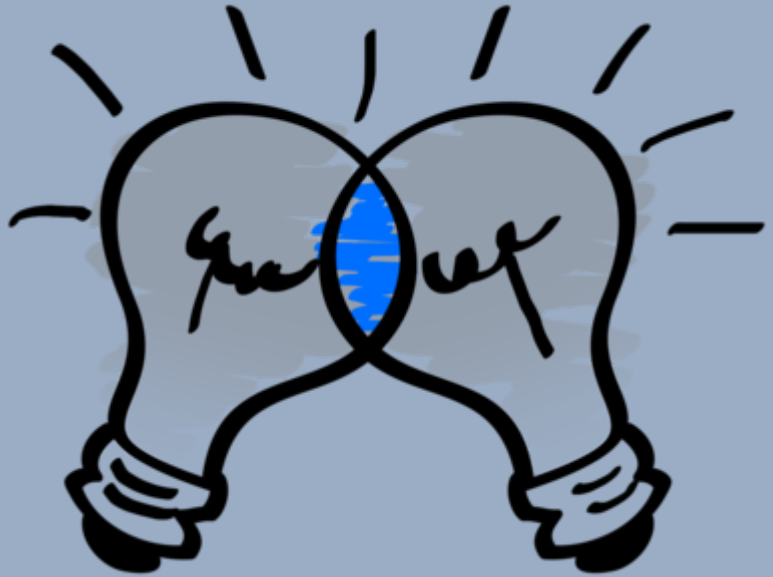


ENERGY MARKETS 101

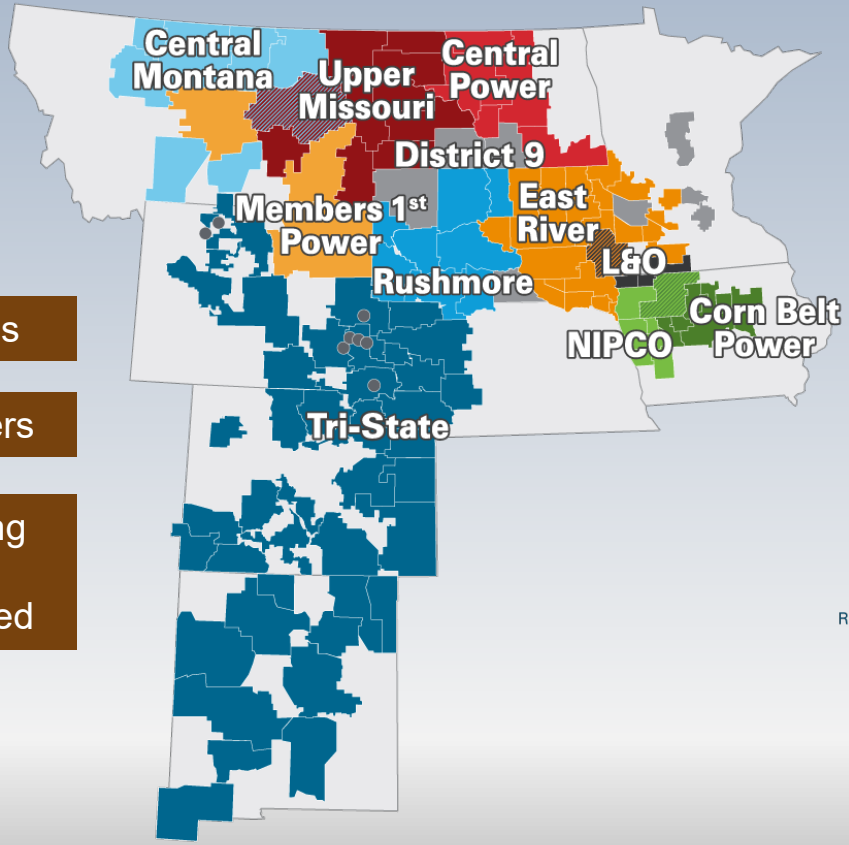
Jean Schafer, Senior Legislative Representative,
Basin Electric Power Cooperative

