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Tri-State Summary 2020 IRP

Purpose of 2020 IRP Process



- Meet Integrated Resource Plan Requirements
 - Western Area Power Administration (WAPA) Contract
- Continued analysis of changing landscape
 - Partial Requirements
 - Increased Distributed Generation
 - Beneficial Electrification
 - Demand Side Management/Energy Efficiency
 - Colorado GHG Reductions
 - Thermal Retirement Analysis
 - Increased Renewable Generation
 - Loss of Load Probability Study/Reserve Margin
- Develop report to inform Tri-State Management, Board of Directors, and WAPA

Western Area Power Administration (WAPA) IRP Process



- Requirements
 - Energy Policy Act of 1992 requires WAPA's long-term firm power customers to prepare integrated resource plans
 - Tri-State purchases ~ 600 MW of federal hydropower
 - WAPA / Tri-State contracts have been extended to 2054 (Loveland Area Projects) and 2057 (Salt Lake City Integrated Projects)
- WAPA published a final rule in 1995 that set out the IRP requirements
- The requirements were last revised on June 20, 2008

WAPA IRP Requirements



- Specific requirements
 - Load Forecasts
 - Evaluation of new resources – full range of alternatives
 - Must consider diversity, reliability, dispatchability
 - Qualitative analysis of environmental effects
- File every 5 years with annual progress reports
- Requires public participation
- Action Plan required
- Final plan filed with WAPA & requires approval

Key Dates



- June – Base Case
- July thru Sept – Scenario work
- TBD - Public meeting(s)
 - Delayed due to COVID19
- October – Final Public Feedback
- November – TS Board Approval
- December Final Report to WAPA



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Tri-State Overview

General Tri-State Information



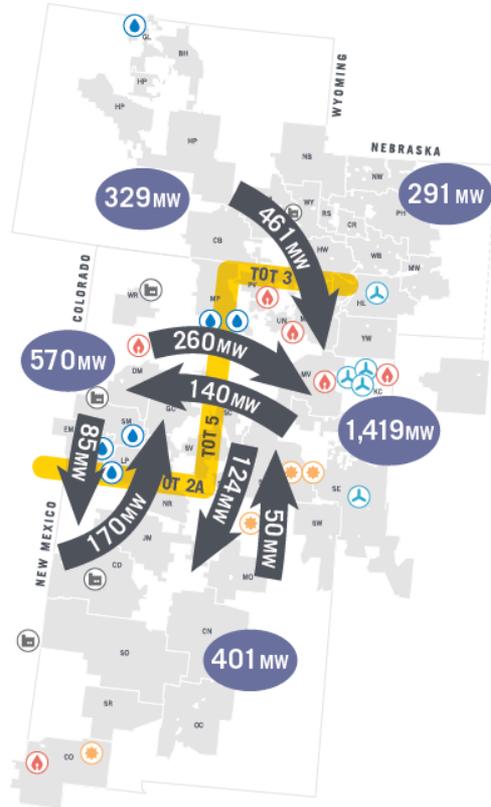
- **Tri-State Generation and Transmission Association** is a not-for-profit wholesale electric cooperative with 46 members in four states. The majority of our members are rural electric cooperatives and public power districts. These utilities purchase power from Tri-State, and in turn deliver power to over a million consumers across over 200,000 square miles of the West.

