

Perspective: Future of the Power Grid through 2050



Southwestern Power Administration (SWPA)

June 2, 2020

Overview



- About Southwestern Power Administration (SWPA)
- SWPA's View of the Future of the Power Grid through 2050 (Trends)
- SWPA's Role in the Future of the Power Grid

About SWPA: Section 5 of the Flood Control Act 1944



- Authorized SWPA to market electric power generated at reservoir projects under the control of the U.S. Army Corps of Engineers (Corps)
- Required power to be marketed to preference customers which are public cooperatives and municipalities
- Authorized SWPA to build or acquire transmission lines and related facilities to deliver the power to preference customers

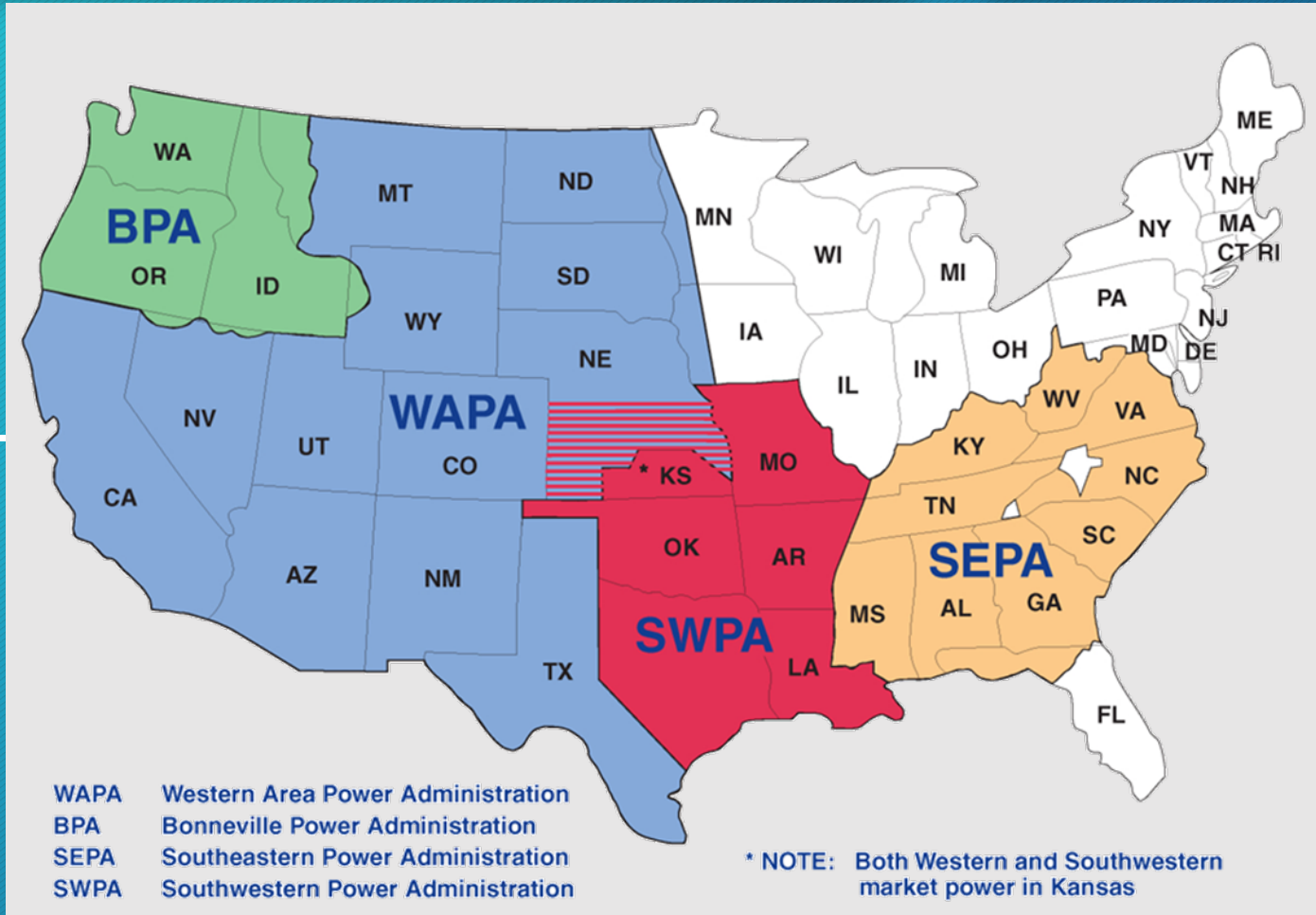


Bull Shoals Dam & Powerhouse, Arkansas (391 MW)