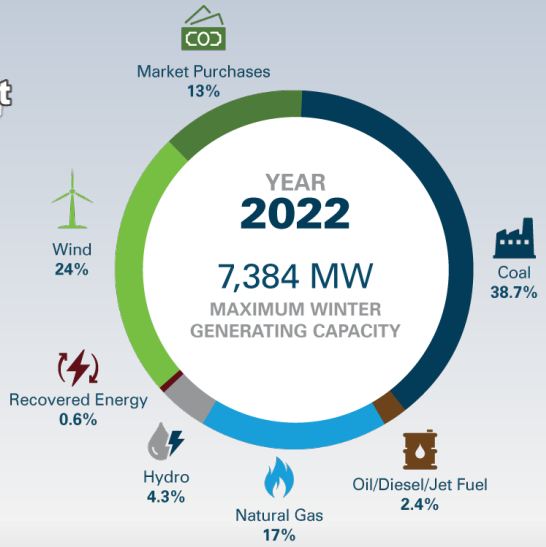
BASIN ELECTRIC SNAPSHOT

141 Members in 9 States

3 million consumer-owners

Largest G&T by operating revenues, MWhs and geographic territory served

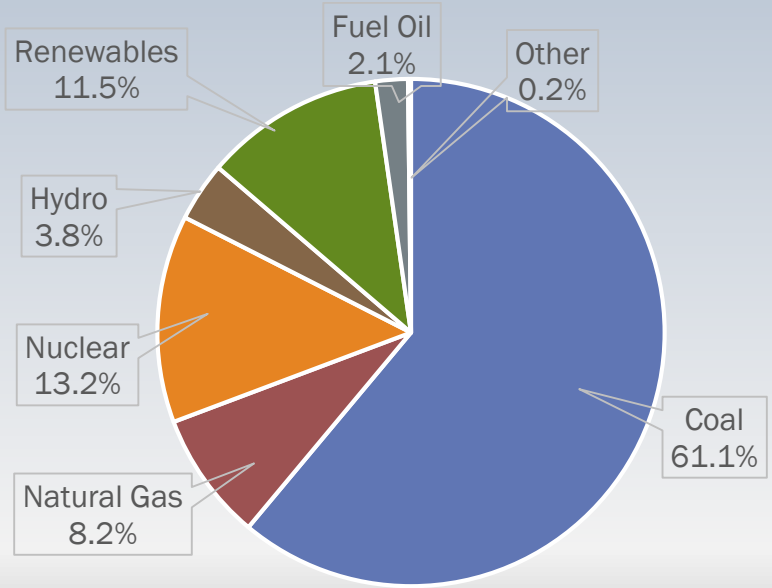




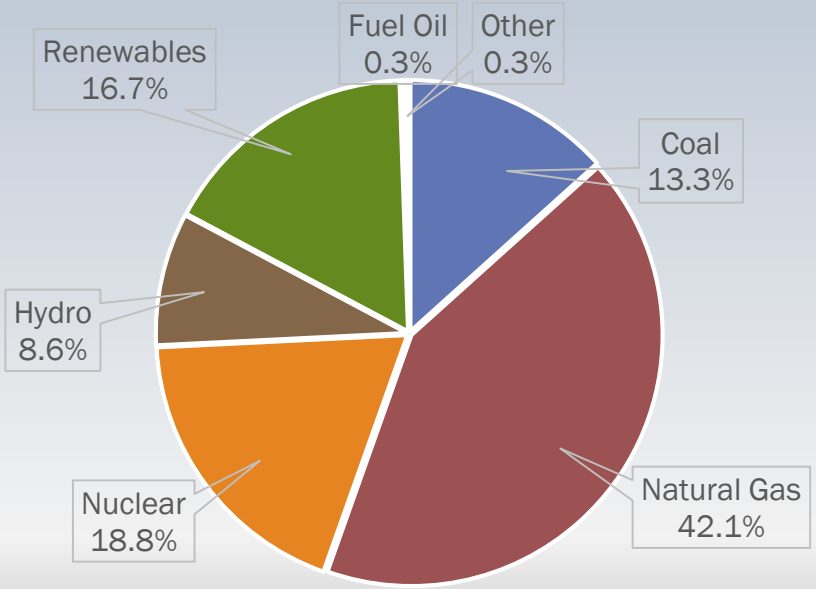
MIX OF GENERATION RESOURCES

The mix of resources used to generate electricity is changing dramatically...

2001 Net Generation, All Sectors



2023 Net Generation, All Sectors *(May)*



Source: Department of Energy, Energy Information Administration

GENERATION ATTRIBUTES

ATTRIBUTES OF BASELOAD

AS A GENERAL RULE

- Coal and nuclear generation are 24/7 dispatchable and rampable power production
- 70-95% Capacity Factor

COAL

- Coal plants are less flexible than gas generation – fixed fuel cost
- It can take several hours, possibly days, to completely shut down and startup a coal plant
  - If a coal plant is not price competitive it will normally reduce output to minimum levels instead of shutting down
  - Potentially selling power at a loss until the market price increases (loads increase or wind generation reduces)
  - Minimum operating levels for a coal plant vary - 40 - 50% capacity
  - Occurring less frequent with Economic Dispatch
  - Fuel is onsite – 30- 45-day supply

ATTRIBUTES OF NATURAL GAS

AS A GENERAL RULE

- Natural gas generation can be used for:
  - Peaking
  - Intermediate
  - Baseload
  - 5-90% Capacity Factor (price and supply)

NATURAL GAS

- Natural gas can be a very low-cost fuel source - fluctuates
- Natural gas has the ability to respond faster to load changes than coal-based generation
- Depending on price, natural gas generation can be dispatched before or after coal generation
- Natural gas has higher transportation interruption risks than coal

