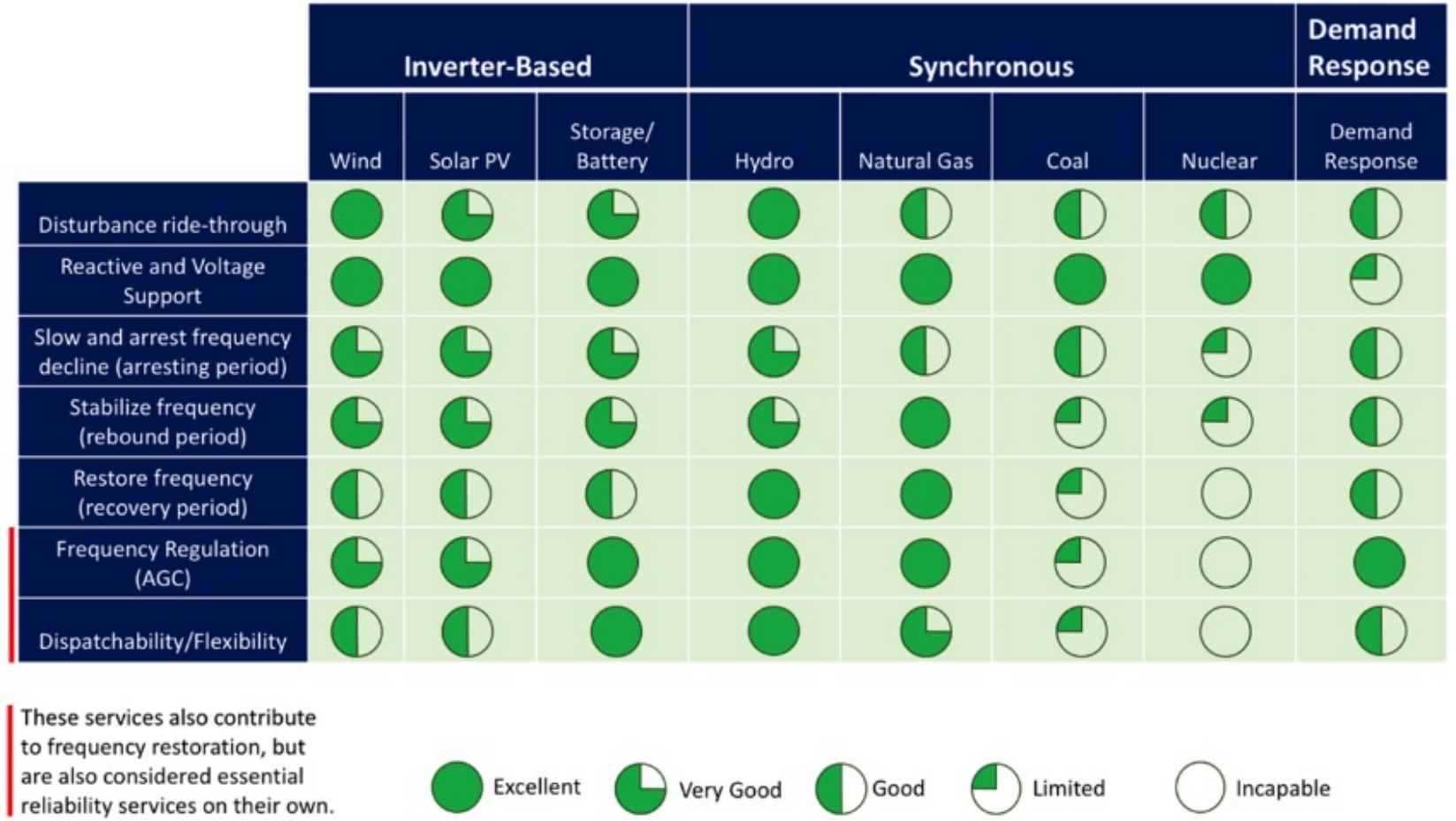
Source: "Grid Integration and the Carrying Capacity of the U.S. Grid to Incorporate Variable Renewable Energy" (NREL)

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches
- Tools

Wholesale markets use the unique characteristics of generation to meet demand



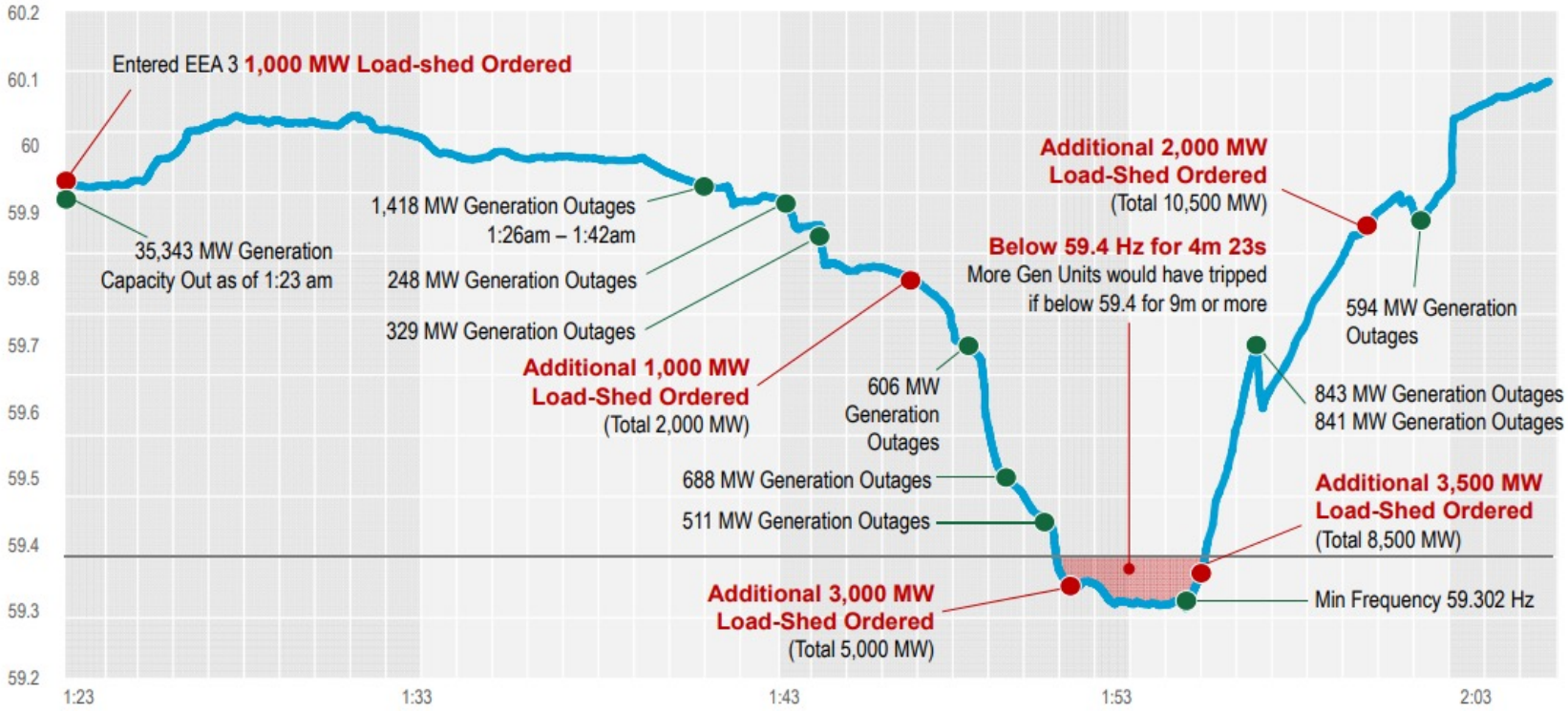
Source: Sources of Grid Reliability Services" (Milligan)

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches
- Tools
- Severe Consequences of Failure

Last year in Texas, the grid operator had to use rolling blackouts to prevent a total grid failure



"The ERCOT system frequency dropped below 59.4 Hz for 4 minutes and 23 seconds on the morning of February 15. Consequently, the grid was within minutes of a much more serious and potentially complete blackout on the morning of February 15."
Public Utility Commission

Source: : "Review of February 2021 Extreme Cold Event – ERCOT Presentation"

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches
- Tools
- Severe Consequences of Failure
- Regional Wholesale Power Markets

Wholesale markets are arranged on a voluntary regional basis

Source: "Review of February 2021 Extreme Cold Event – ERCOT Presentation"

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches
- Tools
- Severe Consequences of Failure
- Regional Wholesale Power Markets
  - Organized Markets. Managed by a non-profit grid managers.

