**Helping our members work together to keep the lights on... today and in the future**

SPP Southwest Power Pool

# SPP LOLE Efforts

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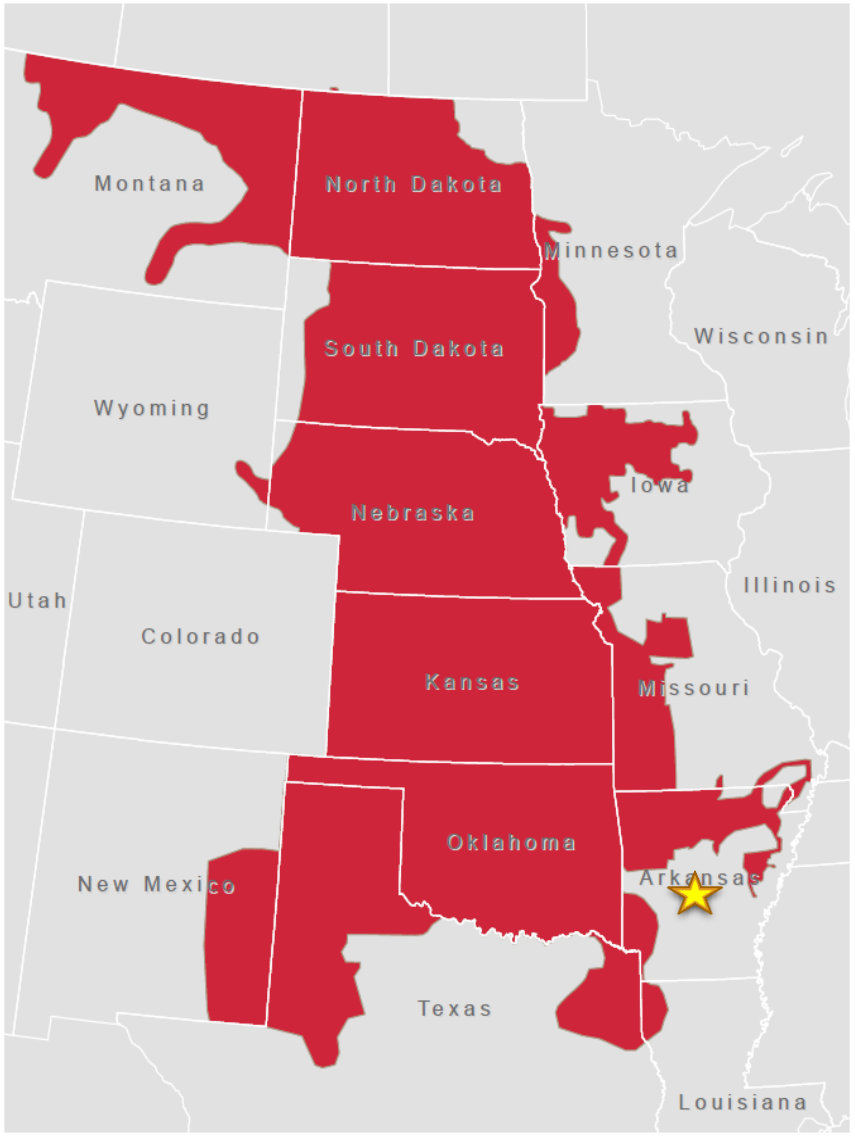
# Southwest Power Pool

- Southwest Power Pool (SPP) Planning Coordinator footprint covers 575,000 square miles
- Includes all or parts of Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas and Wyoming.
- The SPP footprint has approximately 61,000 miles of transmission lines and serves a population of 18 million people



# SPP Planning Reserve Margin

- Planning Reserve Margin Requirement is based on Entity's forecasted peak, not SPP peak
- Current PRM Requirement
  - Each Load Serving Member's Minimum Required Reserve Margin is 13.6%. If a Load Serving Member's System Capacity is comprised of at least 75% hydro-based generation, then such Load Serving Member's Minimum Required Reserve Margin is 9.89%
    - Requirement set in 1998
- Future PRM Requirement
  - Each Load Responsible Entities (LRE) Minimum Required Planning Reserve Margin is 12.0%. If a LRE's System Capacity is comprised of at least 75% hydro-based generation, then such LRE's Minimum Required Planning Reserve Margin is 9.89%
    - June 2017 effective date
    - Summer Peak Season reserve margin requirement