ATTRIBUTES OF RENEWABLES

AS A GENERAL RULE

- Wind and solar are intermittent power with annual capacity factors of 20-50% (less up north)

WIND

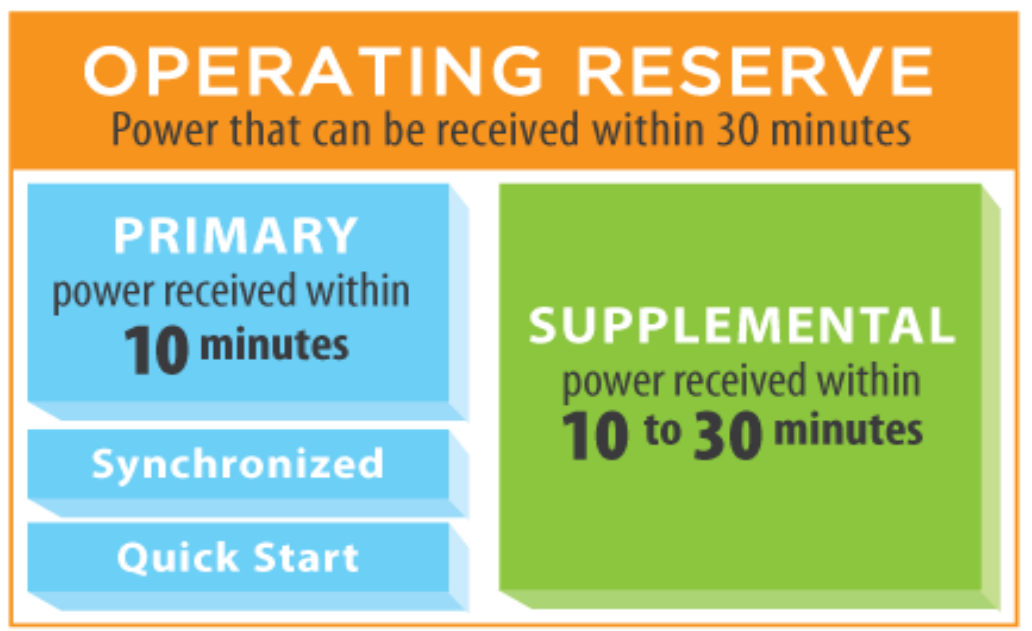
- Wind has zero variable (fuel) costs and priced into the market at zero, or below all other generation costs – excellent wind resources in the Midwest
  - Use Production tax credits (PTCs)
    - Wind owners benefit for 10 years
    - All Federal taxpayers fund PTCs
    - Possible for negative pricing due to “take or pay provisions”
  - Generally, wind is dispatched when it runs
    - Recent RTO changes have shifted wind to curtailable
    - All SPP projects are converted
- Wind facilities lifespan are 20-30 years
  - Repowering of projects is starting to occur

POWER RESERVE DEFINED

OPERATING RESERVE

This power can be from:

- Generators that are synchronized (connected) to the power grid or offline
- Certain loads, designated as demand side response, which can be removed from the grid



SPINNING RESERVE

Provided by resources that are not putting energy onto the grid but are synchronized to the frequency of the system and can provide energy when called to dispatch

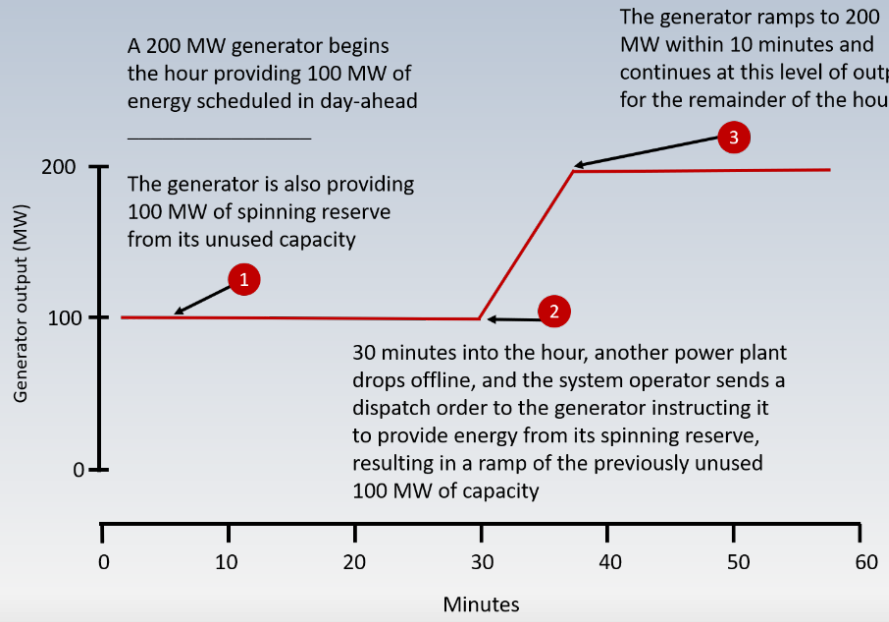
Must be:

- Available in 10 minutes of notification
- Capable of running minimum of two hours after dispatch
- Can be provided by battery storage and flexible loads
- Typical sources include hydropower, gas, coal, or oil steam units with additional UNUSED capacity

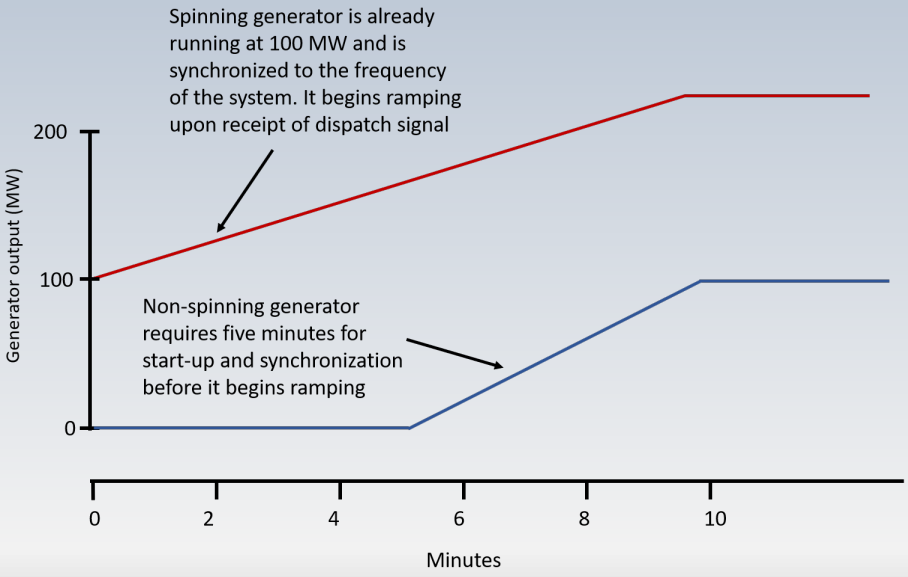
Non-Spinning Reserve: Require 5 minutes of start up and sync prior to ramping

SPINNING VS NON-SPINNING

Spinning:



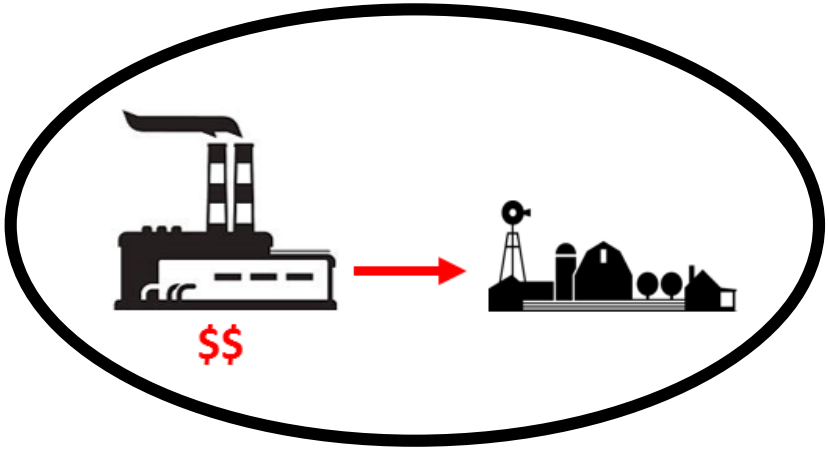
Non-Spinning:

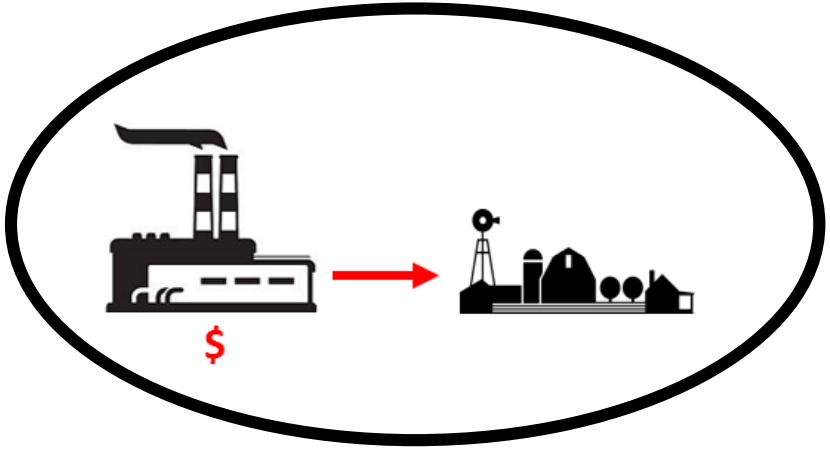


EVOLUTIONS OF THE ELECTRIC GRID

IN THE BEGINNING: SELF SERVE

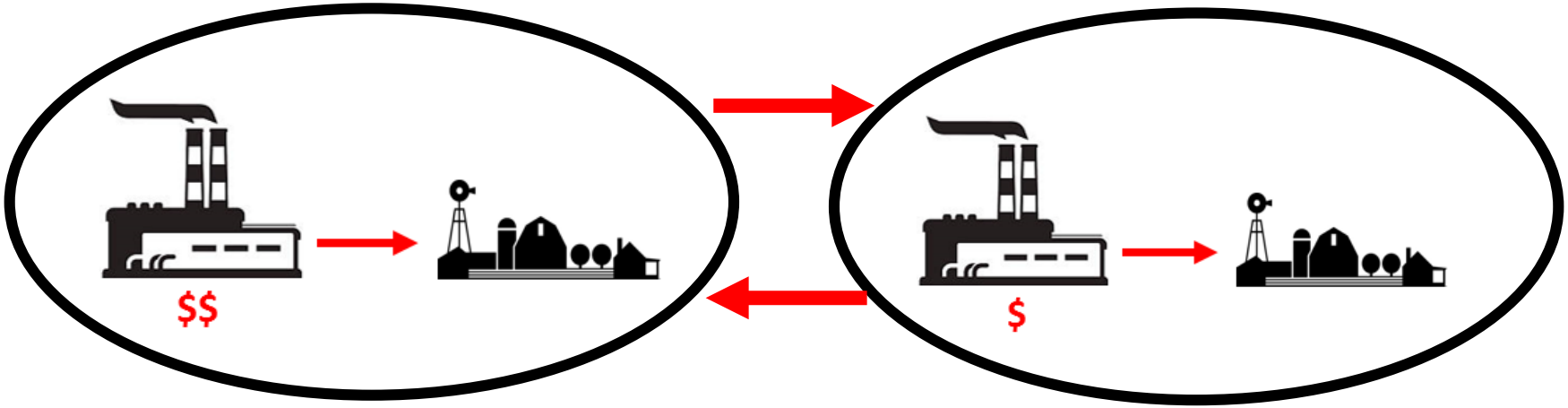
Each utility system served its own geography, and generated to meet its own load as if it were an island





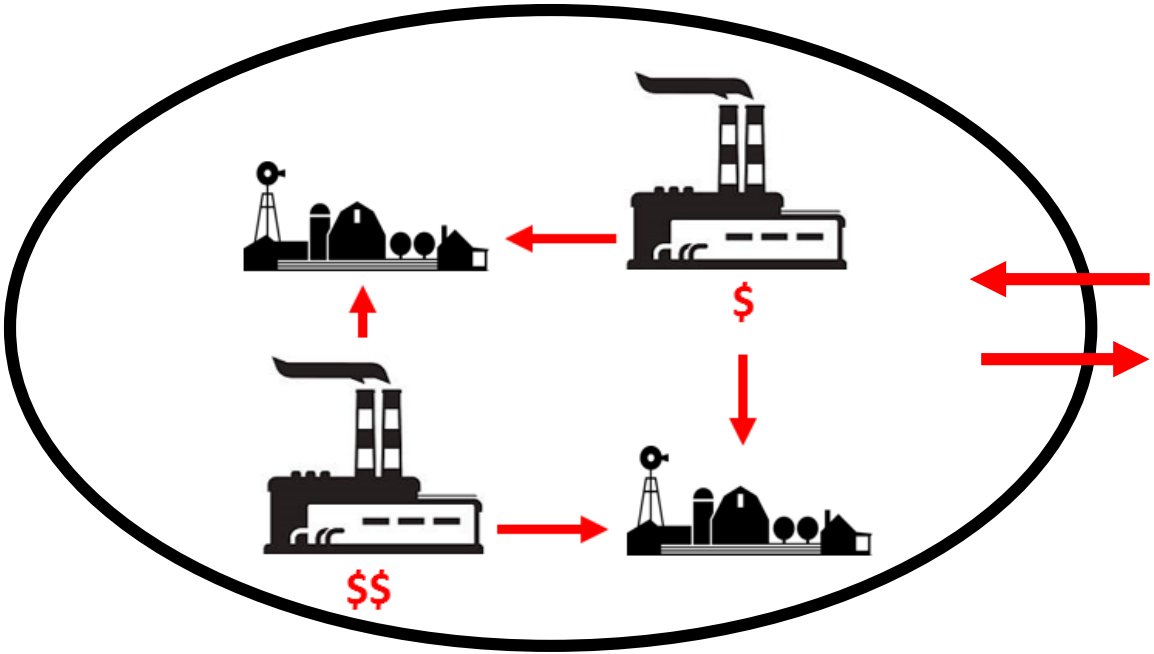
GRID EVOLUTION: BILATERALS

Utilities began bilaterally exchanging power to reduce cost and enhance reliability, but still operated as separate utilities