Some wholesale markets are “organized” and have a central operator that manages the regional system to ensure reliability

Source: “Review of February 2021 Extreme Cold Event – ERCOT Presentation”

WHOLESALE ENERGY MARKETS

HOW THEY OPERATE

- Objective: Reliability
- Approaches
- Tools
- Severe Consequences of Failure
- Regional Wholesale Power Markets
  - Organized Markets. Managed by a non-profit grid managers.
  - Traditional Markets. Managed by local utilities

Some wholesale markets are “traditional” and ensure reliability through cooperation between local utilities

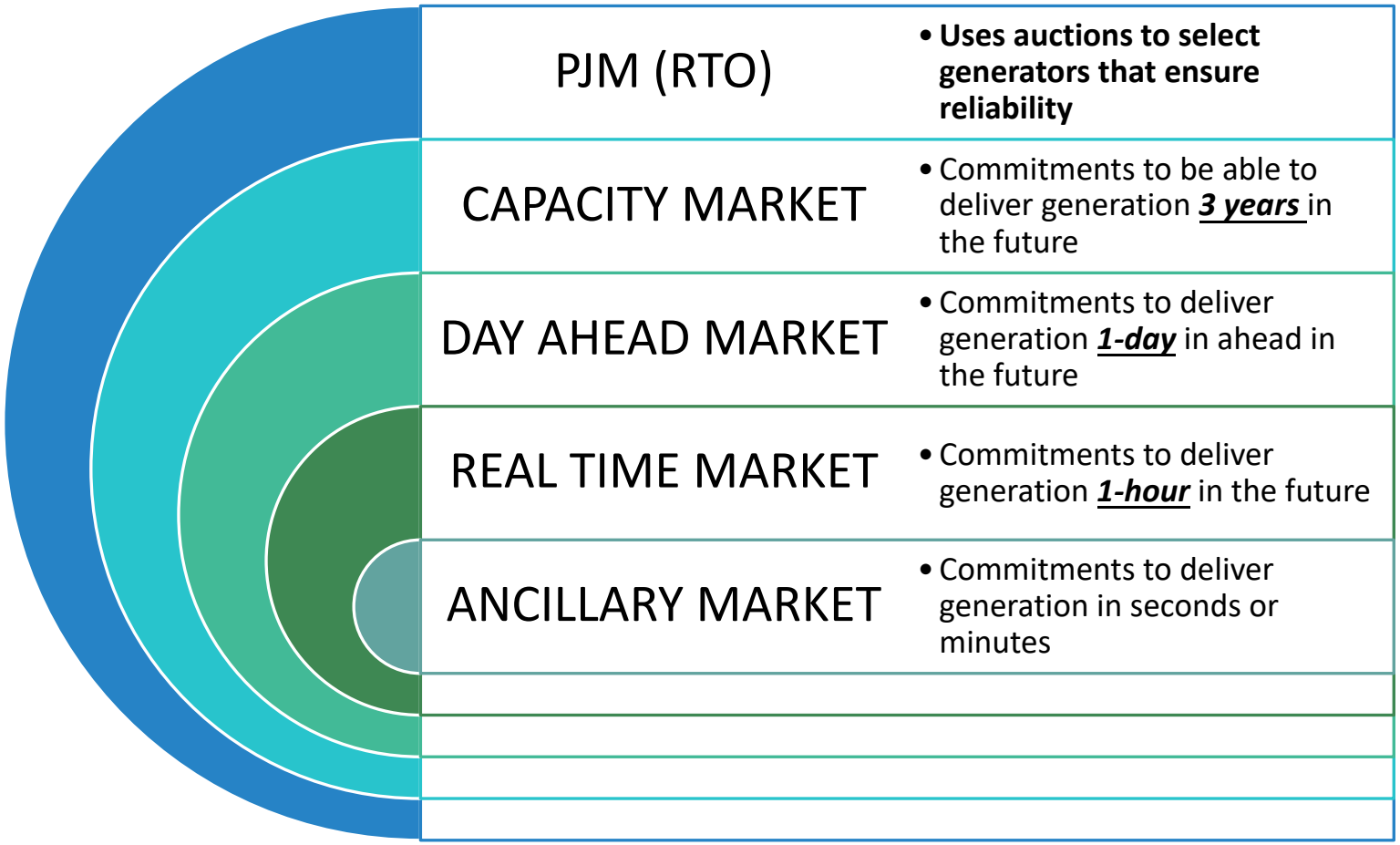
Source: “Review of February 2021 Extreme Cold Event – ERCOT Presentation”

WHOLESALE ENERGY MARKETS

RELIABILITY APPROACH IN ILLINOIS

- PJM is our Regional Transmission Company
- PJM uses auction processes to select power generators to match fluctuating demand within the region
- Generation can be secured across multiple planning horizons
  - Capacity Market. Secures the generating capacity 3 years in advance
  - Day Ahead Market. Secures the generation 1 day in advance
  - Real Time Market. Secures the generation 1 hour in advance
  - Ancillary Market. Secures the generation 1 day in the next seconds and minutes

PJM is the Regional transmission Organization that manages the wholesale power market in Northern Illinois (ComEd)



Energy prices are market-based and reflect the relative level of supply and demand

WHOLESALE ENERGY

CAPACITY MARKET

- Bidding to be available to deliver energy to the grid if called upon at a future date
- Intended to improve long term reliability by compensating generators for providing longer term commitments
- Auction processes can occur 1-3 years in advance
- Penalties for non-performance

PJM compensates generators to be available to deliver power three years into the future at a price that is set through an auction process