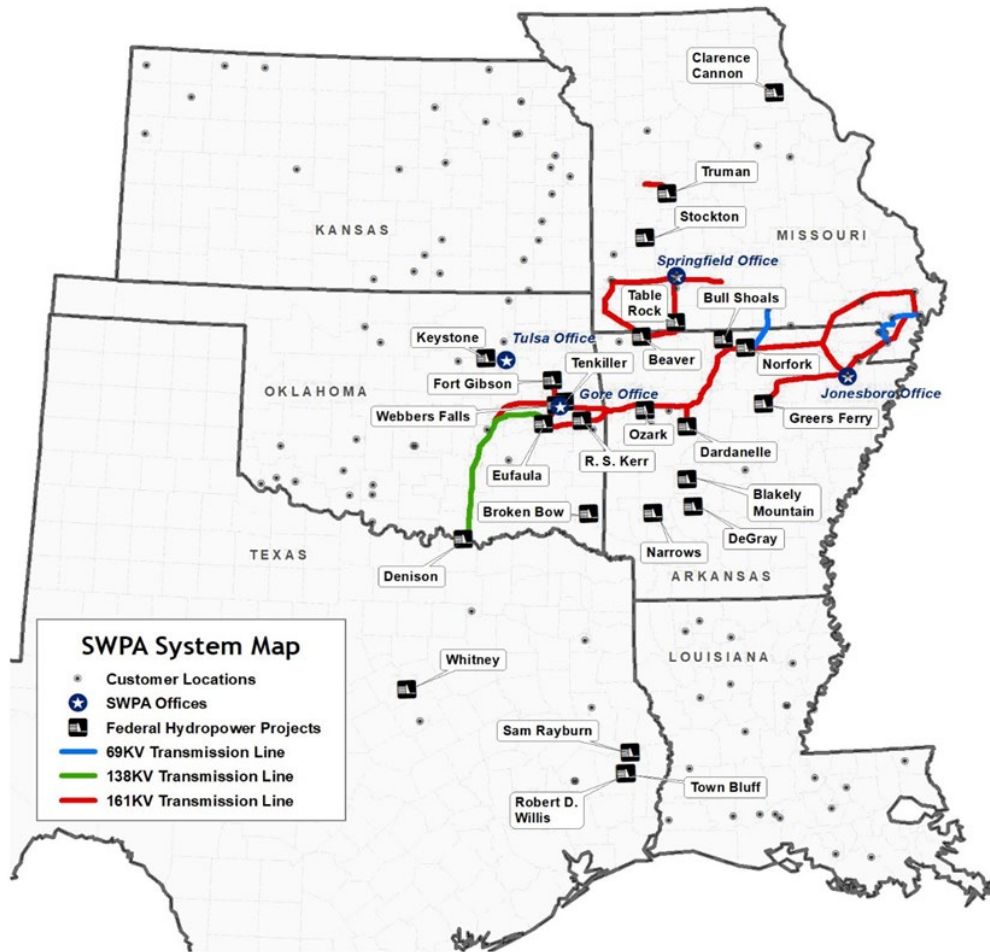
About SWPA: Footprint



- Part of the U.S. Department of Energy and one of four National Power Marketing Administrations (PMAs)
- Markets Federal power in a six-state region to public bodies (preference customers)
- Currently has over 102 customers serving nearly 9 million end-users



About SWPA: Hydropower, Transmission, Facilities



- Markets over 2,000 megawatts (MW) capacity from 24 multi-purpose hydroelectric power projects owned/operated by the Corps, generating on average annually nearly 5.6 billion kilowatt-hours (kWh) energy.
- Operates 1,380 miles of high-voltage transmission lines, 46 communications sites, and 26 substations.
- Headquartered in Tulsa, OK, with Operations Centers in Springfield, MO
- Maintenance units in Gore, OK; Springfield, MO; and Jonesboro, AR.

About SWPA: System Operations



- Operate hydropower projects within physical and regulatory limits (each project is unique)
- Multi-Purpose projects: Flood Risk Mitigation, Hydropower, Water Supply, Navigation, Fish & Wildlife, Recreation
- Repay financial obligations/meet statutory requirements
- Provide customers with a beneficial energy product



Table Rock Dam & Powerhouse, Missouri (200 MW)

About SWPA: System Operations



- Operations coordinated with Southwest Power Pool (SPP) and other Reliability Coordinators
 - Scheduling, tagging, and Tariff administration
 - Redispatch of generation
 - Transmission Loading Relief
 - Reserve Sharing Group participation
 - Outage coordination
- Balancing Authority Area (BAA)
 - Regulation service
 - Operating reserves
 - Transmission system losses
 - NERC requirements



View of the Future of the Power Grid: Trends

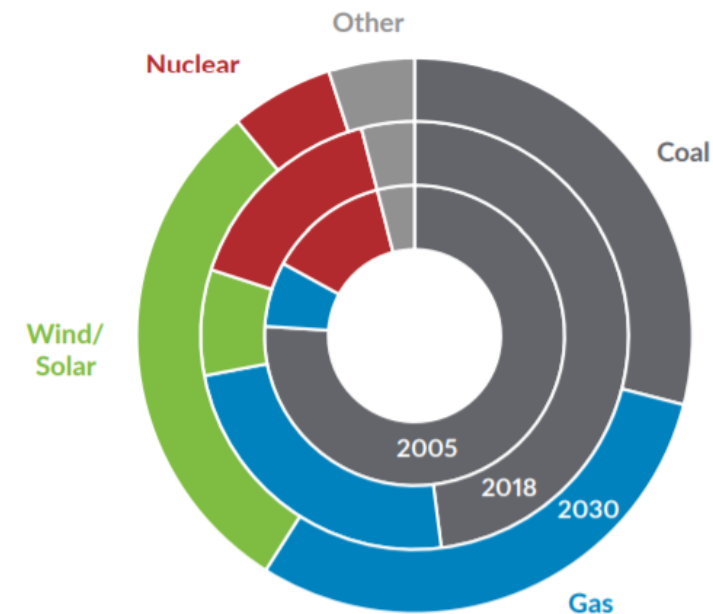


- Generation interconnections continue to trend heavily to renewables (wind, solar)