# SPP Application of the "1 in 10" Criteria

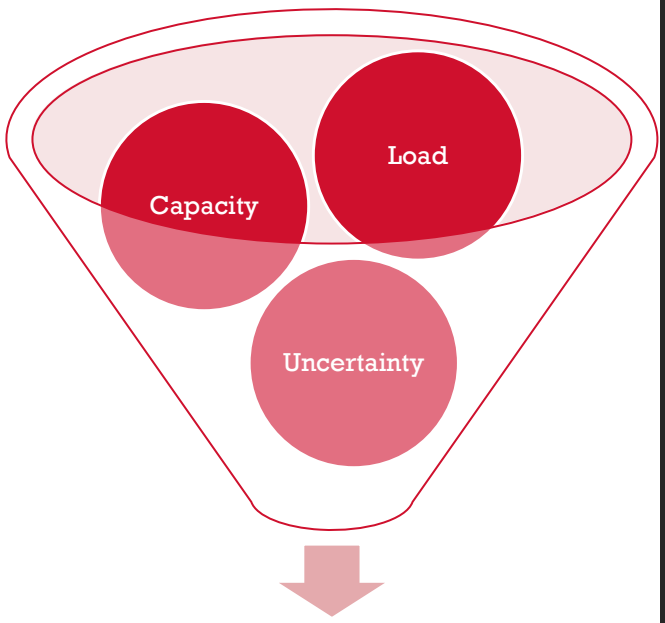
- LOLE is measured in days/year (1day/10year criteria)
- SPP equates any event, regardless of duration, in a day, to a daily event (i.e., any one or more hours in a day equates to a day-long event)

# LOLE Study Characteristics

- Software used: GridView
- Calculates LOLE for SPP Entities
- Uses nodal model with NERC LTRA Demand and Capacity forecast incorporated to create a GridView model
- Monte Carlo analysis (probabilistic analysis)
- Load multipliers chosen randomly
- Generator outages based on maintenance schedule and random through Equivalent Forced Outage Rates (EFOR)
- Minimum of 3000 simulations/year performed (26,280,000 hours)
- LOLE analysis performed on years 2 and 5
- Typical runtime is approximately 75 hours for each study