POWER “POOLS” FORMED

Utilities entered into power-pooling agreements to operate as one system for maximum cost savings and reliability = Regional Transmission Organizations

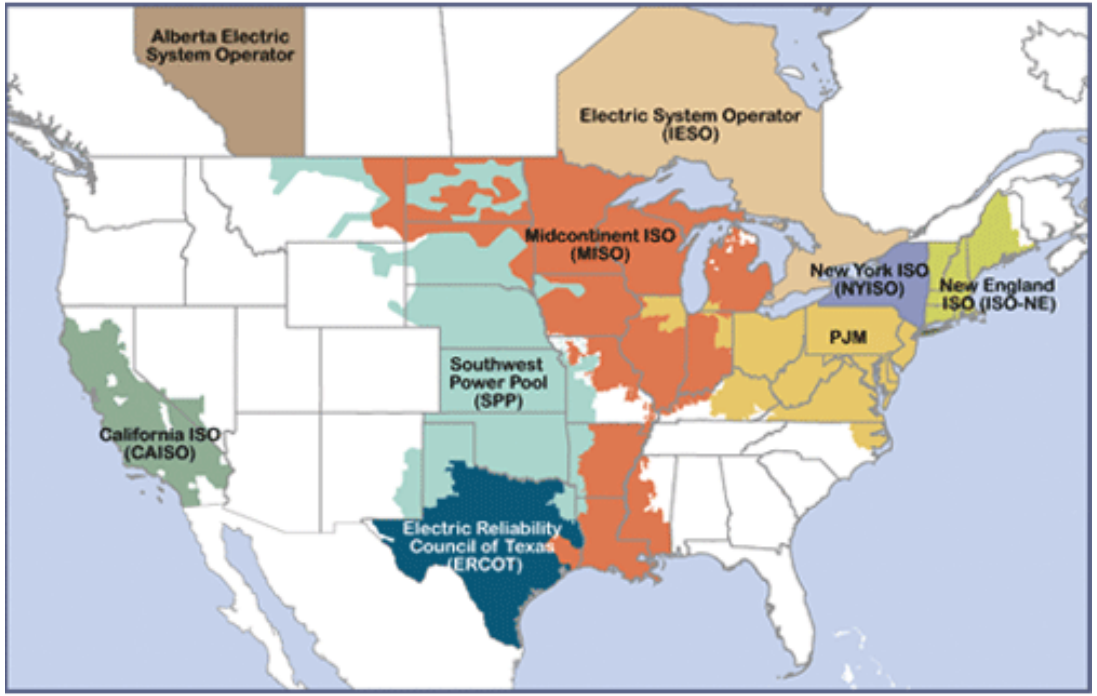


REGIONAL TRANSMISSION ORGANIZATIONS (RTO)

7 RTO and ISO's across US - Dominant form of energy dispatch

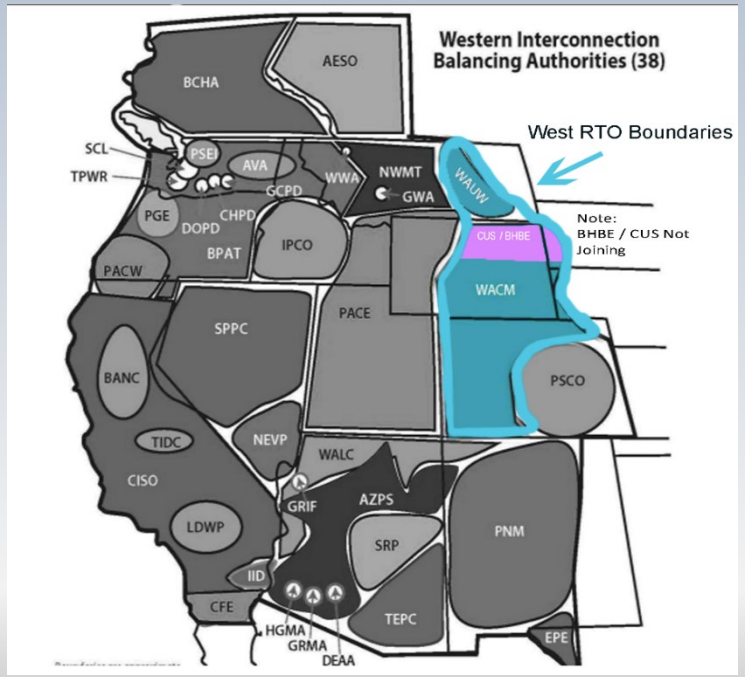
RTO Functions -
Transmission services - shared facilities and cost allocations are socialized