SWPA customer solar farm in Missouri

MISO Energy Mix Transition (GWH) from 2005 to 2018 to 2030
(Based on Utility Announcements and State Integrated Resource Plans)*

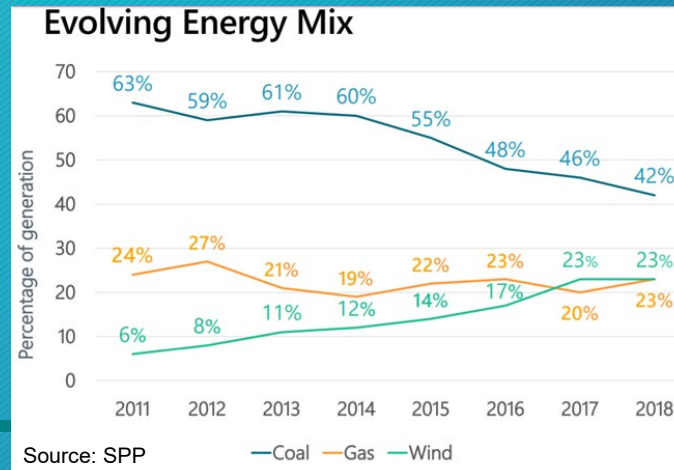
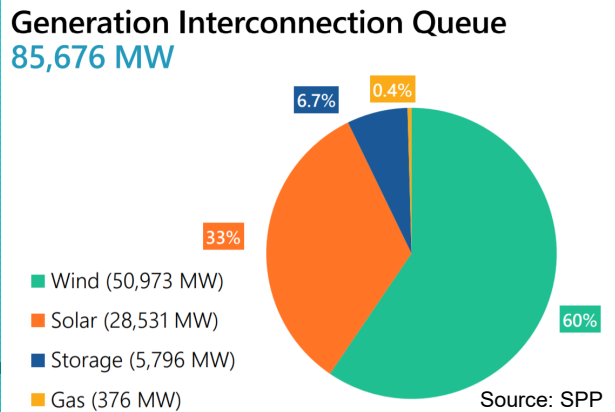


*Chart reflects ratios of generation.

Source: Midcontinent Independent System Operator (MISO)

View of the Future of the Power Grid: Transmission Planning and Changes

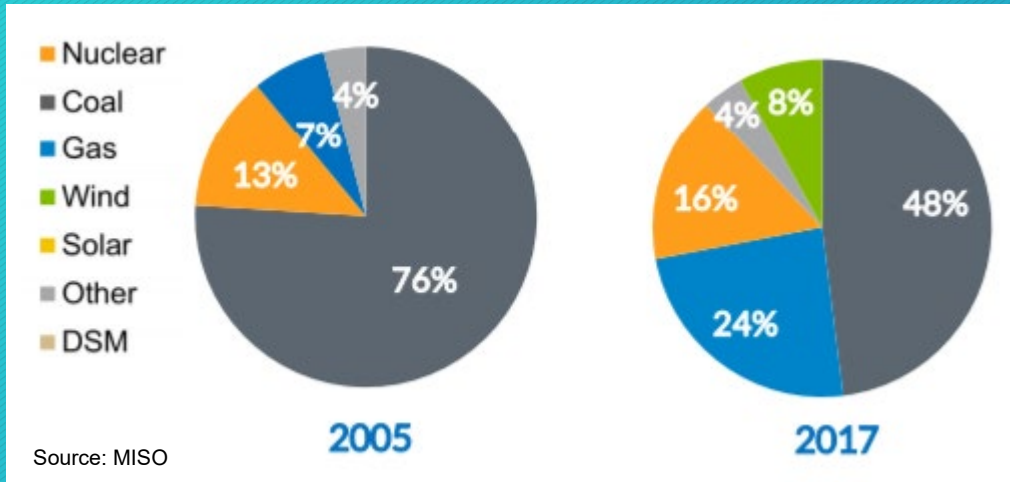
- Transmission planning efforts are dependent on the forecasted energy mix and technologies
- SPP's recent Holistic Integrated Tariff Team (HITT) aimed to ensure reliability, enhance the integrated marketplace, and align transmission planning and cost allocation, in part in response to the changing generation mix and new technologies.