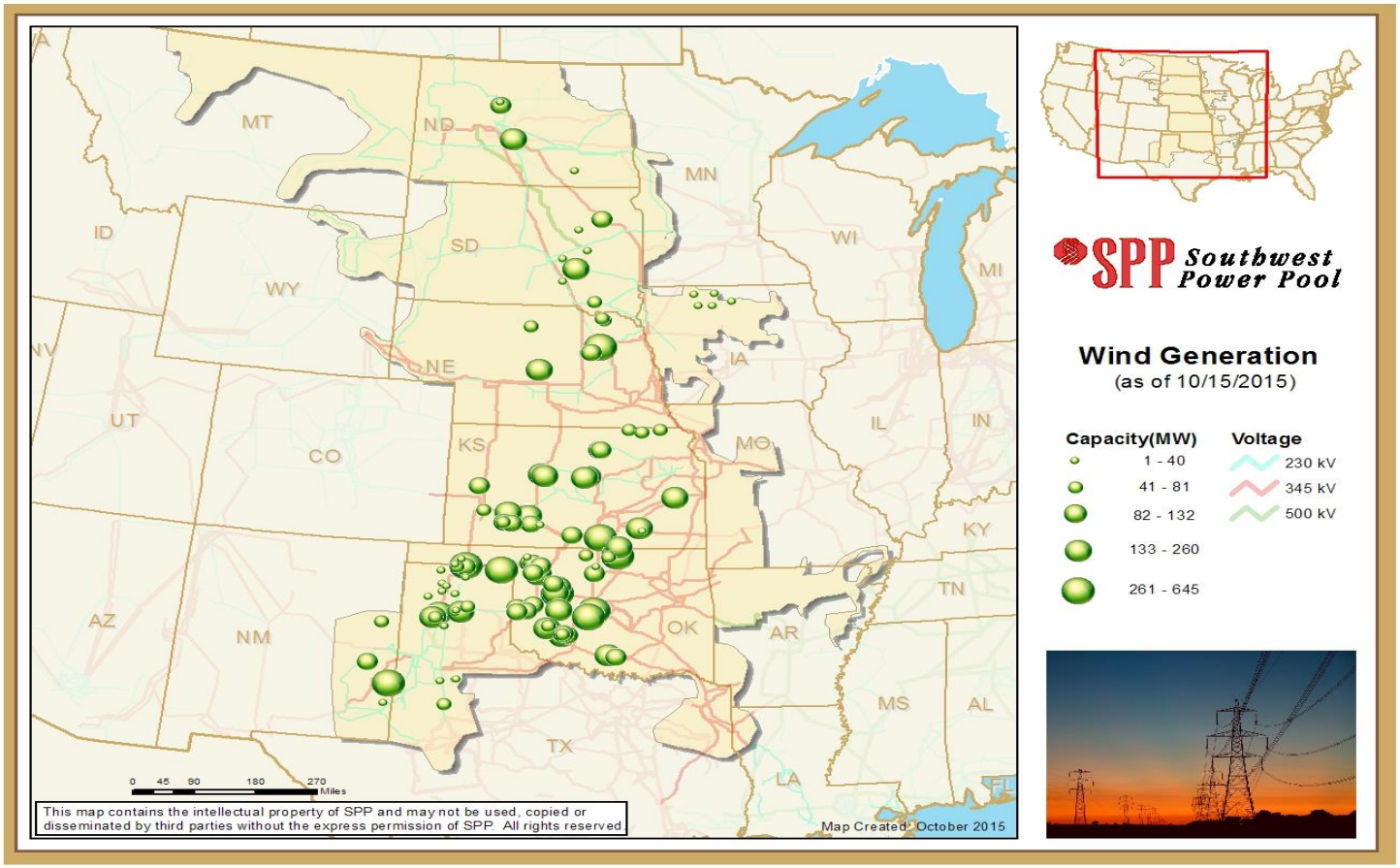
# LOLE Data Inputs

- Area load shapes
- Thermal / Variable Generation data
- Historical wind shapes
- Flowgate and Contingency data
- Transactions (Imports / Exports)
- Load uncertainty data
- Nodal transmission topology
- Generation outage data
- Operational guidelines