Wholesale Power Markets - generation can be sold or purchased or both



BALANCING AUTHORITY (BA)

The entity responsible for maintaining system frequency for an area comprising a collection of generation, transmission, and loads within metered boundaries



- Schedule resources, transmission and loads in the day ahead
- Maintain load-resource balance in real time for the area
- Support the area's interconnection frequency in real time
- 66 BAs in the U.S.
- **West of the DC ties – 38 BAs**

MARKET OPERATIONS

ELECTRICITY MARKETS

- Southwest Power Pool (SPP)
  - 105,454 MW Capacity
  - 31,217 MW Wind
  - Large percentage of wind generation
  - Basin Electric units are in SPP
- Midcontinent Independent System Operator (MISO)
  - 190,000 MW Capacity
  - 30,400 MW Wind
  - Has capacity for more wind generation
  - IOU units are in MISO

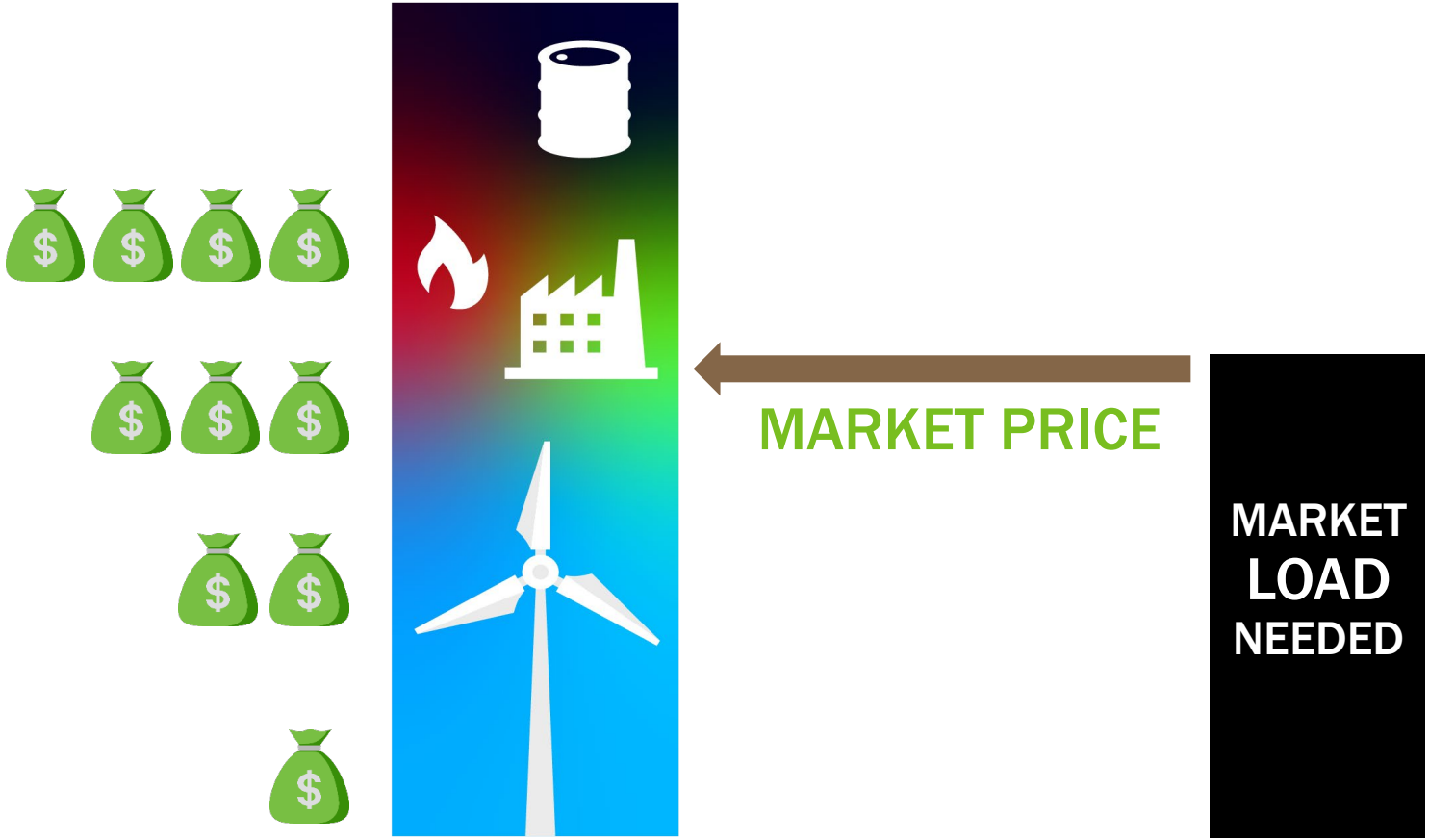
ELECTRICITY MARKETS

- Utilities bid **generation** and **load** into the market
  - Two separate and distinct transactions occur in organized markets
  - Selling generation into the market and buying power from the market
  - Utilities buy power based on the market clearing price
  - Only bid in the variable cost of power (mainly fuel price)
  - Lowest priced generation runs first
  - Fixed costs (labor, mortgage, taxes, etc.) must be recovered from utility ratepayers or in the contracts for Independent Power Producers
    - Cost of Service model

