



Western  
Area Power  
Administration

# Understanding the Electric Grid

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Date – 5/4/2022

DOE Tribal Webinar



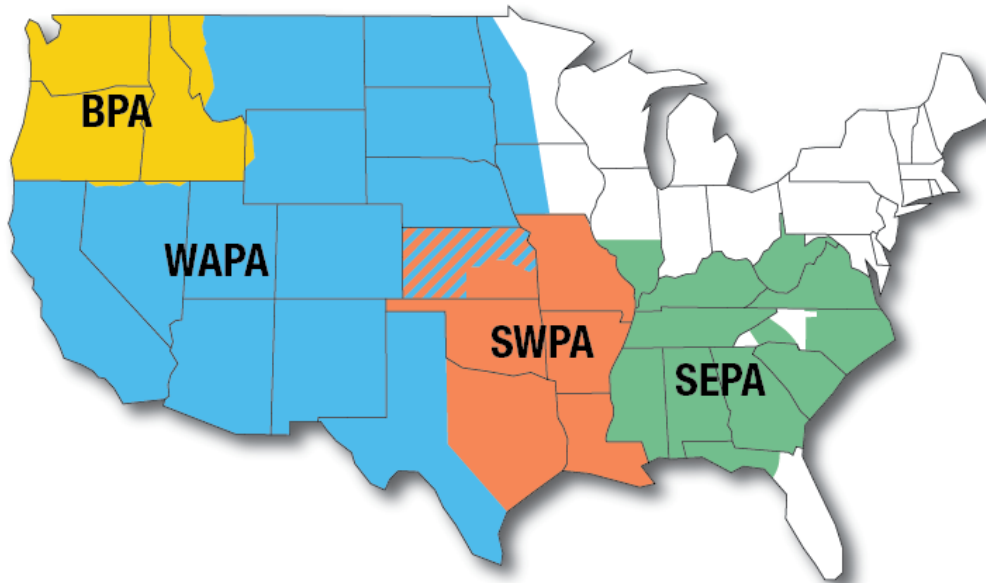
# Objectives

- Provide Overview of Western Area Power Administration
- Provide overview of the electric grid
- Explain fundamentals of the electricity supply chain and where you fit in



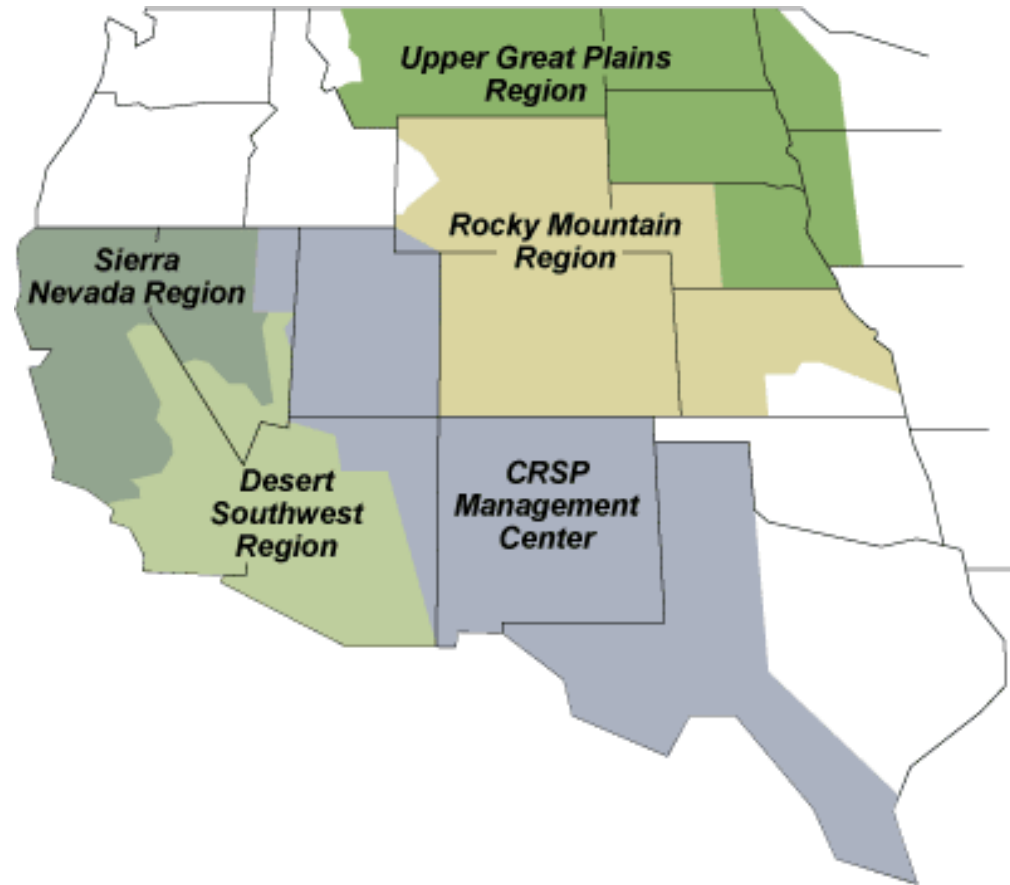
# Who is WAPA?