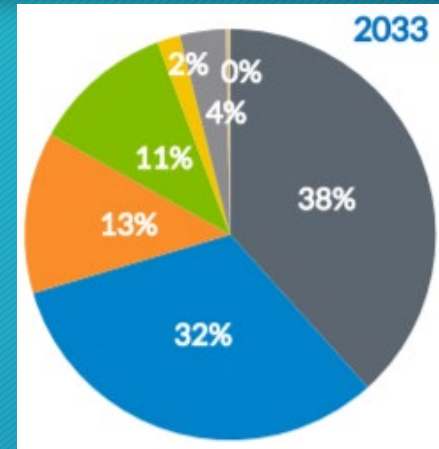


View of the Future of the Power Grid: Transmission Planning and Changes

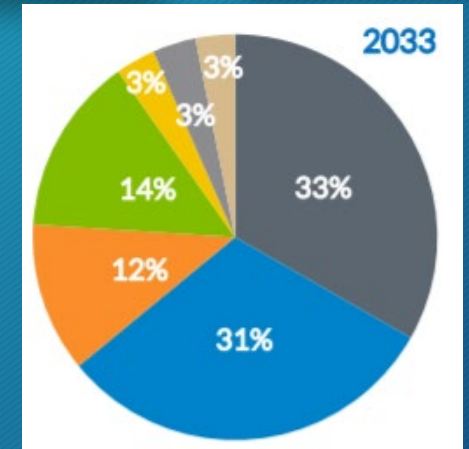
- MISO Futures evaluate limited, continued, and accelerated fleet changes as well as the incorporation of distributed and emerging technologies.
- Even the forecasted limited changes show a significant change in the mix.



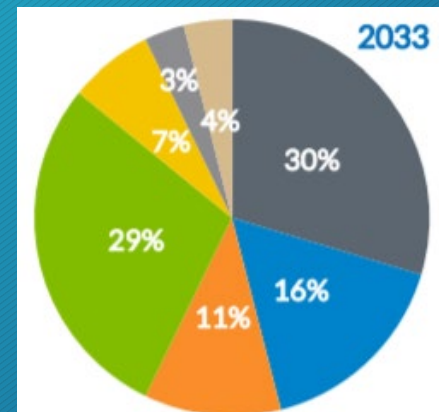
Historical



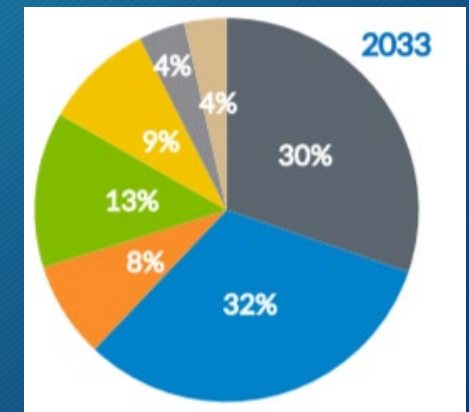
Limited



Continued



Accelerated



Distributed & Emerging
Technologies

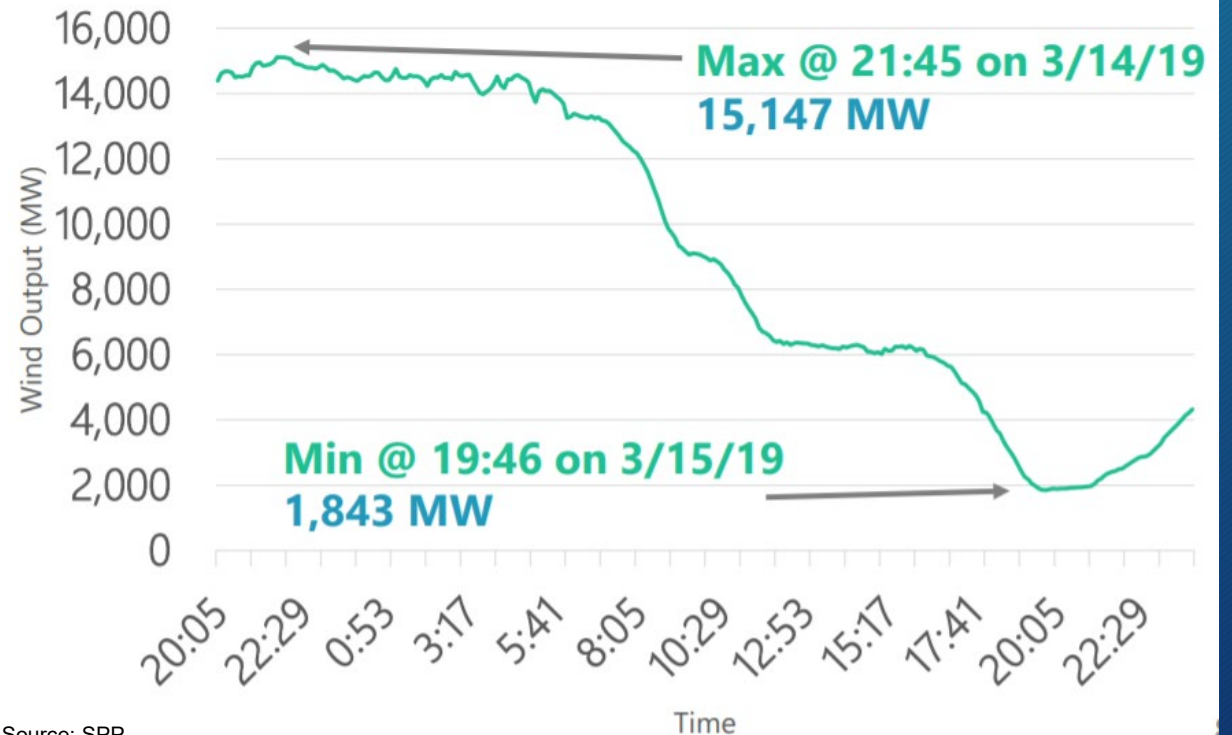
View of the Future of the Power Grid: Reliability