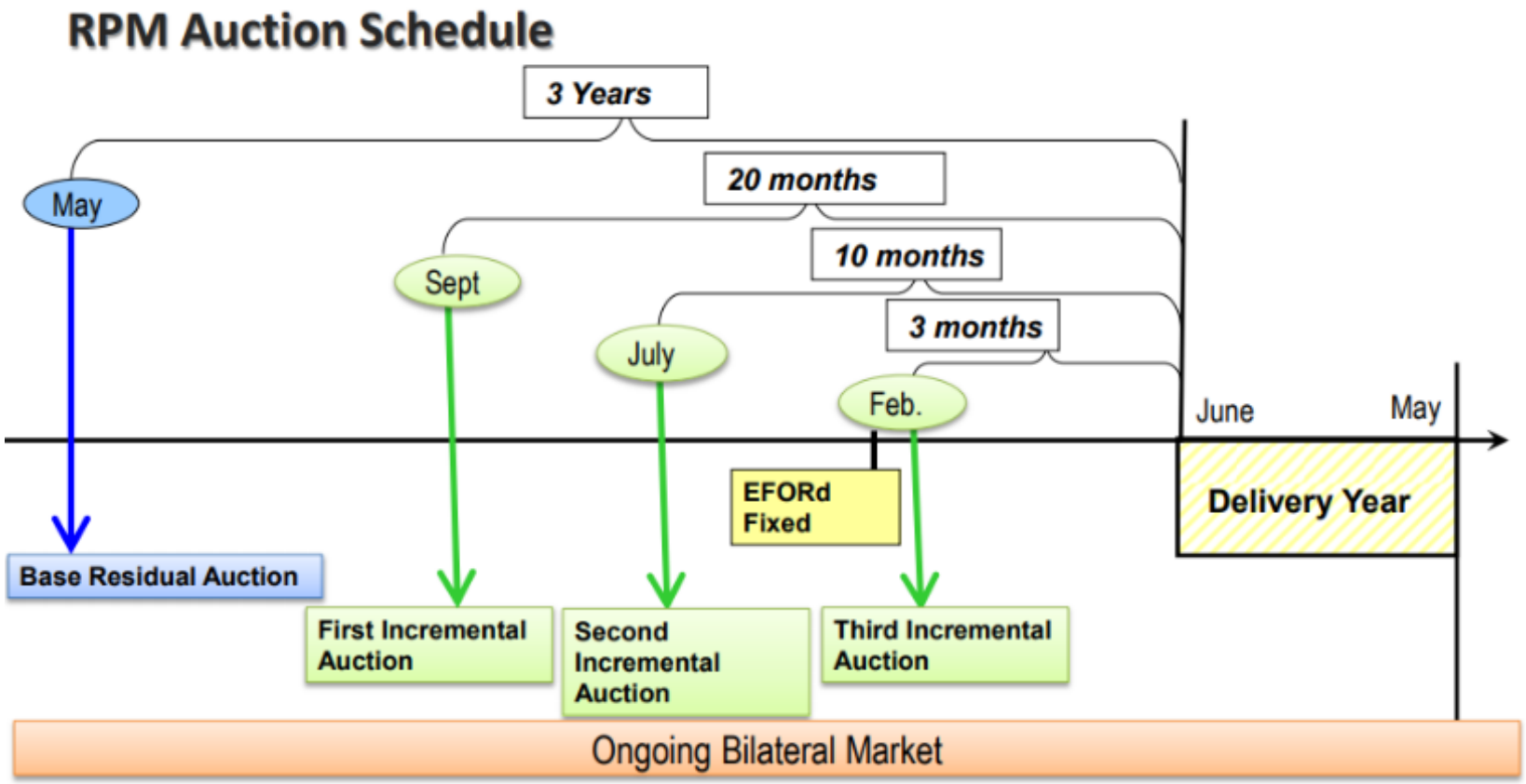


Image Credit: PJM

WHOLESALE ENERGY

DAY AHEAD AND REAL TIME MARKETS

- Generators bid to deliver energy during specific hours on the following day
- Auction sets single clearing price
  - An hourly projected supply requirement is set by the grid manager (A)
  - Generator bids are arranged according to price (B)
  - Clearing price is set by the marginal bidder's offer (C)
  - All bidders beneath the clearing price receive the clearing price (D)

Day-Ahead and Real-Time Market Prices are also set by the auction process

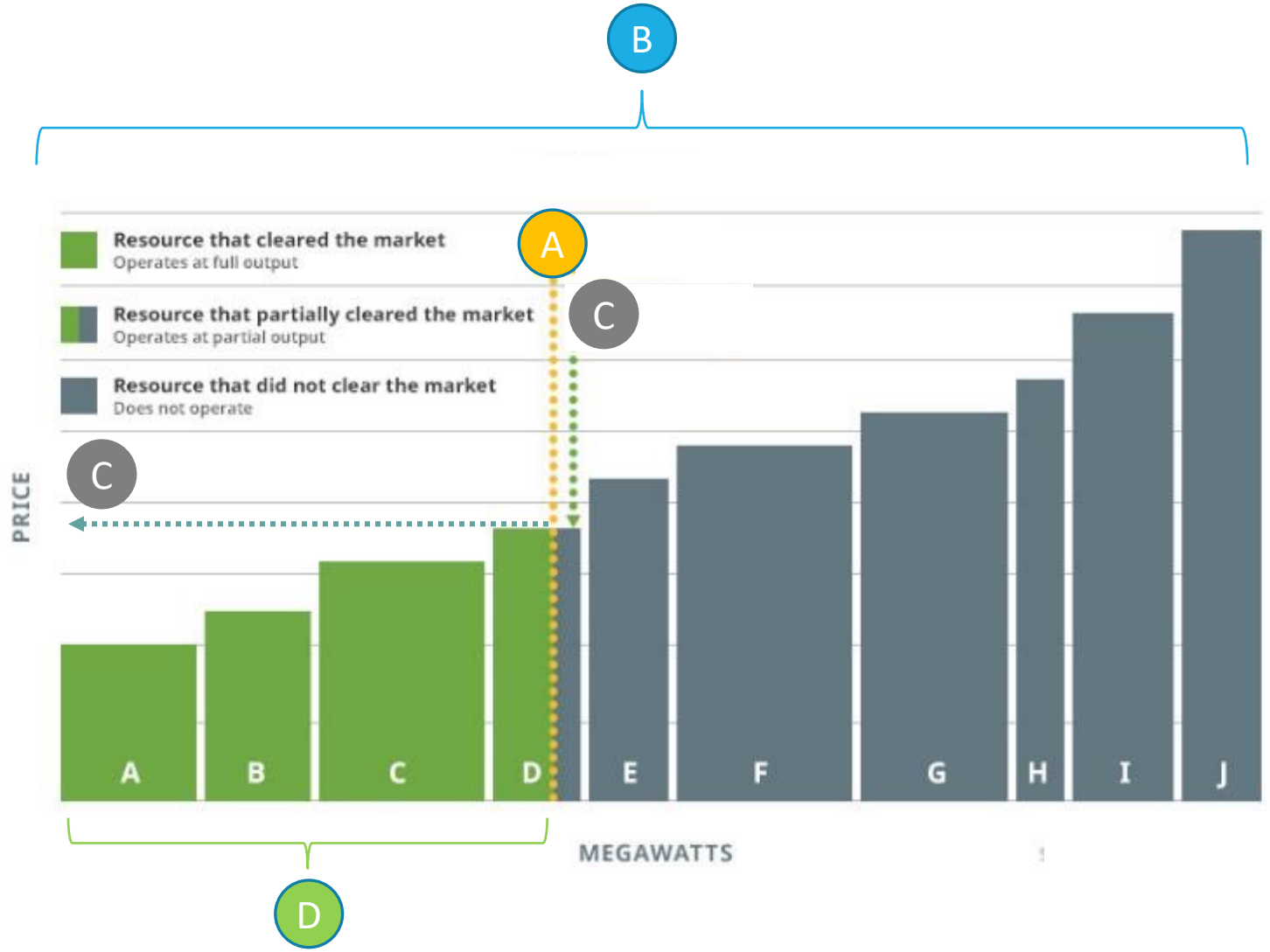


Image Credit: ISO-NE (Independent System Operator)

WHOLESALE ENERGY

IMPLICATIONS

- Capacity prices (that are ultimately paid for by consumers) ***change annually*** (June through May) and vary by subregion