We are one of four power marketing administrations within the U.S. Department of Energy whose role is to market and transmit wholesale electricity from multi-use hydro projects.



# Our service territory

- Serving customers in 15 states from 4 regional offices
- 56 hydropower plants
- 10,479 MW of installed capacity
- 17,107 miles of high voltage transmission lines



# WAPA Functional Responsibilities:

- Design, construction, and maintenance on transmission lines, substations, and other related facilities
- Power marketing of wholesale federal hydro power
- Power system operations
- Transmission marketing
- Transmission Infrastructure Program
- Natural resources management





# Overview of the Electric Grid



# The energy landscape in the US is changing rapidly

- New solar & wind generation capacity continues to grow
- Demand for storage technologies is rising
- Expansion of wind and solar supplies in the west has posed operational challenges for the grid operators
- Utilities are looking for regional solutions to contain costs and address operational challenges
- Transmission capacity is becoming constrained
- Drought conditions persist



*“Yeah, that’s interesting, but what does it mean to me?”*





# That depends on where you fit into the energy supply chain?

- We are all consumers of electricity at some level.....
- Do you own generation assets?
- Do you operate a tribal-utility or do you take services from a third party?
- Is your load residential, commercial, industrial?



# ...and what your energy goals are?

- Be a more responsible and informed consumer
- Maintain long term price stability
- Supply assurance
- Be more environmentally conscious
- Generate revenue/jobs
- ???



“Regardless of where you are in the Electricity Supply Chain or what your energy goals are, a better understanding of the electrical grid will at least make you a more informed consumer and at best more effective at implementing your energy goals.”

