
De-Carbonizing the Campus: Planning, Tools & Technologies
CampusEnergy2023
February 27 – March 2, 2023
Gaylord Texan Resort & Convention Center | Grapevine, Texas
INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION

Advantages of Diverse Fuel Sources

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Facilities & Services

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

PRVN Consultants, Inc.

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Agenda

- University of Illinois overview
- Energy for campus mission
- Understanding the challenge
- Campus utility systems
- Energy procurement
- Why energy diversification
- Future considerations
- Addressing the challenge
- Questions

University of Illinois Overview

- Founded in 1867
- Student population of 56,299 (largest in university history)
- Students represent all 50 states and 100+ countries
- Ranked #13 public university
- Campus has over 650 buildings (22M GSF) on 6,370 acres
- Buildings served by campus district energy and utility systems
- Utilities affect all aspects of student life

Energy for Campus Mission

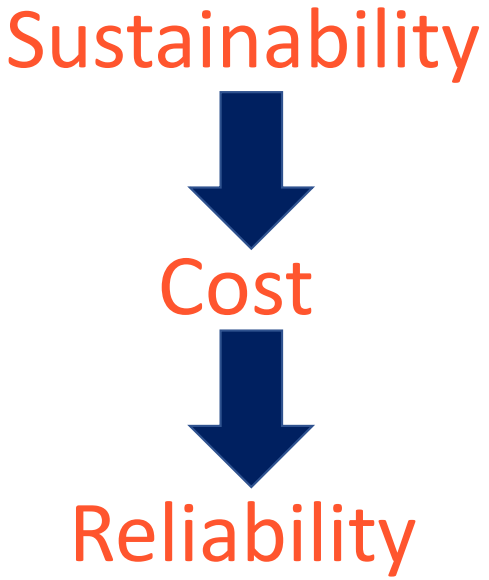
Provide safe, environmentally responsible, reliable, cost-competitive energy to buildings on campus

Key principles when discussing diversification of energy and/or fuel sources

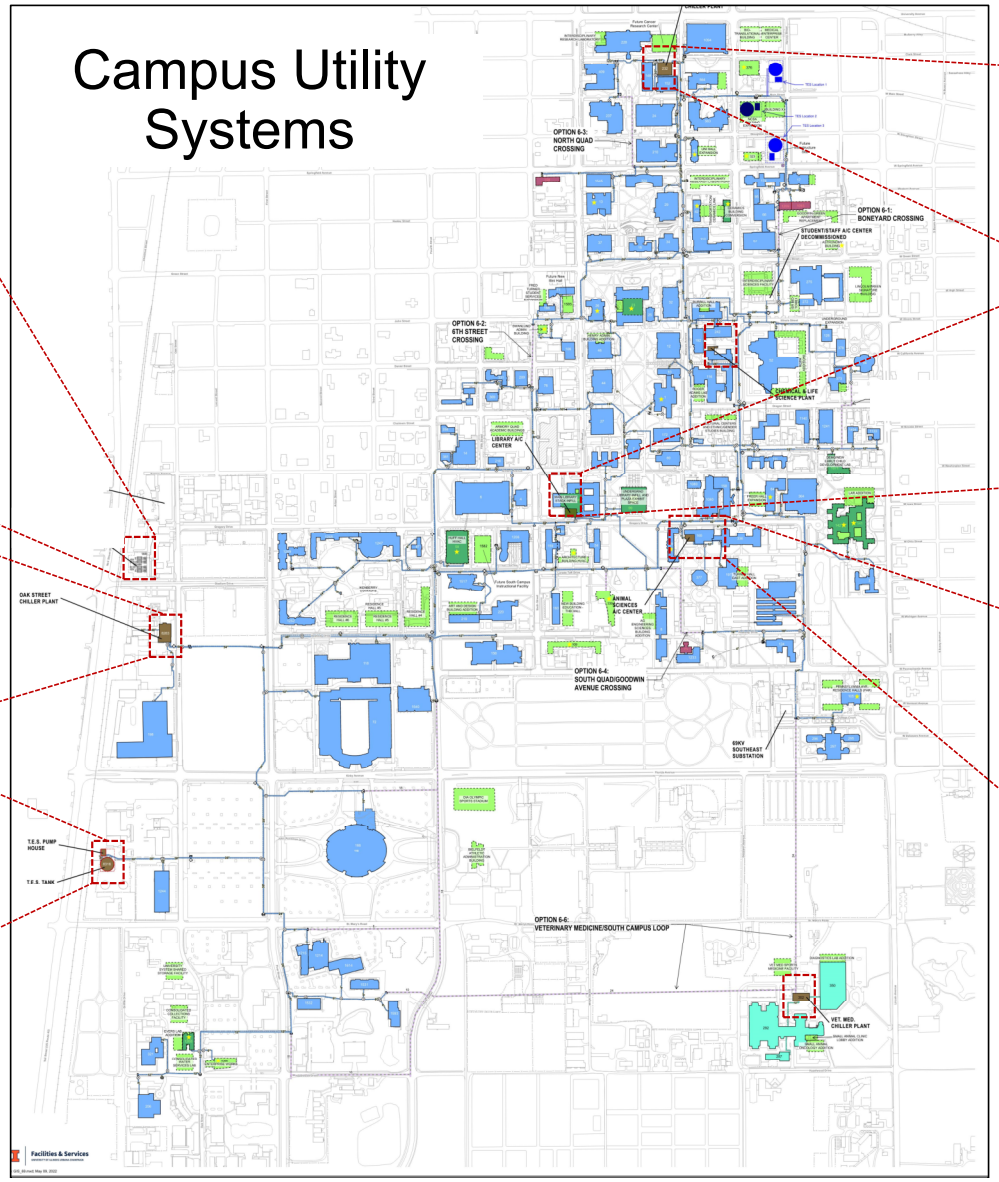
- Safety
- Environmental stewardship
- Reliability
- Cost