Capacity prices change annually for each subregion based on auction results

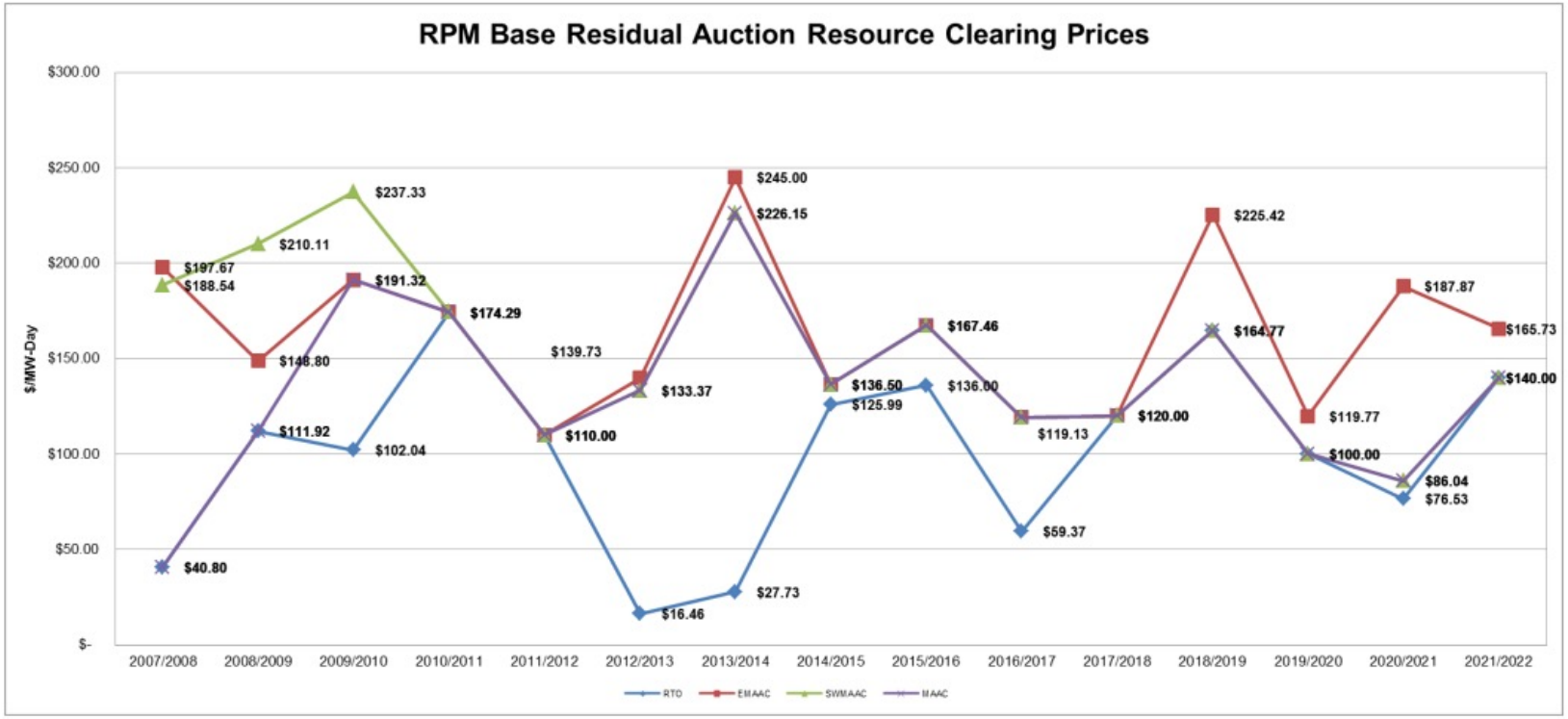


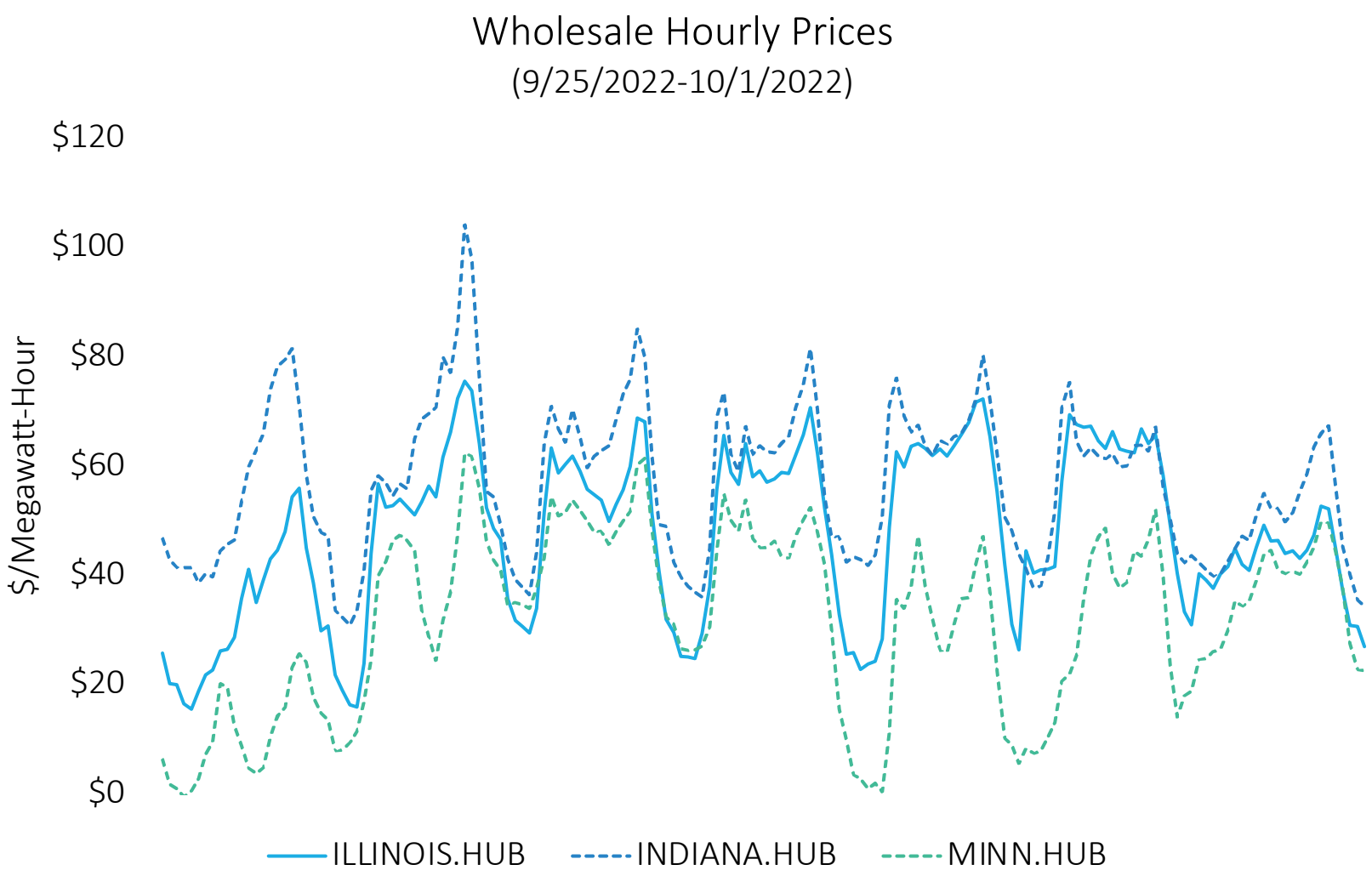
Image Credit: PJM

WHOLESALE ENERGY

IMPLICATIONS

- Capacity prices (that are ultimately paid for by consumers) ***change annually*** (June through May) and vary by subregion
- Energy prices (that are ultimately paid for by consumers) ***change hourly*** (every day) and vary by subregion