*Al Austin*

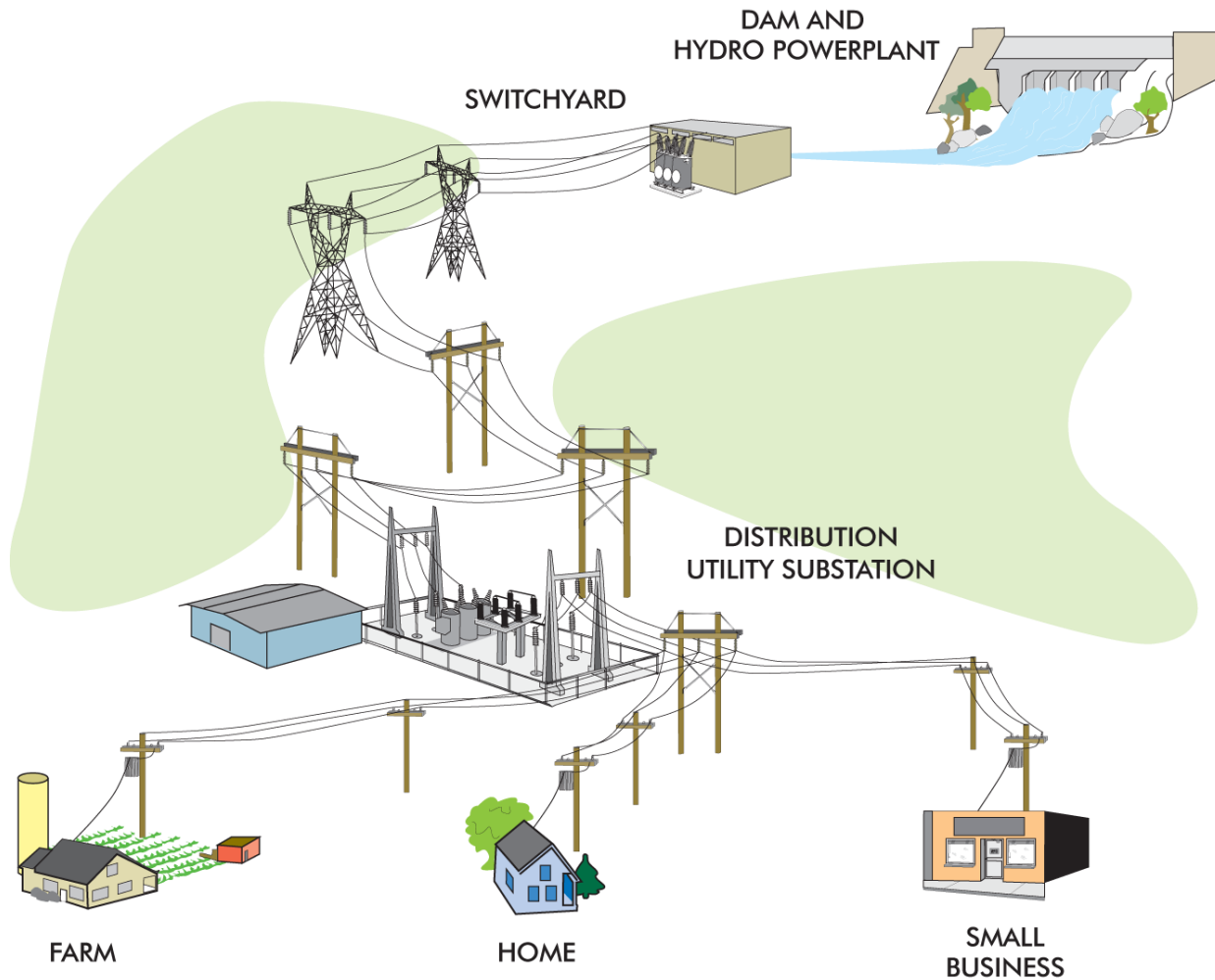


# Some Facts about Electricity

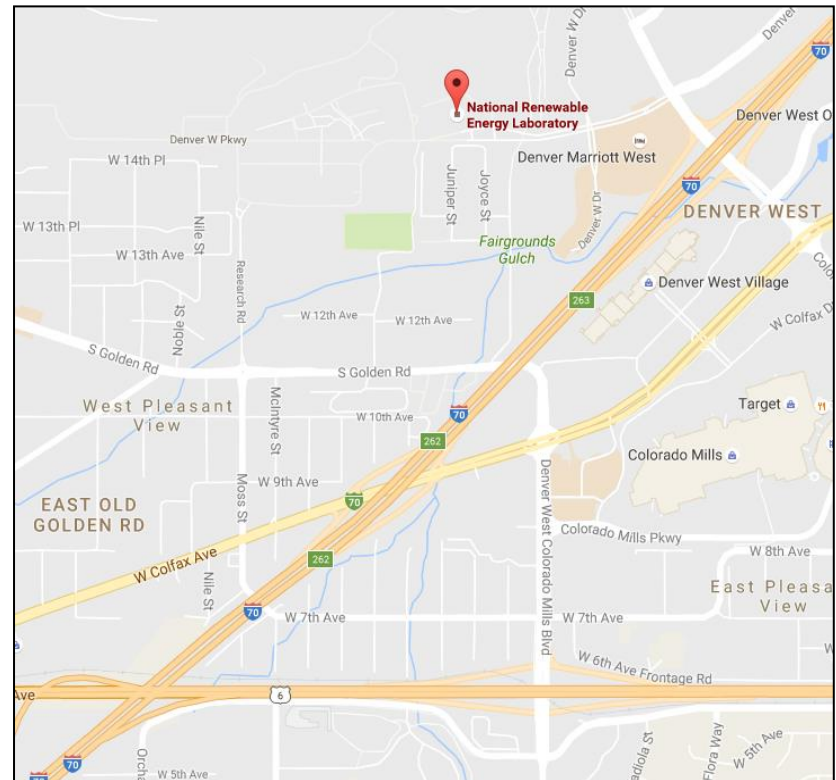
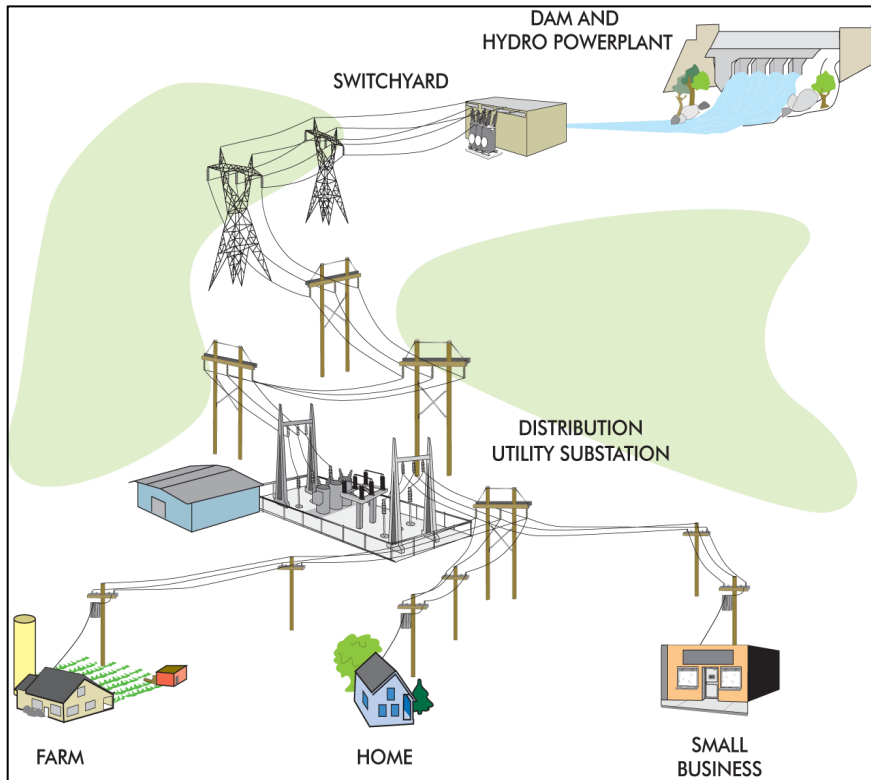
- Electricity requires a physical path (wires) to move from one place to another. There is no “wireless” electrical network.