Understanding the Challenge

- Competing goals within organization
  - Sustainability
  - Cost
  - Reliability
- Support for campus initiatives vs. support for campus mission
- Diversification of energy can help achieve balance



Campus Utility Systems



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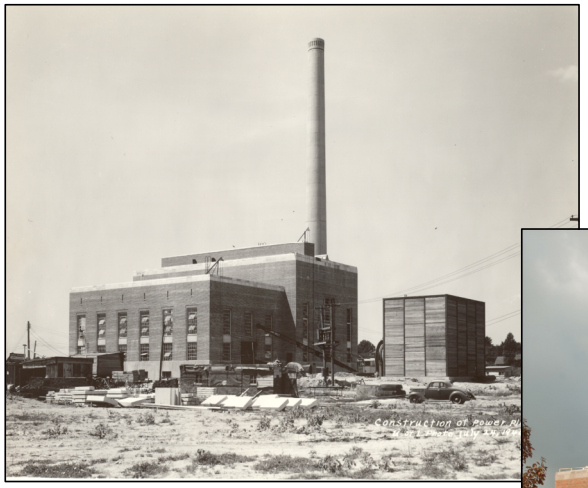
Abbott Power Plant

- 3 natural gas boilers
- 3 coal boilers
- 2 combustion turbines with HRSGs
- 8 steam turbines
- Feeds 150 and 50 psig steam to campus



Natural Gas/Fuel Oil Boilers

Gas/Oil Boilers	Boiler 1	Boiler 2	Boiler 3
Year Installed	2018	2018	2015
Capacity (kpph)	175	175	175
Steam Pressure	850	850	850
Steam Temperature	740	740	740

Solid Fuel Boilers

Soldi Fuel Boilers	Boiler 5	Boiler 6	Boiler 7
Year Installed	1956	1961	1961
Capacity (kpph)	150	150	190
Steam Pressure	850	850	850
Steam Temperature	740	740	740