- Ensuring system reliability as the injection of renewable intermittent generation continues to become the predominate resource serving the majority of loads in RTO's/Markets

Why generation diversity matters:

SPP's record wind swing (13 GW in 22 hours)



Source: SPP

View of the Future of the Power Grid: Energy Storage



- Storage at transmission facilities
- Pumped Storage Hydropower



DeGray Dam
&
Powerhouse,
Arkansas

(68 MW with
28 MW
pumpback)

	Largest Single-Plant Capacity (MW)	Discharge time	Max cycles or lifetime	Energy density (watt-hour per liter)	Efficiency
Pumped hydro	3,000	4h - 16h	30 - 60 years	0.2 - 2	70 - 85%
Compressed air	1,000	2h - 30h	20 - 40 years	2 - 6	40 - 70%
Molten salt (thermal)	150	hours	30 years	70 - 210	80 - 90%
Li-ion battery	100	1 min - 8h	1,000 - 10,000	200 - 400	85 - 95%
Lead-acid battery	100	1 min - 8h	6 - 40 years	50 - 80	80 - 90%
Flow battery	100	hours	12,000 - 14,000	20 - 70	60 - 85%
Hydrogen	100	mins - week	5 - 30 years	600 (at 200bar)	25 - 45%
Flywheel	20	secs - mins	20,000 - 100,000	20 - 80	70 - 95%

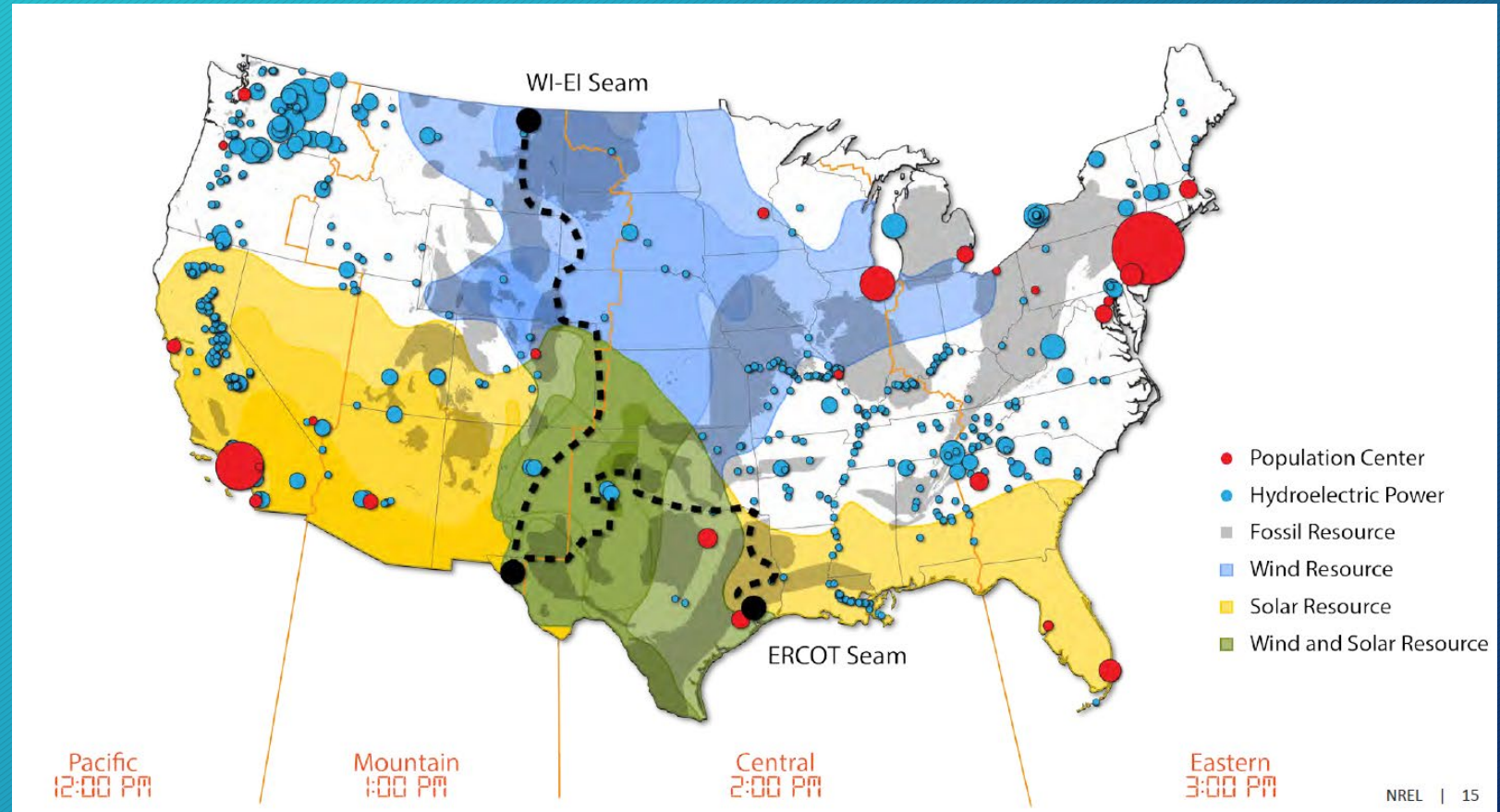
Environmental and Energy Study Institute (EESI), Fact Sheet: Energy Storage (2019), Characteristics of selected energy storage systems (source: The World Energy Council)