- Storing electricity (at least on any large scale) has been impossible up until recently.
- The physics of electricity require a constant balance between supply and demand or bad things can happen
- Producing electricity and the necessary supporting infrastructure is a capital intense effort



# The Power Grid



# Power Grid is similar to our roadways



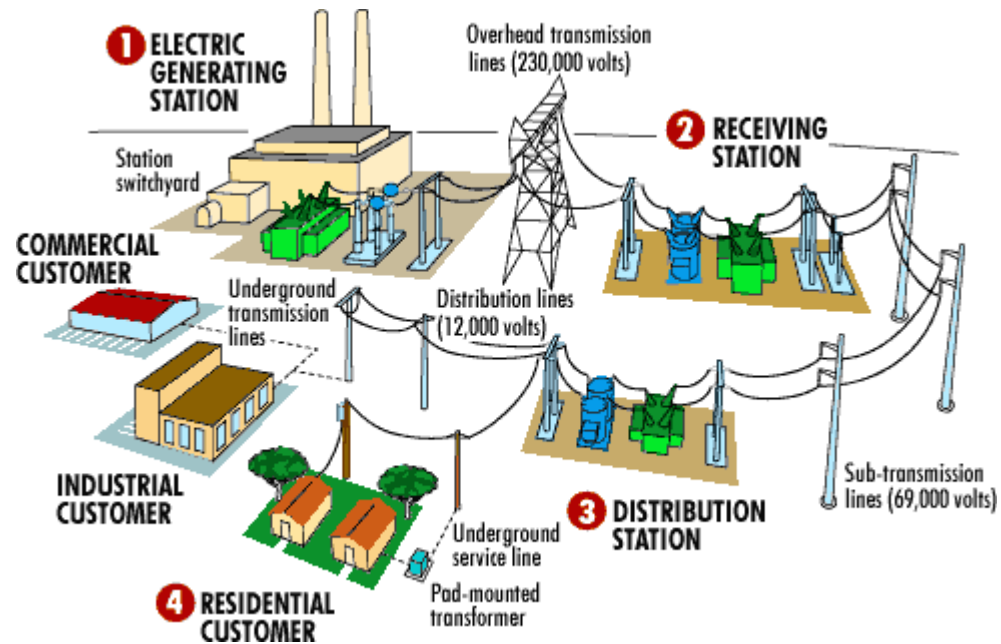
*The high voltage transmission system is like our interstate highway system, while  
The distribution system is like our city streets.*