Energy prices change hourly for each subregion based on auction results

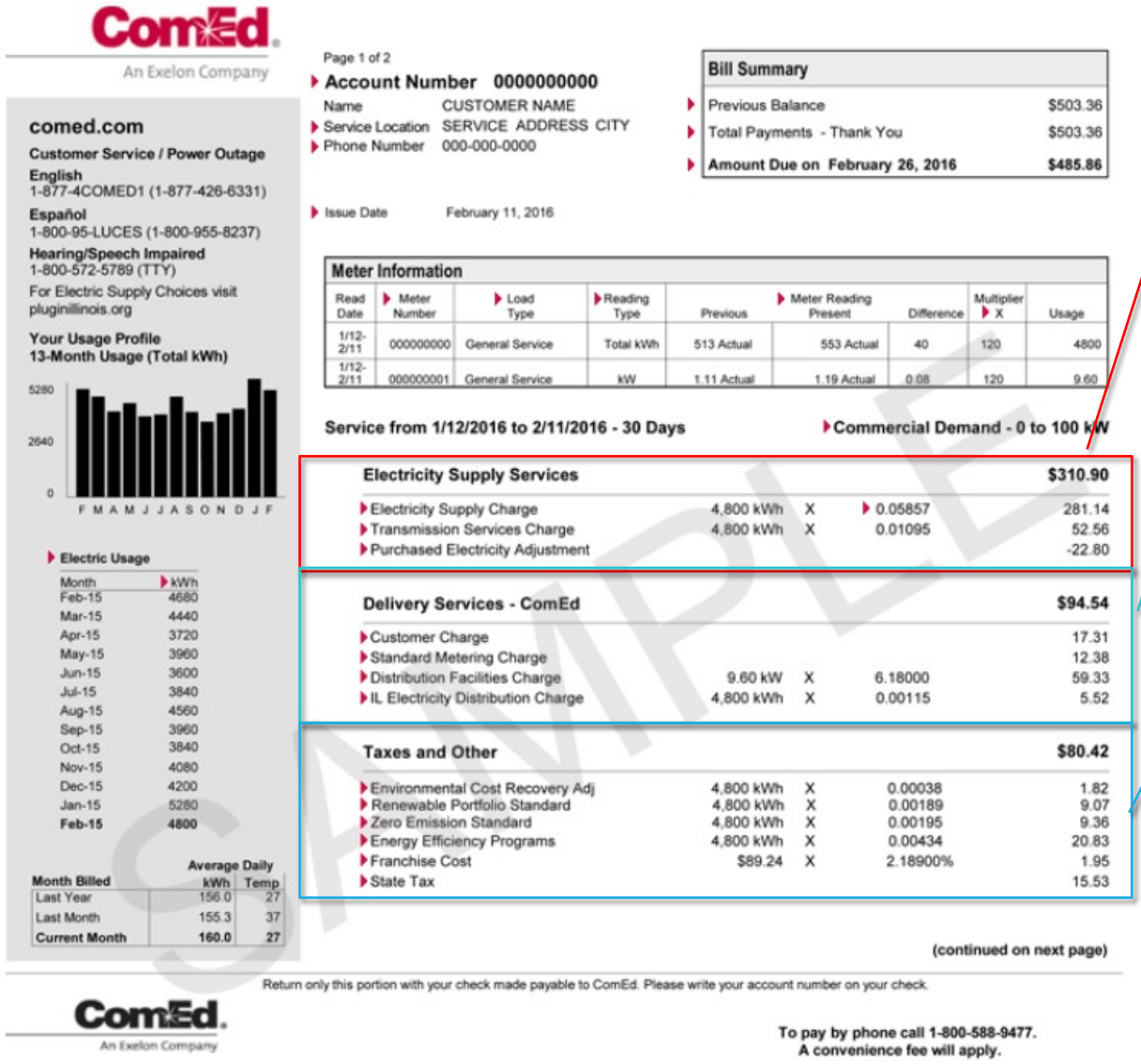


RETAIL ENERGY MARKETS

HOW THEY OPERATE

- Objective: Consumer Cost

The total cost of energy for consumers is the sum of Supply + Delivery + Taxes/Fees



ComEd
An Exelon Company

Page 1 of 2

Account Number 0000000000
Name CUSTOMER NAME
Service Location SERVICE ADDRESS CITY
Phone Number 000-000-0000

Issue Date February 11, 2016

Bill Summary

Previous Balance	$503.36
Total Payments - Thank You	$503.36
Amount Due on February 26, 2016	**$485.86**

Meter Information

Read Date	Meter Number	Load Type	Reading Type	Previous	Meter Reading Present	Difference	Multiplier X	Usage
1/12-2/11	000000000	General Service	Total kWh	513 Actual	553 Actual	40	120	4800
1/12-2/11	000000001	General Service	kW	1.11 Actual	1.19 Actual	0.08	120	9.60

Service from 1/12/2016 to 2/11/2016 - 30 Days — **Commercial Demand - 0 to 100 kW**

Electricity Supply Services **$310.90**

Electricity Supply Charge	4,800 kWh	X	0.05857	281.14
Transmission Services Charge	4,800 kWh	X	0.01095	52.56
Purchased Electricity Adjustment				-22.80

Delivery Services - ComEd **$94.54**

Customer Charge				17.31
Standard Metering Charge				12.38
Distribution Facilities Charge	9.60 kW	X	6.18000	59.33
IL Electricity Distribution Charge	4,800 kWh	X	0.00115	5.52

Taxes and Other **$80.42**

Environmental Cost Recovery Adj	4,800 kWh	X	0.00038	1.82
Renewable Portfolio Standard	4,800 kWh	X	0.00189	9.07
Zero Emission Standard	4,800 kWh	X	0.00195	9.36
Energy Efficiency Programs	4,800 kWh	X	0.00434	20.83
Franchise Cost	$89.24	X	2.18900%	1.95
State Tax				15.53

(continued on next page)

comed.com
Customer Service / Power Outage
English
1-877-4COMED1 (1-877-426-6331)
Español
1-800-95-LUCES (1-800-955-8237)
Hearing/Speech Impaired
1-800-572-5789 (TTY)
For Electric Supply Choices visit pluginillinois.org

Your Usage Profile
13-Month Usage (Total kWh)

Electric Usage

Month	kWh
Feb-15	4680
Mar-15	4440
Apr-15	3720
May-15	3960
Jun-15	3600
Jul-15	3840
Aug-15	4560
Sep-15	3960
Oct-15	3840
Nov-15	4080
Dec-15	4200
Jan-15	5280
Feb-15	**4800**

Month Billed	Average Daily kWh	Temp
Last Year	156.0	27
Last Month	155.3	37
Current Month	**160.0**	**27**

Return only this portion with your check made payable to ComEd. Please write your account number on your check.

ComEd
An Exelon Company

To pay by phone call 1-800-588-9477.
A convenience fee will apply.

SAMPLE

Supply (65-90%)

Delivery (10-20%)