ELECTRICITY MARKETS

- Utilities give control of generation dispatch and transmission to the market operator
- Utilities still own, operate and maintain generation and transmission facilities - Vertical Integration
- The billings for the power and transmission are handled by the market operators - SPP and MISO

MARKET COMMITMENT OF GENERATION



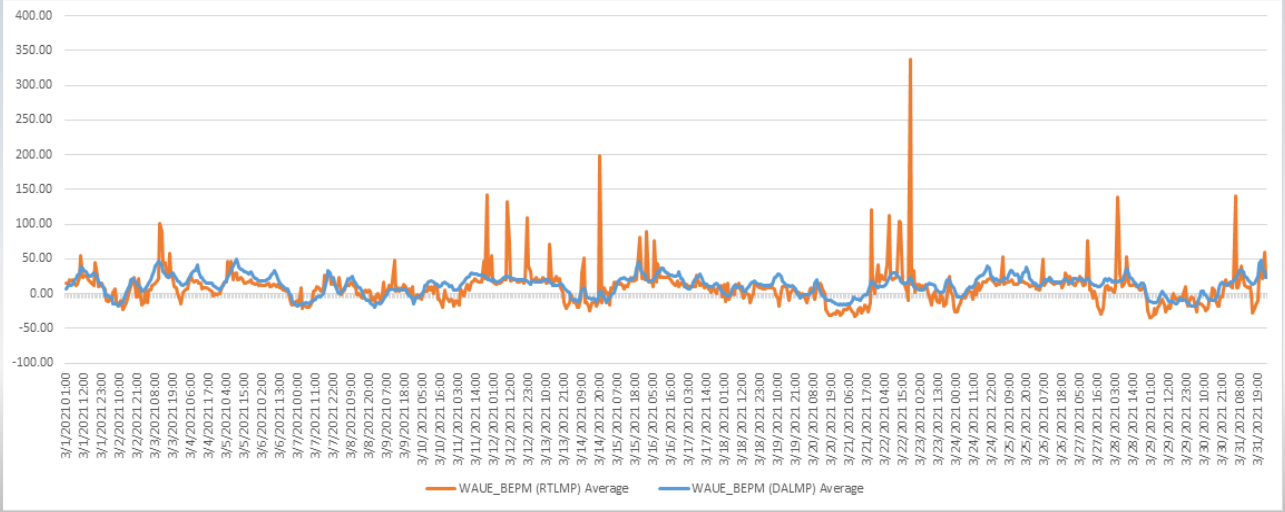
MAJOR PRICE DRIVERS

Day Ahead

- Types of generation in the market
- Levels of load in the market
- Natural gas prices
- Weather forecast

Real Time

- Changes in wind levels
- Changes in load due to weather
- Resources tripping
- Congestion
- Lines tripping



UTILITY CONCERNS

CONCERNS…

- Generators, like baseload coal and nuclear, are not being adequately compensated for the services, such as 24/7 operation
  - Baseload units retiring without adequate replacements
- RTO rules are shifting to allow more diverse market-based incentives
  - Developing policies that enhance fuel assurance
- Newest - Cost impacts of transmission capacity for new generation

FUEL ASSURANCE POLICIES

Performance Based Accreditation (PBA) Benefits

- Values – conventional resources that are reliable and available to perform when needed most
- Incents – underperforming resources to improve
- Ensures – appropriate capacity value to calculate PRM
- Provides – capability to meet system needs (does not change the total capacity required to meet system reliability but impacts entities and resources differently)

Planning Reserve Margin changes - 12% to 15%

- Purchase existing excess capacity from others
- Defer currently planned retirements
- Reduce off-system sales
- Increase demand response/interruptible load

QUESTIONS??

FREQUENCY RESPONSE

Frequency response is managed by bulk system operators to ensure systems can maintain frequency within an acceptable range except in extreme circumstances.

- Inertia – the energy stored in large rotating thus slowing a change in system frequency - turbines
- Generator governors – control systems that monitor the generator frequency and ramp up or down whenever frequency deviates
- Loads with underfrequency relays (UFRs) – curtailable loads controlled by a relay that curtails loads when frequency drops below a specific value – demand side
- Regulating reserve – sources of supply that can ramp up or down within a few seconds in response to a control signal from the system operations energy management system - continuous