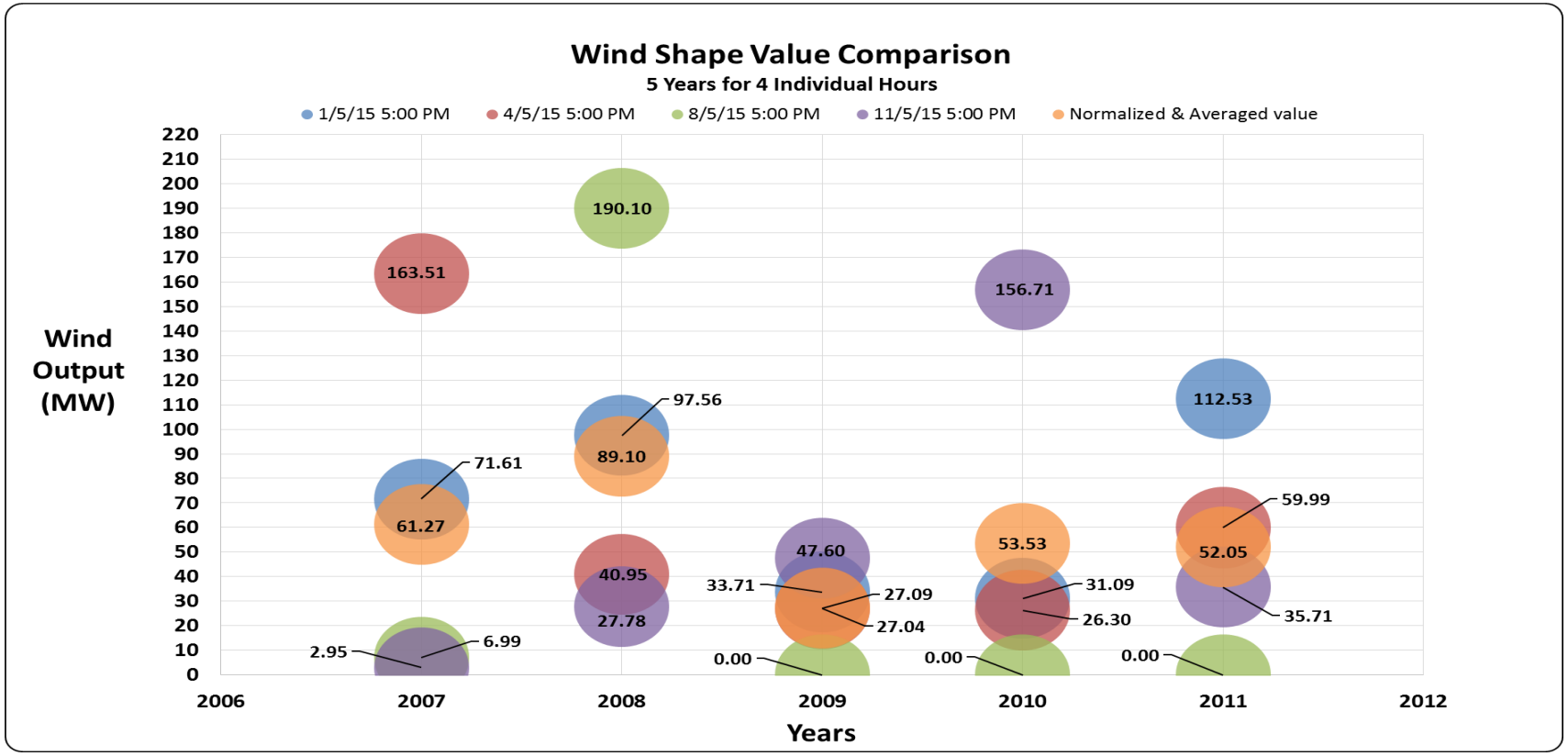
# Wind Resources

- The location of wind resources within the SPP region are geographically diversified



# Wind Resources

- The example shows four historical hourly wind output values for five years and the normalized, averaged hourly wind shape value compared historical values