Power Generation

Steam Turbines	TG01 thru TG04	TG06 thru TG07	GT01 thru GT02	TG08	TG09	TG10
Type	Condensing/ Extraction	Condensing/ Extraction	Combustion	Back Pressure	Condensing/ Extraction	Back Pressure
Capacity (MW)	3.0	7.5	12.5	12.5	12.5	7.0

Heat Recovery Steam Generators

Heat Recovery Steam Generators	HRSG 1	HRSG 2
Year Installed	2002	2002
Capacity (kpph)	110	110
Steam Pressure	850	850
Steam Temperature	740	740

On-Site Solar Installations

- Solar farm 1.0
  - Capacity of 5.87 MWdc (~7,200 MWh annually)
  - Located on 20.8 acres
- Solar farm 2.0
  - Capacity of 12.32 MWdc (~20,000 MWh annually)
  - Located on 54 acres
- Business Research Council Laboratory
- Other rooftop solar panels

Chilled Water System

- UIUC has 5 regional chilled water plants
- Total installed capacity of 46,600 tons
- Chiller fleet includes two chillers with steam turbine-driven compressors (10,000 tons)
- Cogenerated steam at 150 psig and 400°F supplies steam turbine chillers
- Remaining chillers use electric motor-driven compressors (36,600 tons)

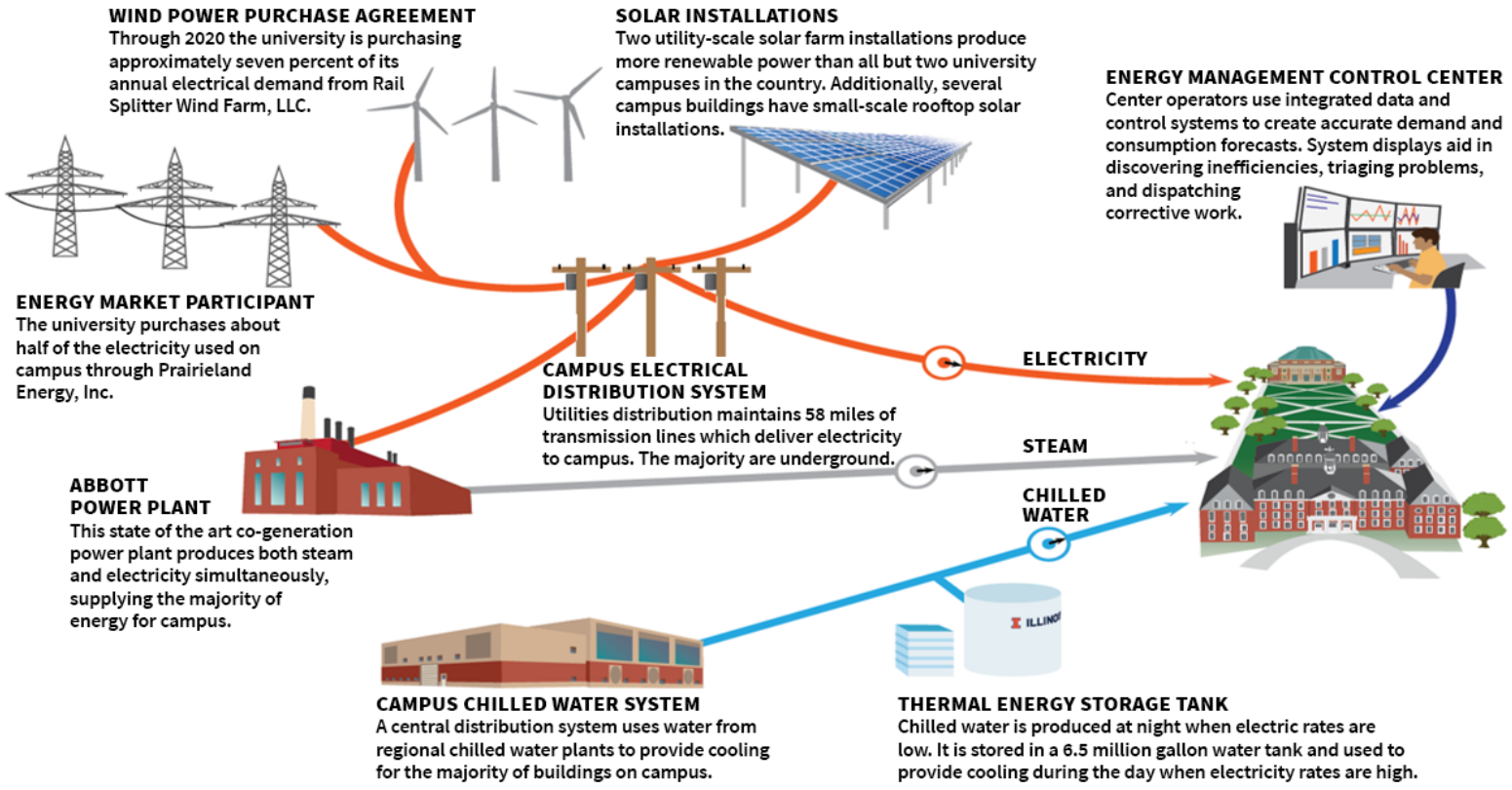
Thermal Energy Storage (TES)