View of the Future of the Power Grid: East Meets West



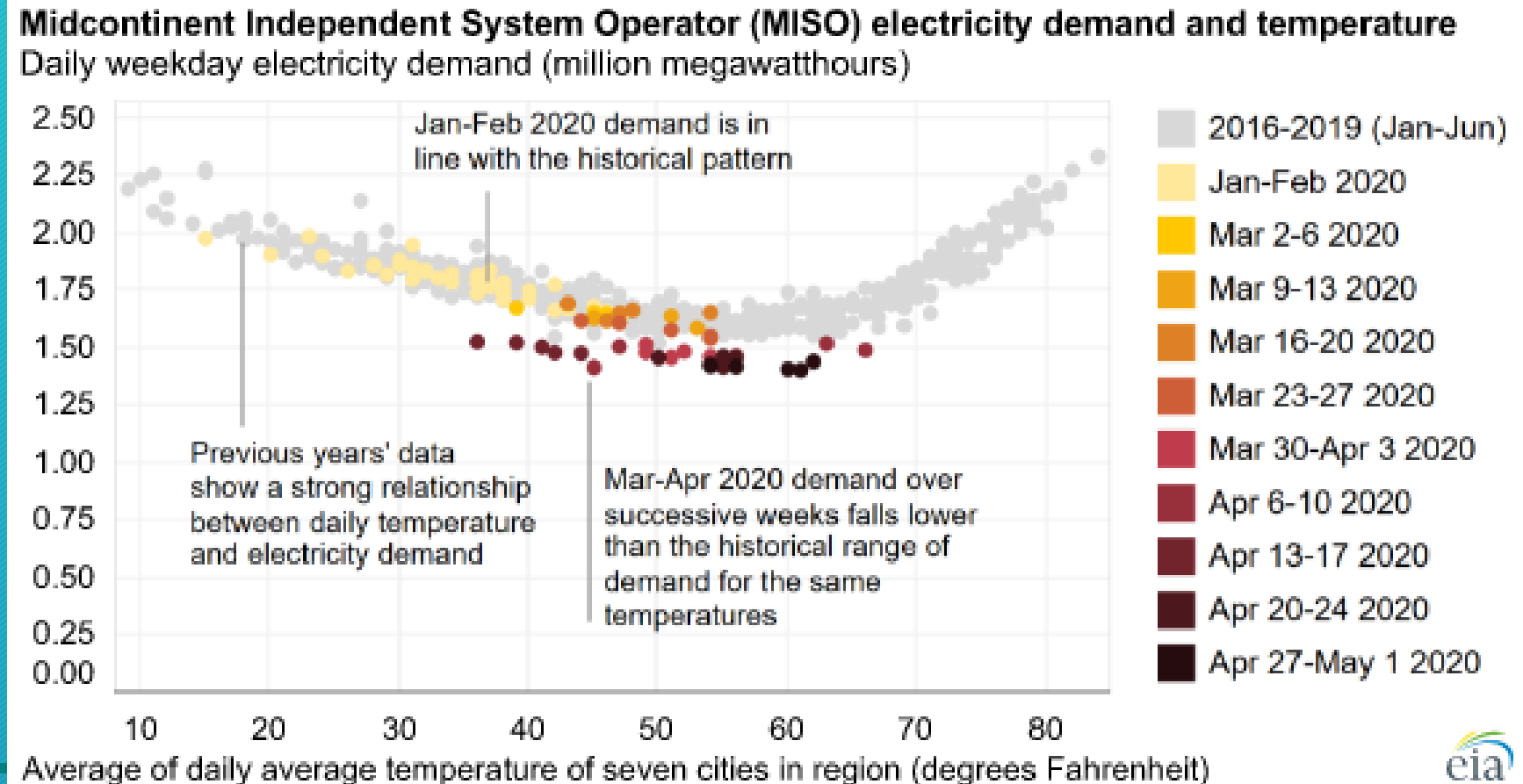
- Connect the Eastern and Western Interconnections:
 - Better distribute renewables
 - Economic gains
 - Opportunity for strategic placement of technologic advances

U.S. Interconnections
seams graphic from
National Renewable
Energy Laboratory
2018 TransGrid-X study.