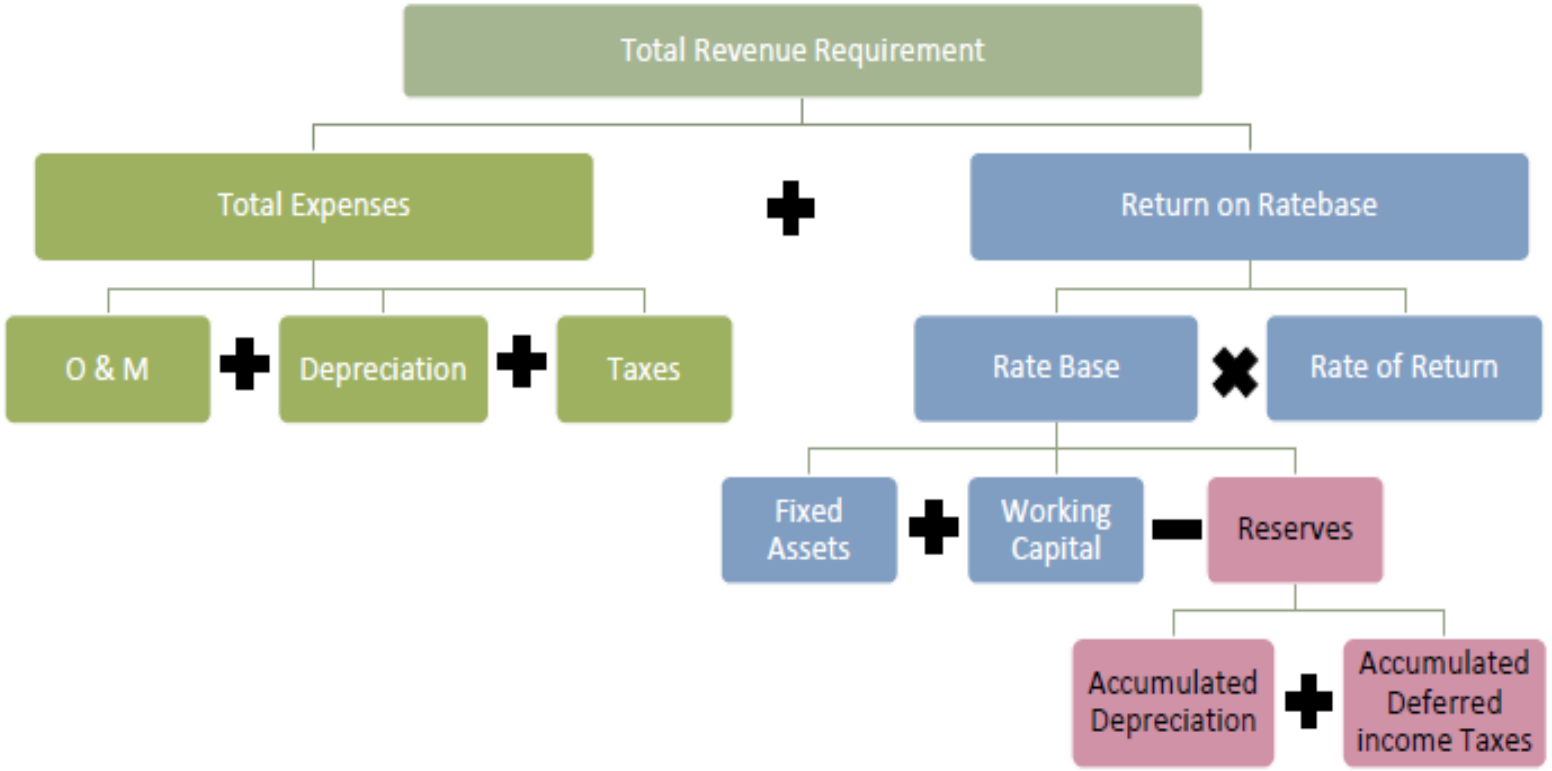
Taxes/Fees (5-15%)

RETAIL ENERGY MARKETS

HOW THEY OPERATE

- Objective: Consumer Cost
- Rate of Return Ratemaking

Originally, utilities were allowed to set rates to recover their operating costs on a pass-through basis *plus* a Return On and Return Of capital expenditures

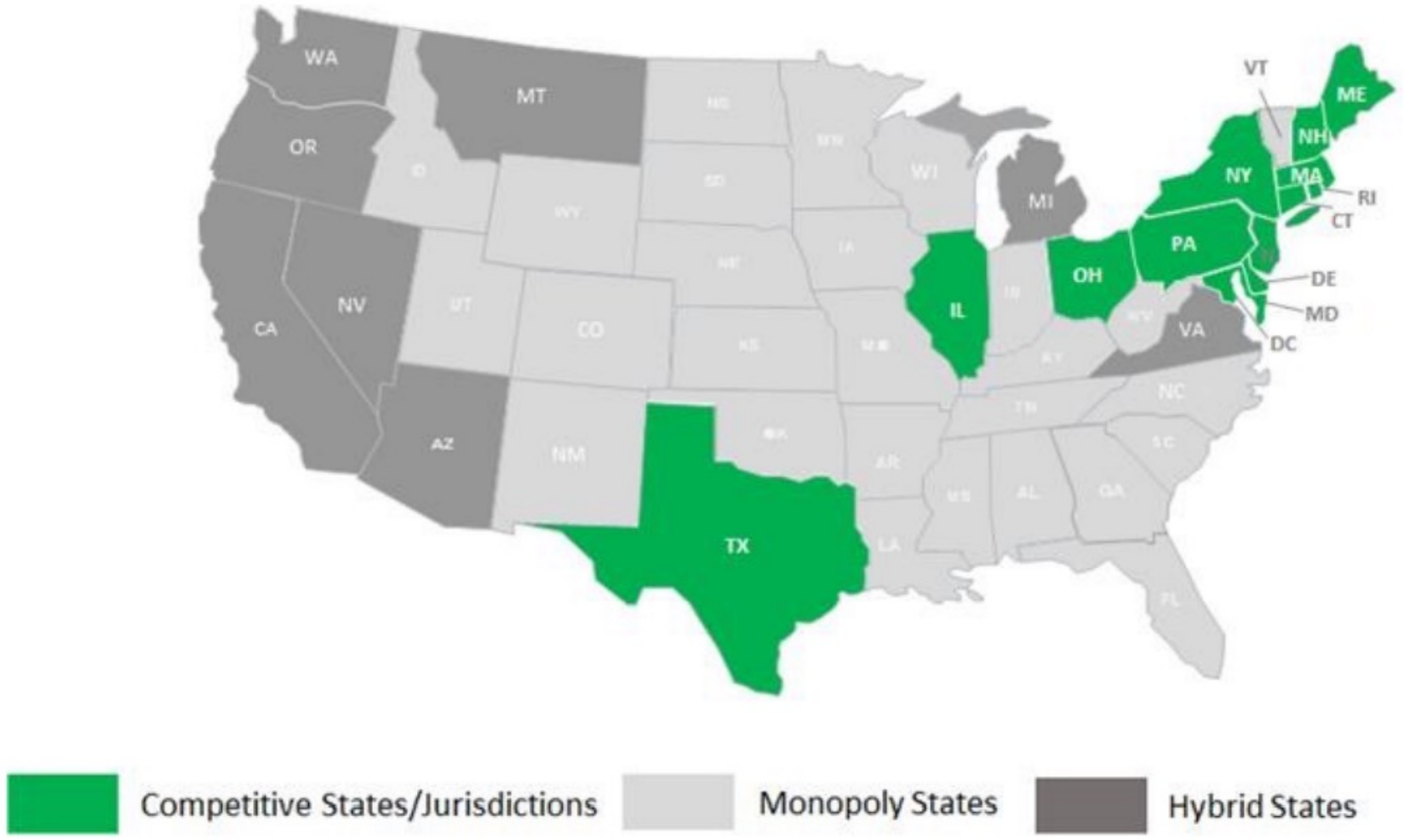


RETAIL ENERGY MARKETS

HOW THEY OPERATE

- Objective: Consumer Cost
- Rate of Return Ratemaking
- Deregulated (“Choice”) Markets developed starting in the 1990’s

“Deregulation” was intended to reduce the cost of power generation by moving utilities out of the power generation business and introducing competition