- 6.5 million gallon stratified chilled water TES tank
- Discharges 5,400 tons over 9.2 hours
- Provides firm capacity as well as partial electrical load shift
- Reduced peak electric load ~5 MW
- Dispatched based upon day ahead hourly pricing
- Bid into MISO as demand response resource
- TES saved ~$100,000 in FY22

Energy Efficiency Improvements

- Retro-commissioning program
  - University team has updated 80+ campus buildings (10M GSF) since 2007
  - Reduced energy consumption by an average of 27%
  - $84 million in avoided utility costs
- Energy performance contracting
  - Heat recovery chillers
  - VAV conversion
  - Building envelope
  - Energy recovery systems

District Energy Overview



Campus Energy Sources

- Fuel oil
- Natural gas
  - Purchased
  - Fuel source for CHP
- Coal
- Electricity
  - Procurement
  - On-site generation from CHP system
  - Wind power PPA
  - On-site generation from solar photovoltaic
- Heating
  - Campus steam from CHP
  - Localized heat recovery chillers
  - Localized geothermal system
- Cooling
  - Campus chilled water from district cooling plants
  - Thermal energy storage
  - Localized heat recovery chillers

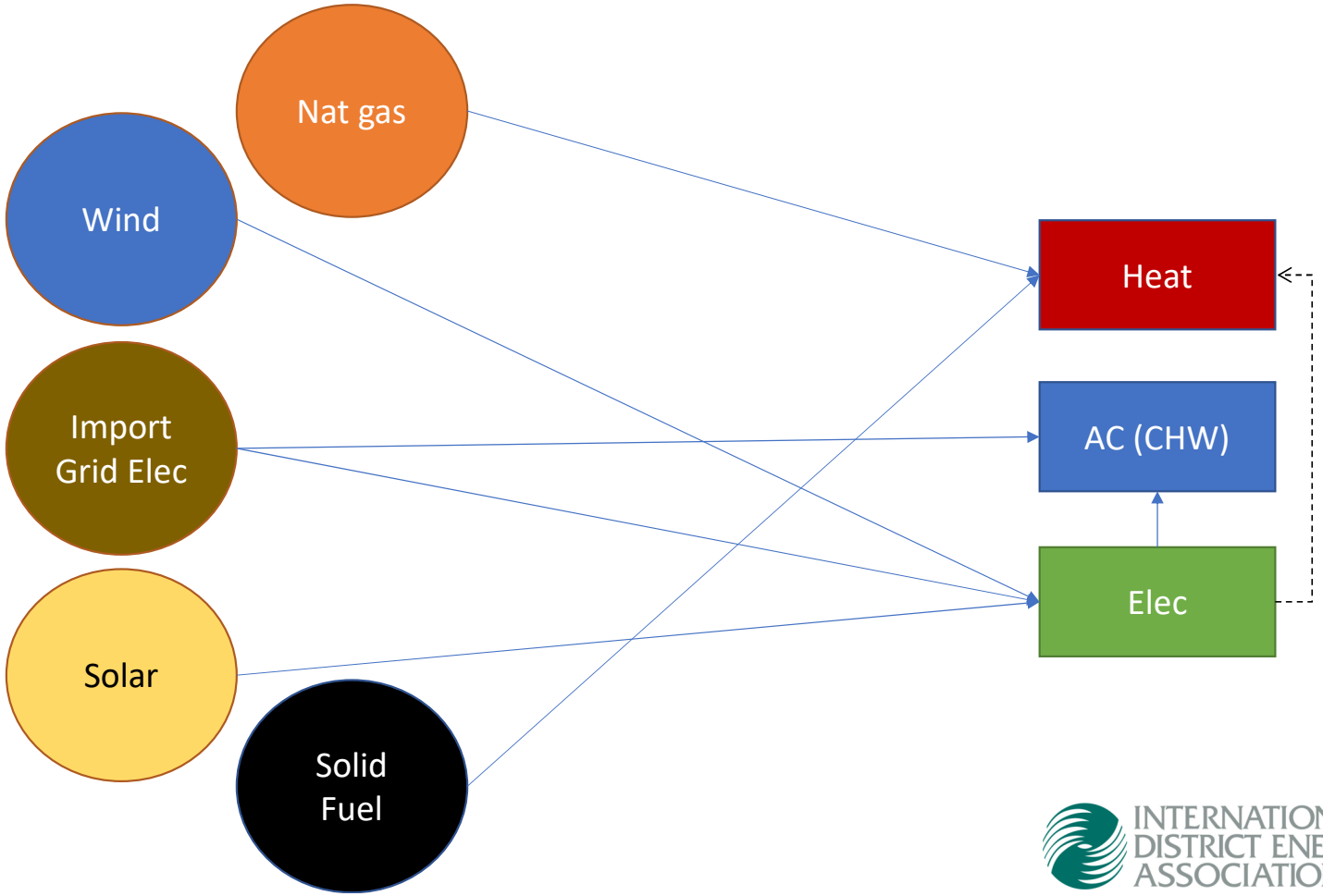
Energy Procurement

- Procurement philosophies
  - Electric & nat. gas hedge (to what level?)
  - Physical hedge vs. financial hedge (short-term/long-term)
  - Solid fuel contracts
  - Power purchase agreements (wind, solar)
  - Spot market purchase
  - Virtual power purchase agreements (swaps)
- Fuel diversification considerations
  - Market volatility
  - Potential premiums
  - Force majeure