# The Energy Supply Chain

- Generation “Supply”
- Transmission
- Distribution
- Consumption “Load or Demand”



# Reliability...who's operating the grid?

- The North American Electric Reliability Corporation (NERC) is the organization whose primary focus is the reliability of the power grid.
- NERC was formed after the northeast blackout of 1965.
- Developed a functional model that defines roles and tasks that must be performed to ensure reliable operations.
- Develops and maintains a set of reliability standards that establish how the grid should be operated.
- NERC can levy sanctions for non-compliance



# NERC Functional Areas

- Generator Owner/Operator
- Transmission Owner/Operator/Service Provider
- Distribution Provider
- Load Serving Entity



# Balancing Authority

- Entity that is responsible for running a specific portion of the power grid
- Maintain balance between resources (supply) and loads (demand)
- Manage energy flows between BAs and on all their transmission lines
- Must adhere to stringent reliability standards
- Maintain a 24x7 operation center

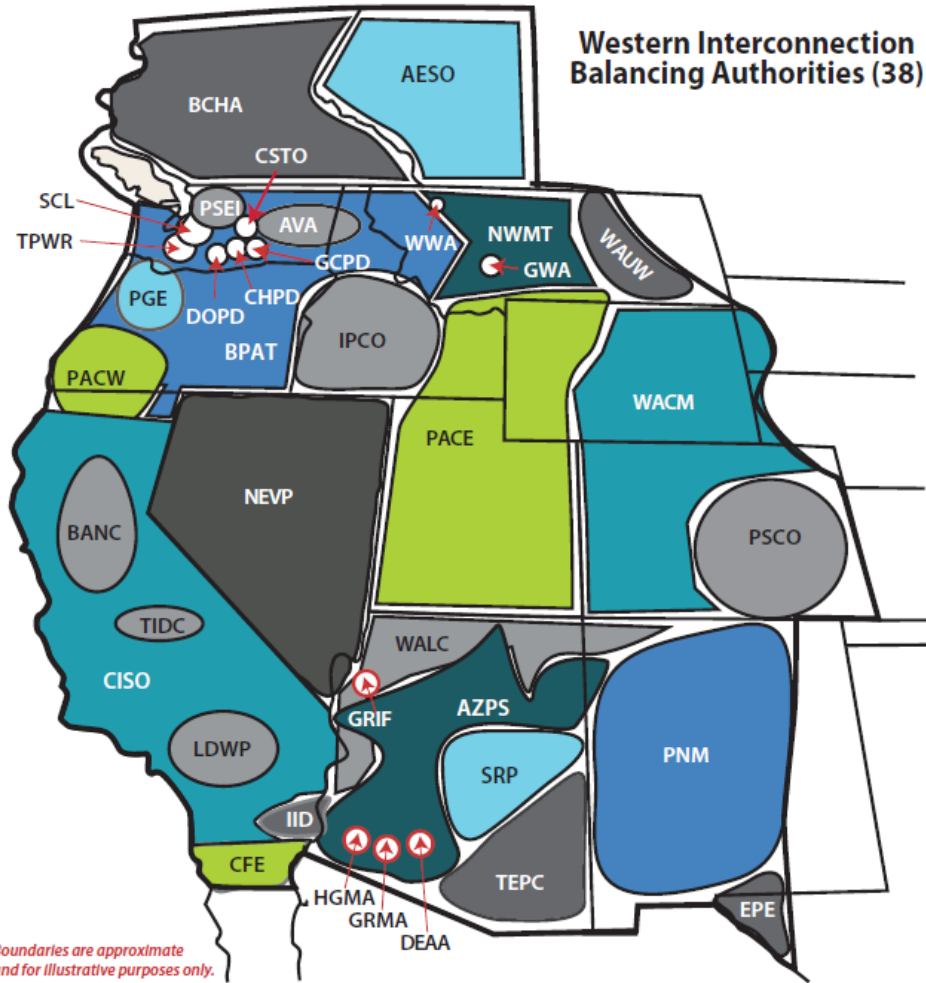


# Balancing Authority (cont.)

- Provide the following ancillary services:
  - 1) Reactive Supply and Voltage Control
  - 2) Scheduling and Dispatch Services
  - 3) Energy Imbalance Service
  - 4) Operating (Spinning/Supplemental) Reserves
  - 5) Generator Imbalance Service
  - 6) Regulation and Frequency Response Service



# Balancing Authorities in the West





# Common Utility Functions/Responsibilities

- Maintain adequate supply of resources to serve demand obligations
- Construct and maintain transmission and distribution networks (the wires)
- Meet all NERC reliability standards
- Plan for future load growth
- Provide transmission services under a FERC filed tariff
- Establish Rates through regulated process



# How do utilities secure a reliable, low-cost supply of energy?

- Forecast their demand obligations (load & exports)
- Develop a day ahead plan to meet energy and ancillary service requirements
- Identify resources they have available to meet the demand (internal generation, imports, purchases)
- Economically dispatch resources
- Make adjustments in real time to account for changes to demand and resources