RETAIL ENERGY MARKETS

HOW THEY OPERATE

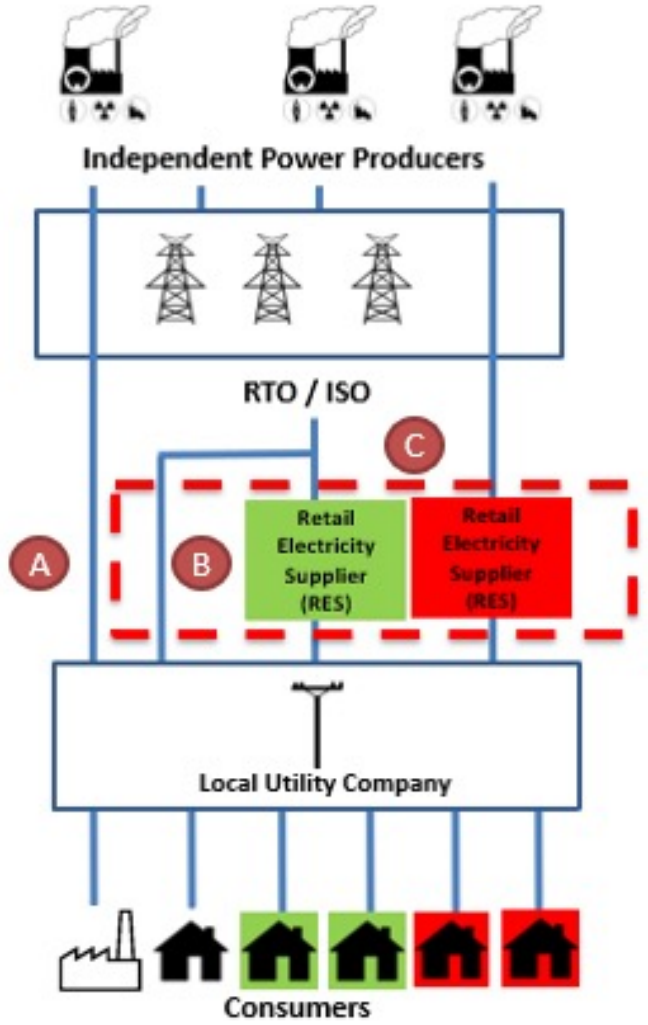
- Objective: Consumer Cost
- Rate of Return Ratemaking
- Deregulated ("Choice") Markets developed starting in the 1990's
- Retail energy suppliers entered agreements with consumers to set a price for energy purchases form the wholesale market and schedule delivery of that energy to the local utility and the consumer

"Deregulation" replaced utility-owned power plants with "Independent Power Producers (Exelon, NRG, Calpine), and introduced Retail Energy Suppliers to set energy supply prices for consumers

A Industrial consumers could contract directly with an IPP and arrange for delivery through the regional transmission system and local utility

B Some consumers (residential and small commercial) can still secure electricity supply through the local utility which would source that supply through the RTO/ISO

C Any consumer could purchase electricity through a retail electricity supplier which will secure supply through the RTO/ISO or directly with an IPP



RETAIL ENERGY MARKETS

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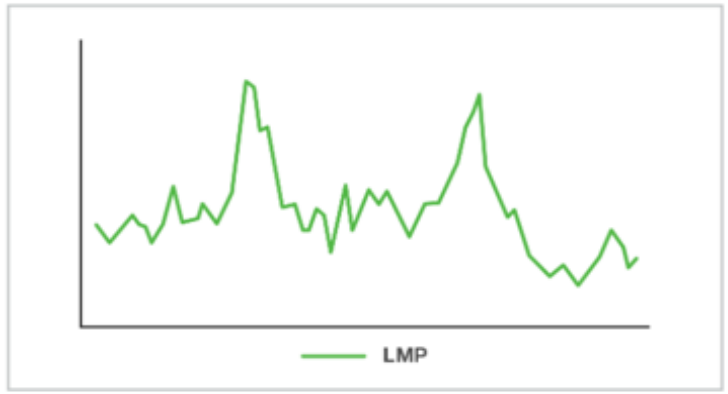
- Consumers can accept all or no price risk, but just like insurance: more protection comes at a higher price

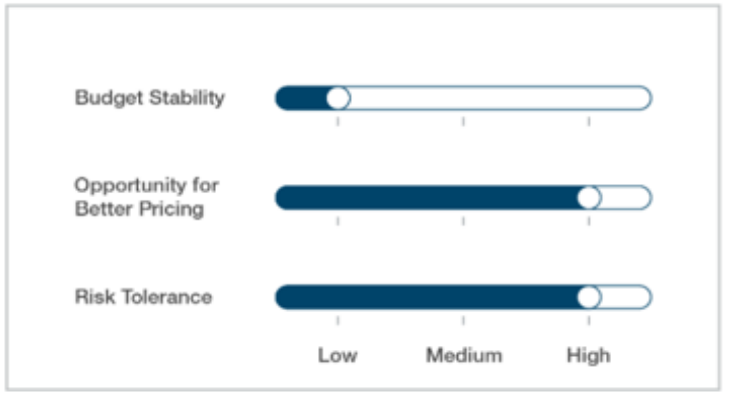
Consumers can choose pricing that fully exposes them to wholesale market price volatility, or a fixed price that has no volatility for periods of 6 months to 5 years

INDEX SUPPLY PRODUCT

STRUCTURE

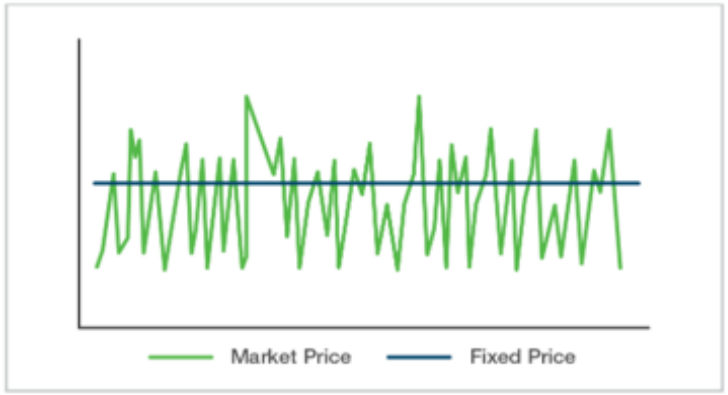


RISK PROFILE



FIXED PRICE PRODUCT

STRUCTURE



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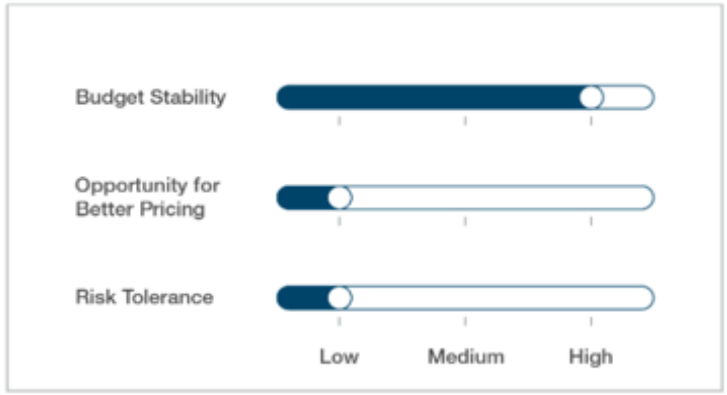

RETAIL ENERGY MARKETS

HOW THEY OPERATE

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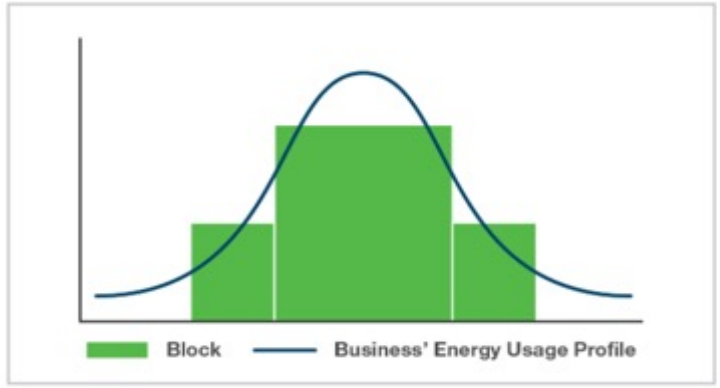
- Consumers can accept all or no price risk, but just like insurance: more protection comes at a higher price
- Consumers can also layer purchases to manage their exposure to changing wholesale market prices for power

Consumers can choose pricing that fully exposes them to wholesale market price volatility, or a fixed price that has no volatility for periods of 6 months to 5 years