View of the Future of the Power Grid: Changes in Load

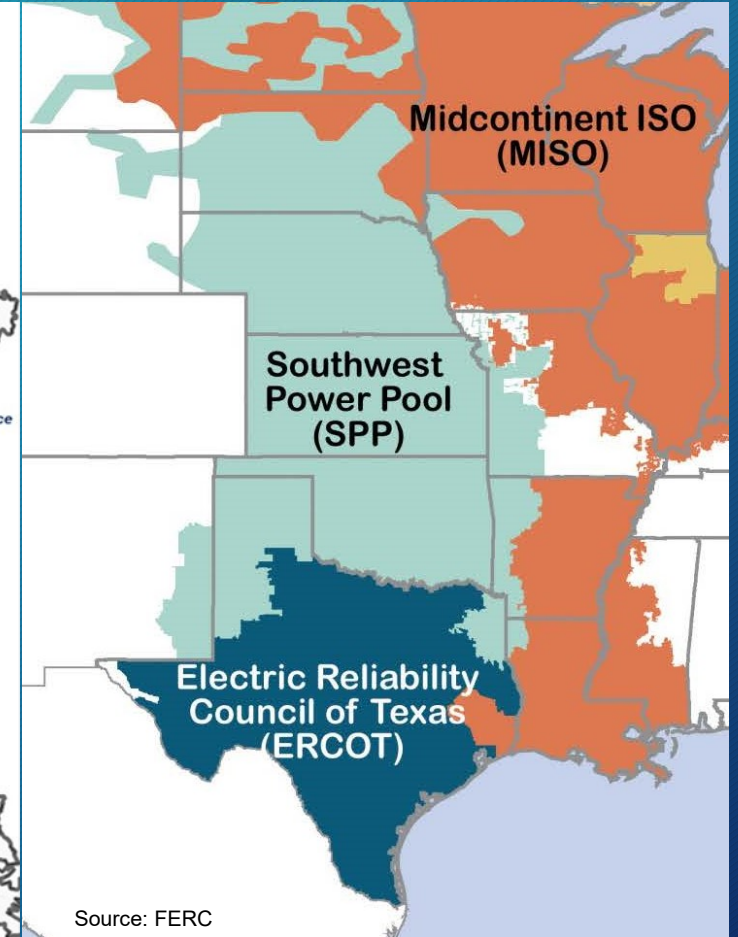
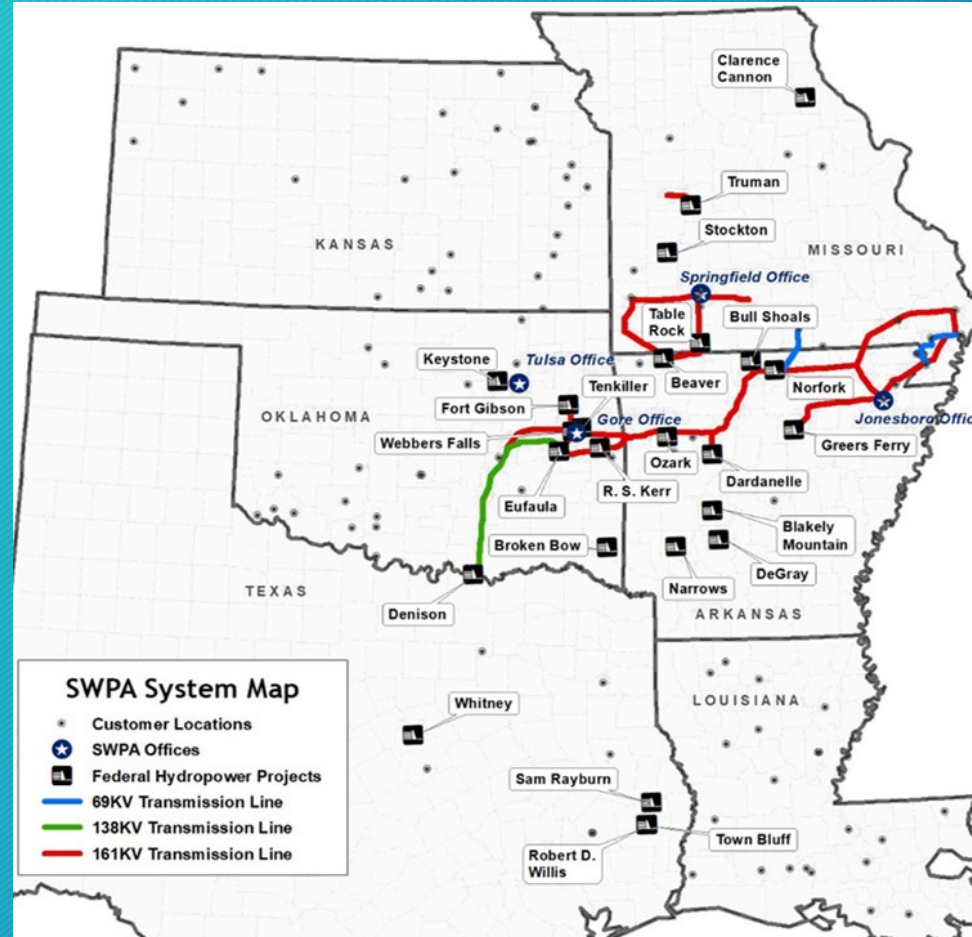
- COVID-19 has resulted in reduced power demand across the nation
- MISO reporting 9-13% reduction in demand
- SPP reporting 8-10% reduction in demand
- This has delayed new investment as well as ongoing O&M





SWPA in the Future of the Power Grid: Uniquely Situated

- SWPA's transmission system interconnects with SPP, MISO, and others
- SWPA markets from hydropower projects in the SWPA, SPP, MISO, and ERCOT Footprints
- SWPA's customers span SWPA, SPP, MISO, ERCOT, and other Footprints