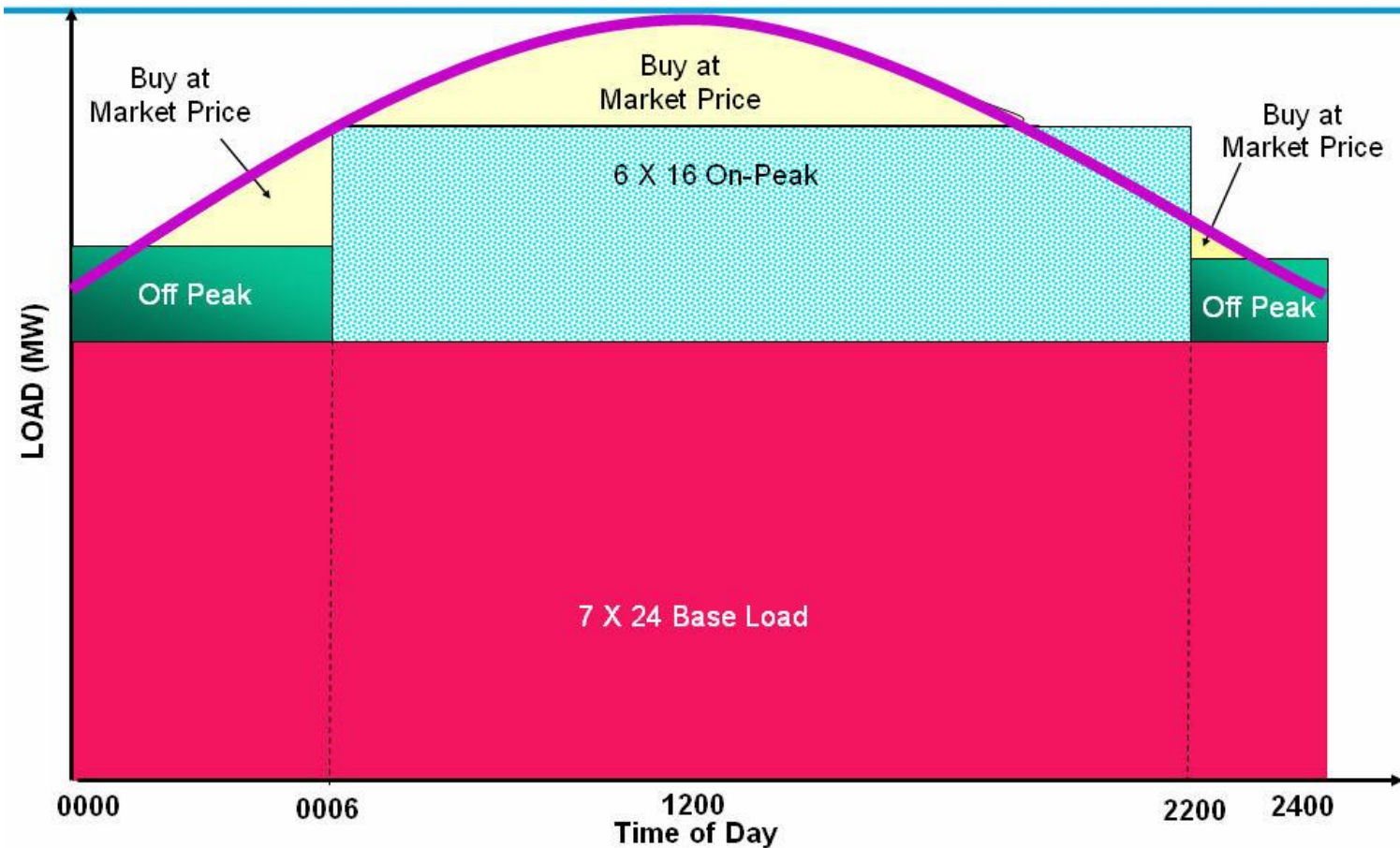


# Bi-Lateral Markets

- Utilities constantly compare wholesale market prices relative to their own production costs and will buy/sell accordingly.
- Different time horizons – Forward, Day Ahead, Real Time (hour ahead)
- Transactions priced at \$/MWh.
- Limited sub-hourly volumes
- Contracts are settled directly with counterparties
- Liquidity can be limited depending on location