Why Energy Diversification

All In

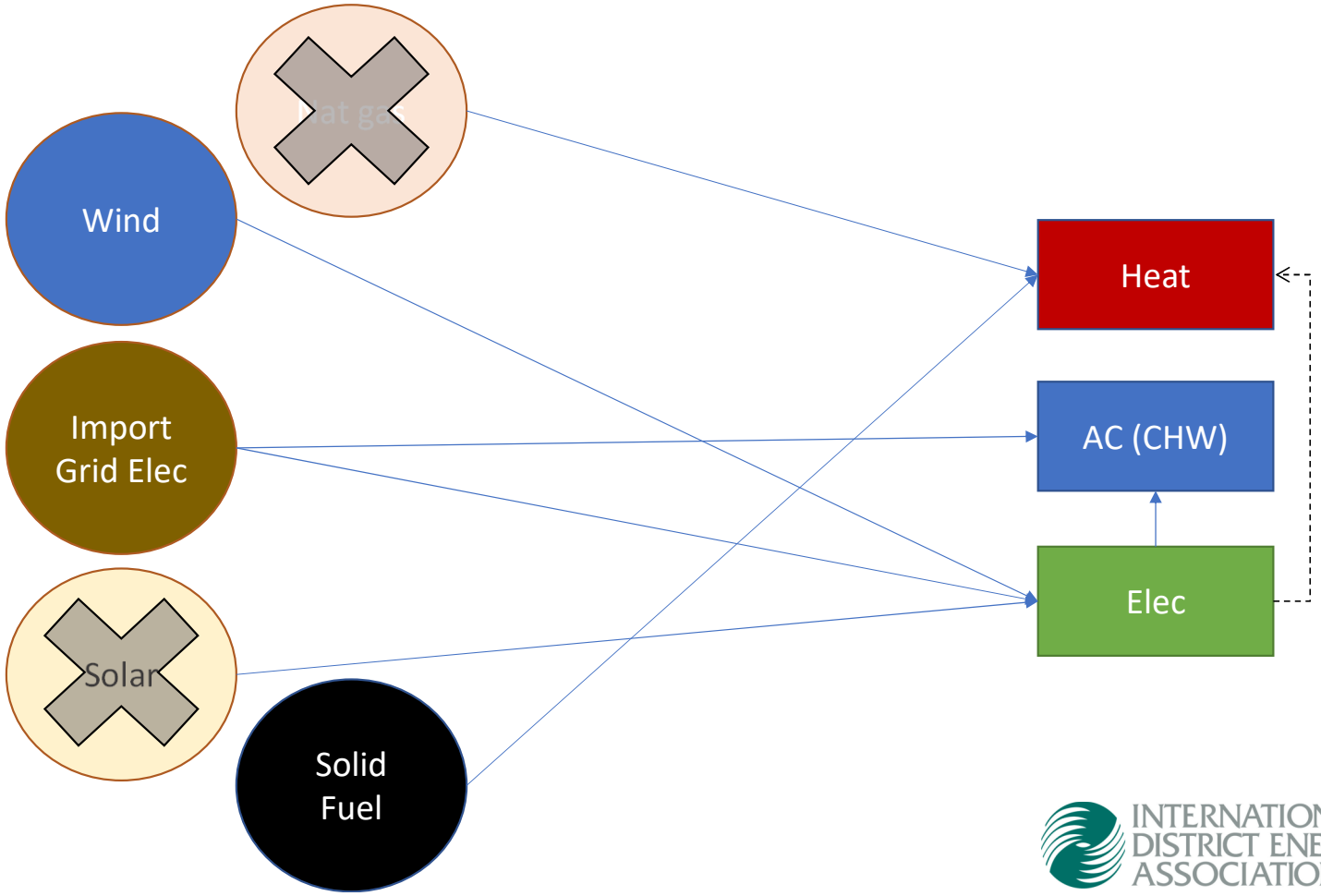
All assets available on a bright sunny day



Why Energy Diversification

Cold Day

-5 deg OAT, OFO on gas pipeline, cloudy



Real World Examples

- Historic winter storm – February 2021
  - Nicknamed the Presidents Day Market Massacre. Spot market prices soared to $130/D-therm.
  - Without fuel diversity and hedging program for nat. gas, cost for 4 days would have exceeded $7.8M. Our nat. gas budget for that FY was $8.1M.
  - Impacted electric prices on MISO because of coal retirements.
- Recent cold weather – December 2022
  - Loss of compressor stations and high demand on gas transmission pipeline system created Operational Flow Order (OFO), reducing available gas to University operations (aging infrastructure).

Real World Examples

- Inflationary pressures
  - Summer 2022 – capacity came in at $230/MW-day or $84,000 per MW.
  - Increased use of nat. gas for electric production
  - Increased cost of nat. gas (supply, geo-political)
  - Lack of infrastructure to support new and imported energy (rolling blackouts)

Future Considerations

Future Initiatives

- Carbon capture pilot project with DOE
- Biomass (solid fuel)
- Biogas or synthetic natural gas (SNG)
- Compressed natural gas storage
- Nuclear
- Hydrogen
- Localized microturbines

Challenges

- Logistics (sourcing fuel, etc.)
- Equipment changeout

Addressing the Challenge

- Safety remains paramount
- Improves reliability
- Can help improve sustainability
- Address priorities with competing considerations
- Energy diversification allows these principles to work in concert

Resiliency

Questions

Thank You!

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