BLOCK & INDEX PRODUCT

STRUCTURE



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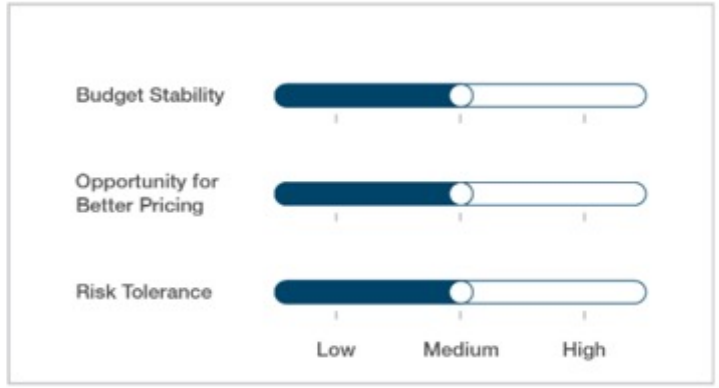
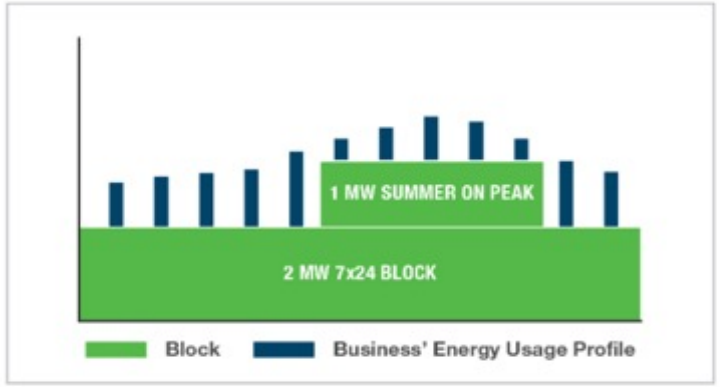
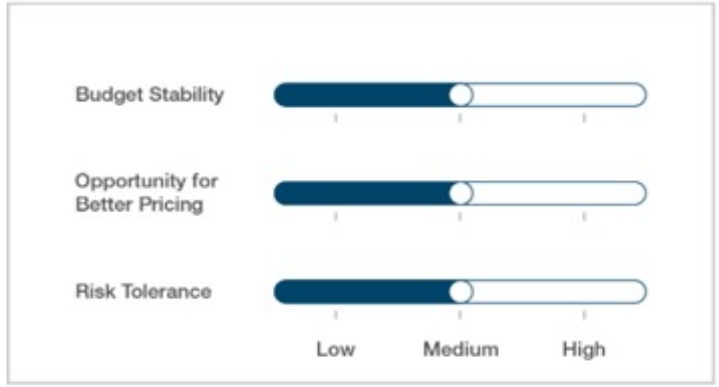


LAYERED BLOCK & INDEX PRODUCT

STRUCTURE



RISK PROFILE



RETAIL ENERGY MARKETS

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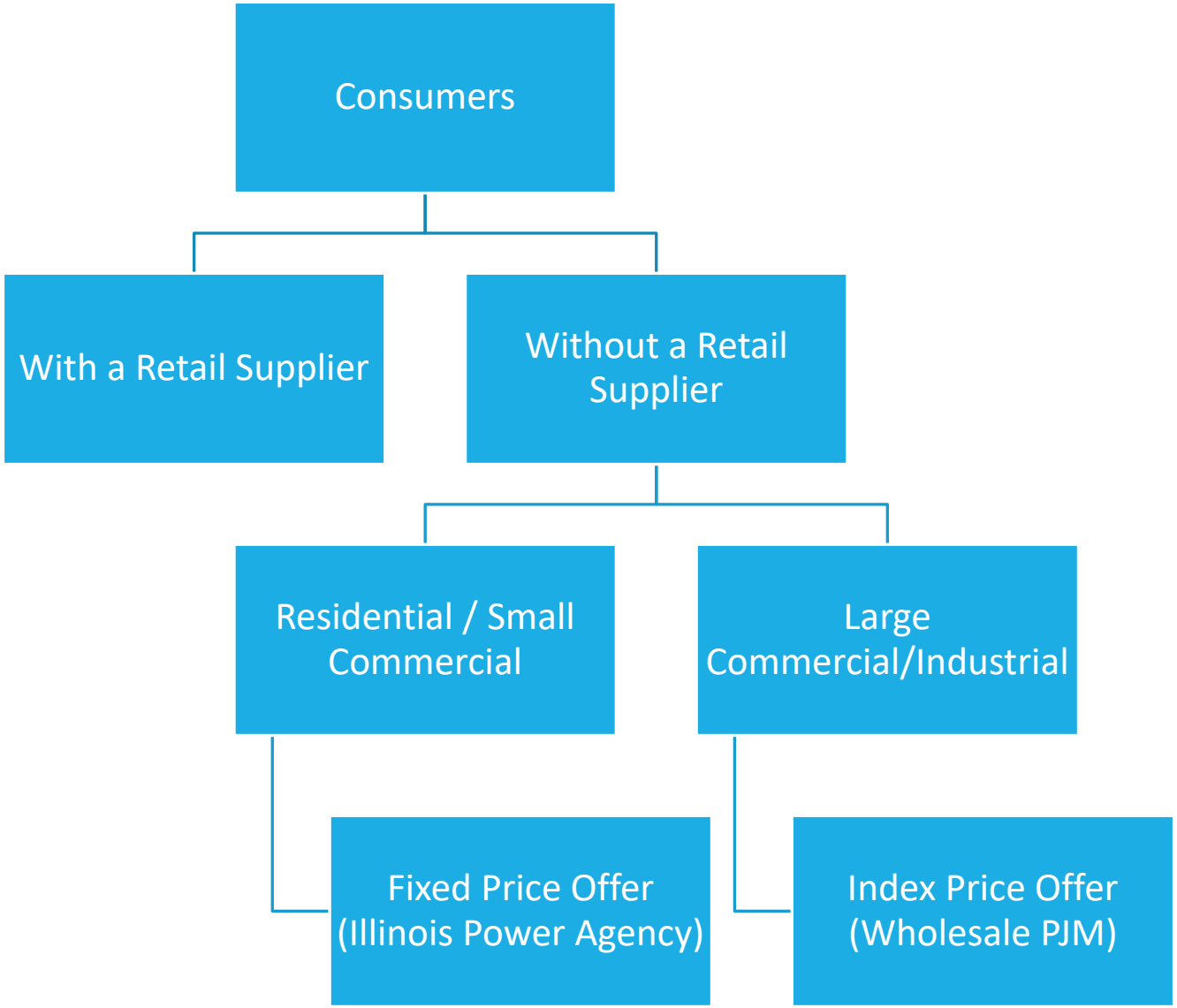
- Consumers can accept all or no price risk, but just like insurance: more protection comes at a higher price
- Consumers can also layer purchases to manage their exposure to changing wholesale market prices for power
- Consumers that do not use a retail energy supplier receive default pricing

Consumers can choose pricing that fully exposes them to wholesale markets



DISCUSSION

KEY CONCEPTS

The following are the key concepts for this session:

Wholesale Energy Markets	▪ Involve energy sales between **generators and resellers** ▪ The focus of wholesale markets is on **reliability** – not price ▪ Organized markets (like **PJM**) secure generation through long term (**Capacity**) and short term (**Day-Ahead-Real Time, Ancillaries**) delivery contracts ▪ Prices for Capacity, Day-Ahead-Real Time, Ancillaries are set through **auctions** ▪ **Prices change** annually (Capacity) and hourly (Day-Ahead-Real Time, Ancillaries)
Retail Energy Markets	▪ Involve energy sales between **resellers and consumers** ▪ The focus of retail markets is on **cost** – reliability is assumed ▪ Deregulated retail markets (like Illinois) allow consumers served by **investor-owned utilities** to select their supplier ▪ Retail Energy Suppliers **purchase variable rate energy** and capacity from the wholesale market and **sell partial or fully-fixed rate energy** to consumers ▪ Retail Energy Suppliers are really **selling a price hedge (like insurance)** – not actual energy

DISCUSSION AND QUESTIONS

Open to the class

THANK YOU

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