# Developing a Supply Plan

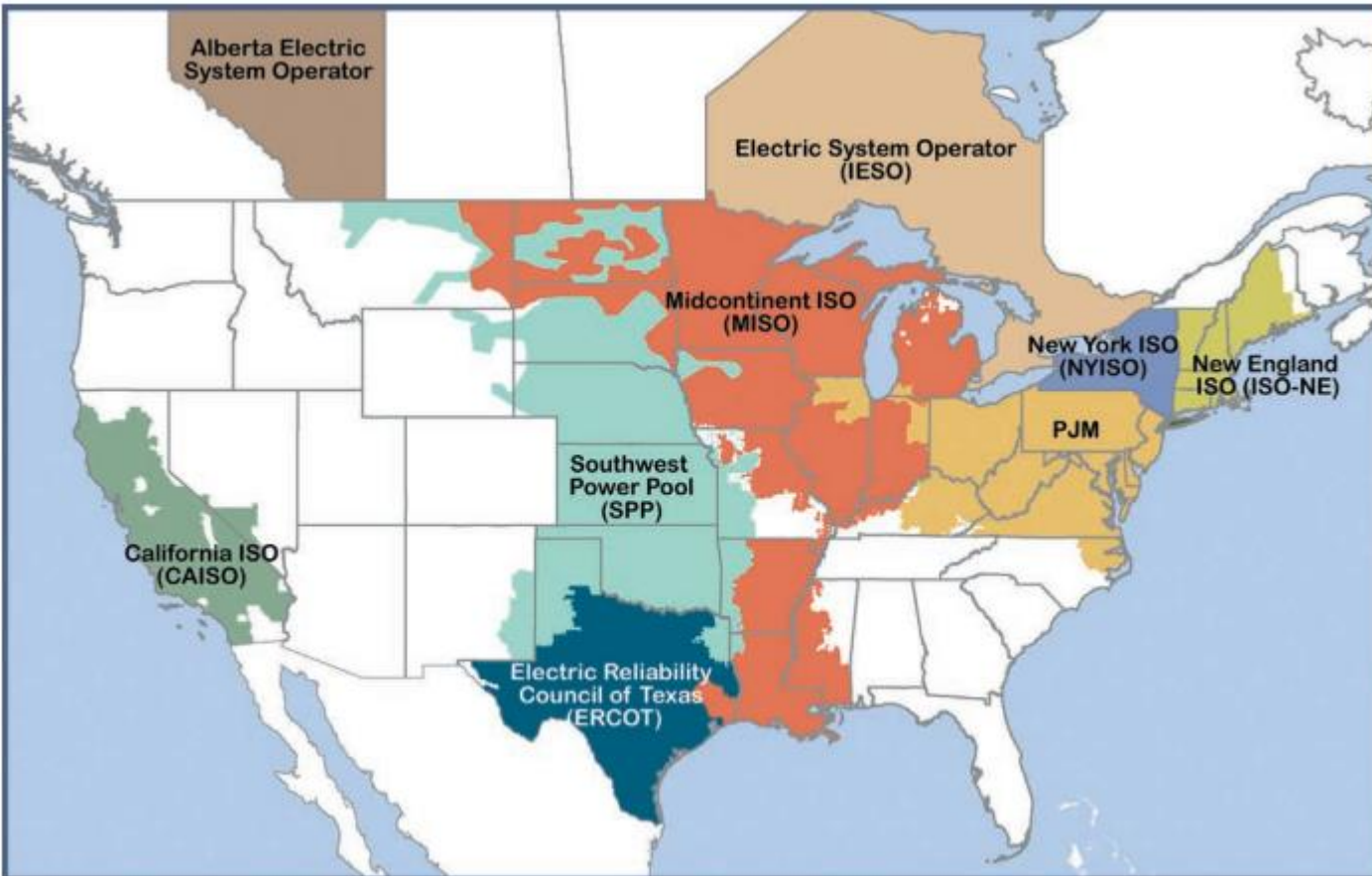


# Bilateral vs Centralized Markets

Bilateral Markets	RTO Centralized Markets
One party sells to another party (like buying a car)	Electricity products cleared by a centralized market operator (like the stock market)
Hourly transactions - poorly matched to increasing amounts of renewable generation	5 minute transactions - much more responsive to changing system conditions
Fragmented operating footprints result in capital and operating inefficiencies	Larger operating footprints with diverse resources are more efficient and more reliable
Limited visibility to conditions on neighboring systems can create reliability issues	Wide area situational awareness and control of the system has reliability benefits



# RTOs in North America



Source: Velocity Suite, ABB

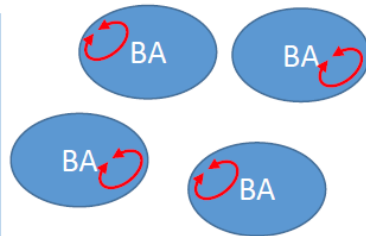




# How is a centralized market different than what we have now?

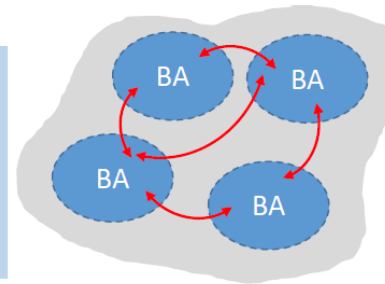
## Without a market

Each BA must balance loads and resources **within its borders.**



## In a market

The market dispatches resources across BAs to balance energy



- Poor situational awareness & control
- Limited pool of balancing resources
- Inflexibility
- Hourly scheduling and dispatch
- High levels of reserves
- Economic inefficiencies
- Increased costs to integrate wind/solar

- Advanced situational awareness & control
- Diverse pool of balancing resources
- Increased flexibility
- Five minute dispatch
- Decreased levels of regulating reserves
- More economically efficient
- Decreased integration costs



With all the activity in the energy industry, having an improved understanding of your position in the electricity supply chain will hopefully help you navigate through it all.

*Thank you for your participation!*



# Resources

- **Electricity Explained (US Energy Information Administration)**

<https://www.eia.gov/energyexplained/electricity/delivery-to-consumers.php>

- **Energy 101 (US Department of Energy)**

<https://www.energy.gov/oe/information-center/educational-resources/electricity-101>

- **NREL 2018 Renewable Energy Data Book**

<https://www.nrel.gov/docs/fy20osti/75284.pdf>