Source: FERC

SWPA in the Future of the Power Grid: Market, RTO, BAA

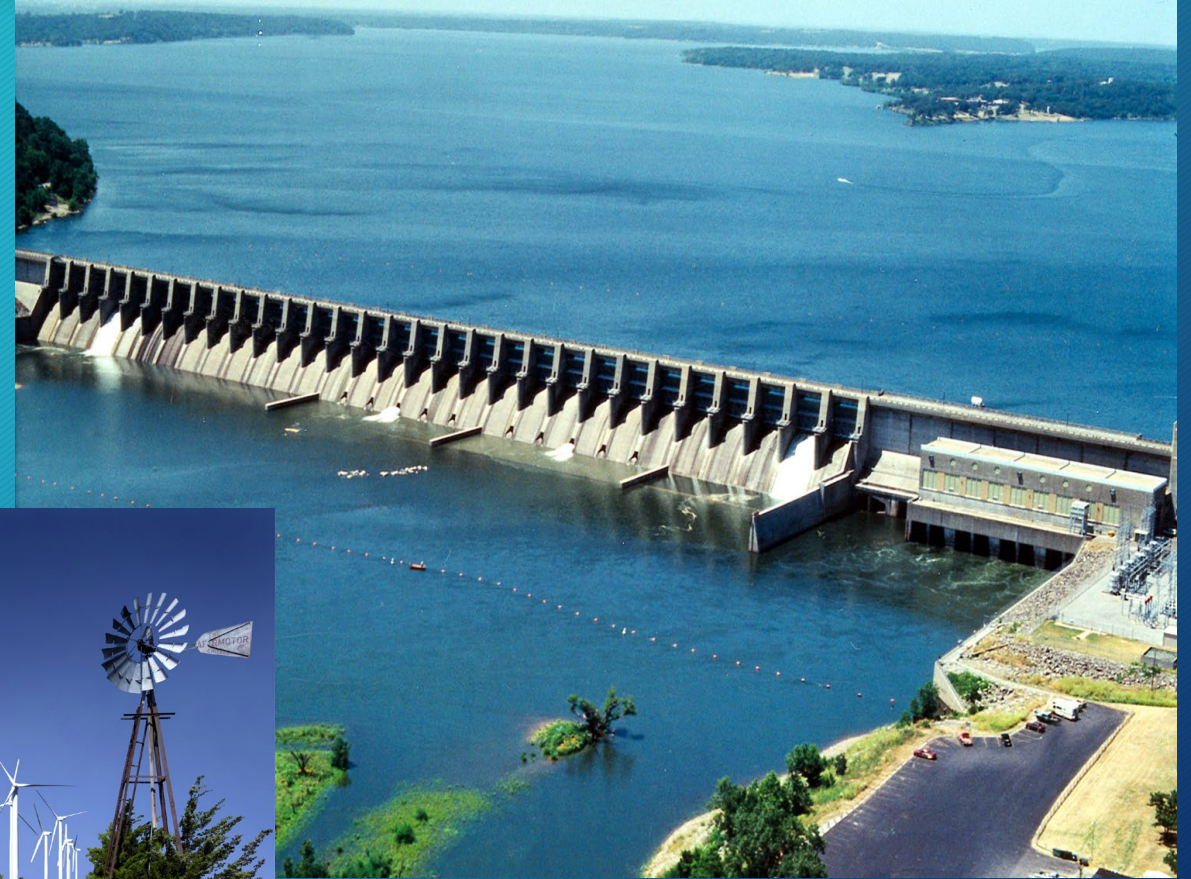


Market/RTO/BAA	Interconnected System Customers, Marketed MW	Electrically Isolated Project Customers, Marketed MW
SWPA	34.0	0.0
SPP	1082.3	25.5
MISO	236.4	59.4
ERCOT	0.0	106.0
Other	151.0	0.0
Total	1867.7	190.9



SWPA in the Future of the Power Grid: Hydropower - the original renewable

- Continued provider of the original renewable energy, providing stability to the intermittent renewables
- Challenges valuing existing hydropower for renewable credits
- Continued focus on interconnecting federal power resources and delivering federal power
- Federal voice from within the power industry



Fort Gibson Dam & Powerhouse, Oklahoma (48 MW)



SWPA in the Future of the Power Grid: Energy and the Environment

- Ensuring a balance between energy production and providing exemplary environmental stewardship
 - In 2019, SWPA projects sacrificed 76,000,000 kWh of generation to improve water flow and quality in the tailraces below the dams.
 - The financial impact from this effort was \$2.5 million in lost revenue and customer benefits.
 - SWPA participates in water quality working groups, endangered species coordination, and state and local water planning efforts in all four states where projects are located.



SWPA in the Future of the Power Grid: The Power of Hydropower



- Using the natural hydropower characteristics to provide ancillary services to energy markets and to provide blackstart capability for restoration
- All SWPA projects have a normal response time of 10 minutes and an emergency response time of 5 minutes.
- When project is providing reserves, response time may be even faster.



Narrows Dam & Powerhouse, Arkansas (26 MW)



SWPA in the Future of the Power Grid: DOE Initiatives

- Opportunities to partner and support DOE/federal initiatives:
 - Cyber Security Initiatives
 - Supply Chain stability
 - Physical Security of the power system and facilities
 - Use of technology to detect anomalies in the power system (sensor arrays, etc.)
 - Enhanced Data Analytics and Artificial Intelligence incorporated to provide resiliency, flexibility, and efficiency operating the power system)
 - Provide resiliency and enhanced reliability to national critical infrastructure and defense
- These initiatives are separate and apart from SWPA's section 5 authorities mentioned previously



Questions?