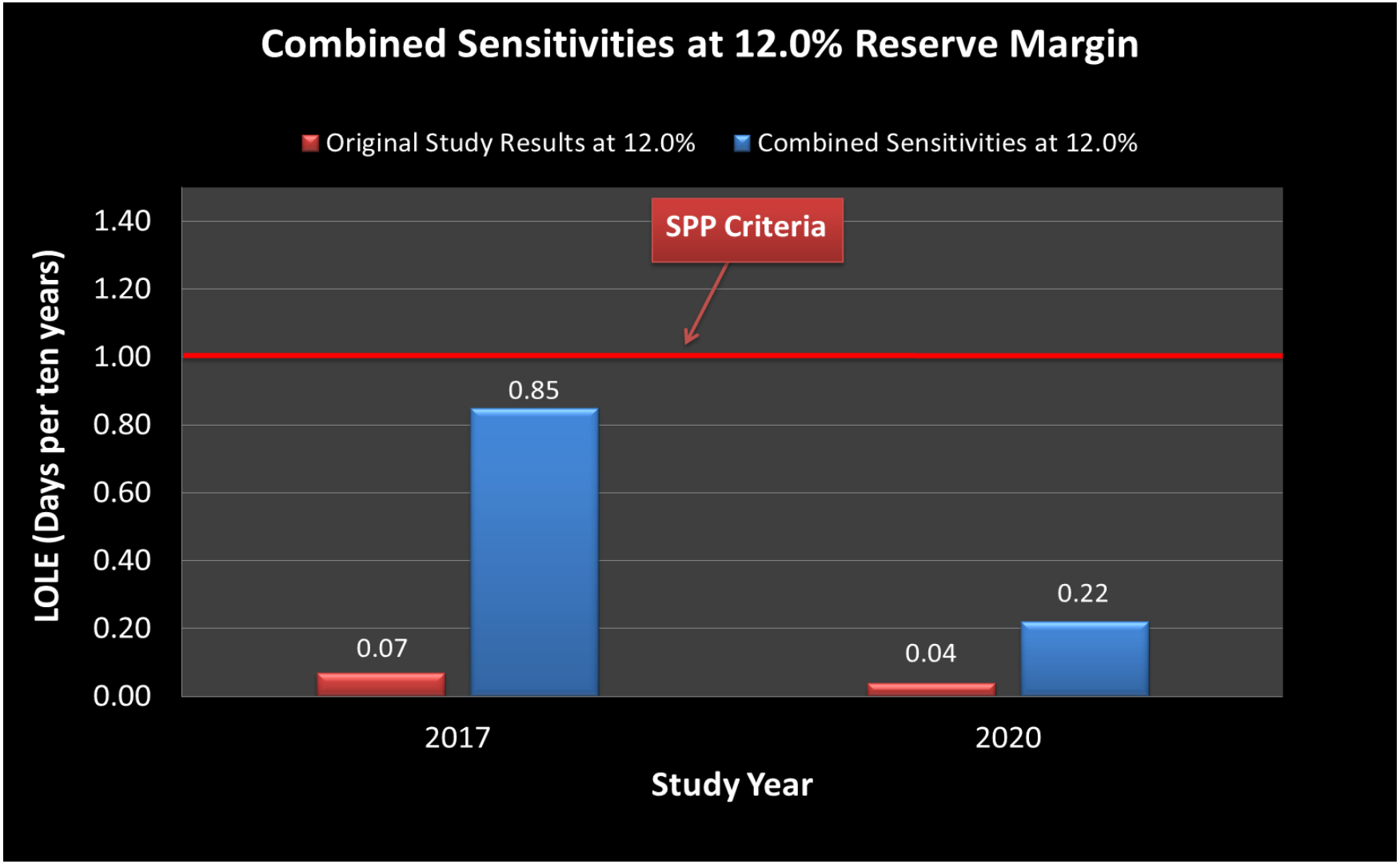
# Additional Assumptions

- Nodal modeling of topology, bus, load, and generator data
- Incorporation of flowgate and contingent elements information
- Monitor branches 230 kV and above
- Monitor all branch interfaces with external regions
- Adjustment of reserve margin by increase of load

# Combined Sensitivity Analysis

- All assumptions were modeled the same as the original study scope except the following:
  - Historical one year load and wind shapes (2011)
  - Increased maximum LFU (9%)
  - Monitored transmission (100kV and above)
  - Shortened summer season (6/22 – 9/8)
  - Additional capacity retirements
- Sensitivity performed at 12.0% Reserve Margin

# Combined Sensitivity Analysis



# Impacts of adjusting SPP Reserve Margin

- Goal is to maintain reliability as economically as possible
- Benefits of a lower Planning Reserve Margin
  - Financial savings due to reduction in generation investment
  - Could align with generation retirements due to EPA regulation
  - Demonstrates the value of Transmission upgrades

# LOLE Hurdles and Issues in SPP

- How to incorporate wind uncertainty variability
- Forced outage modeling for partial outages
- How to incorporate transmission availability
- Forced outage rates for interregional transactions
- Modeling energy availability of demand response programs and behind-the-meter resources
- Hydro availability limitations
- Seasonal limitations

# Questions