General Tri-State Information



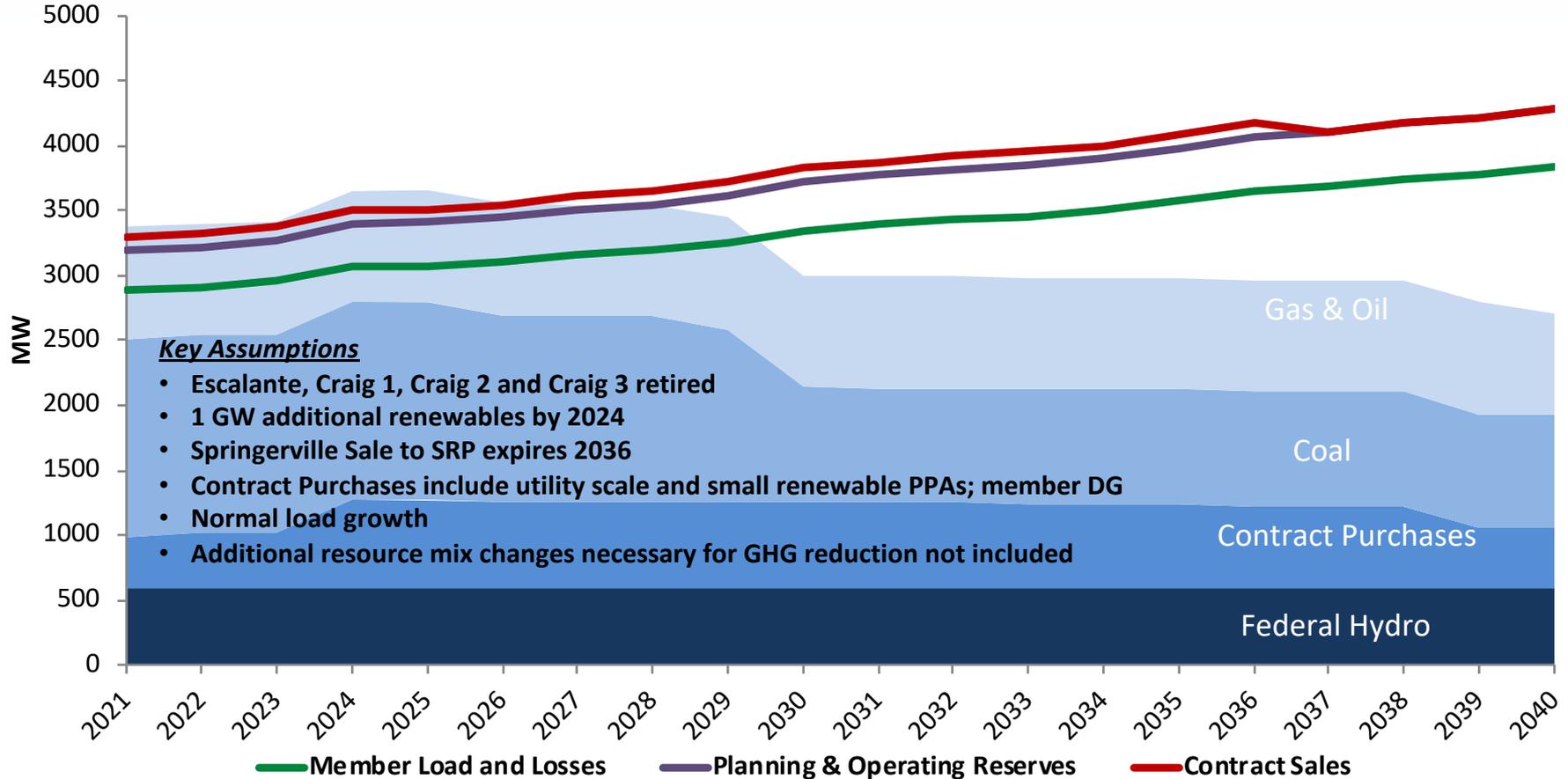
- tristate.coop
- Tri-State sells electric power to its utility members under the terms of long-term wholesale electric service contracts extending through 2050 for 42 members and through 2040 for one member
 - Delta Montrose Electric Association membership terminates summer of 2020
- In 2019, the Tri-State's peak demand was 3,010 MW, with energy sales to its utility members of 16,413 GWH

Tri-State System

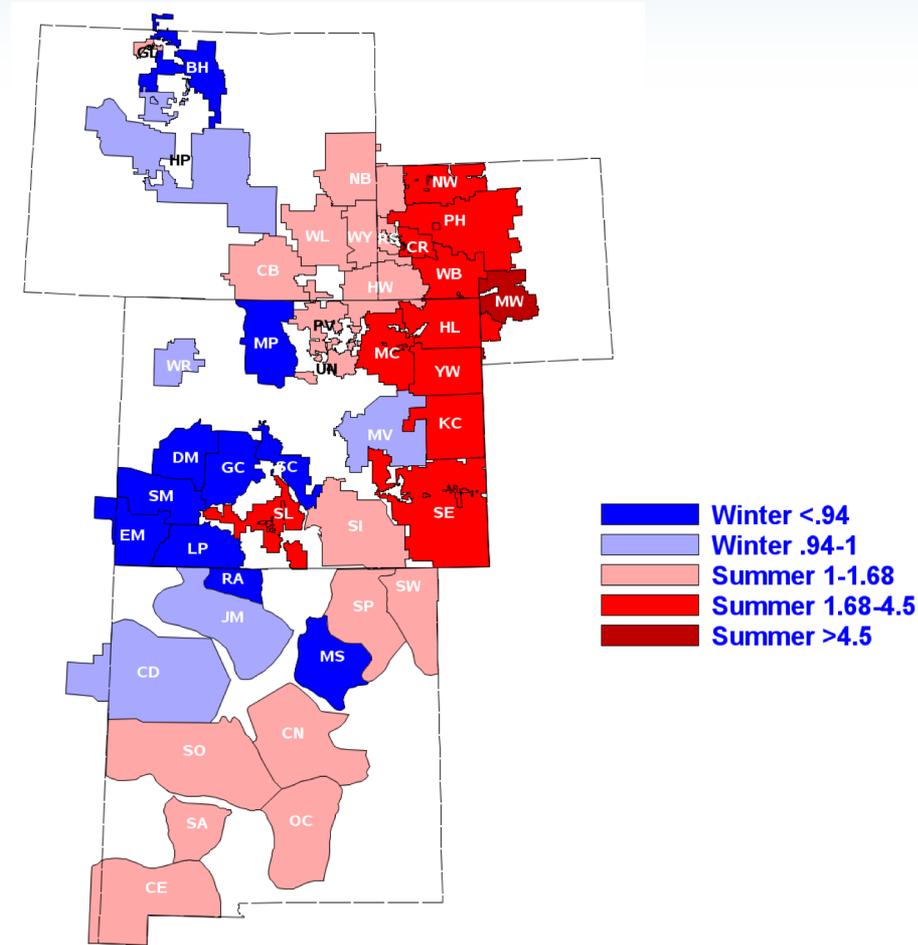


- TOT** Transmission constraint
- ➔ Tri-State owned capacity
- ☀ Solar
- 🌬 Wind
- 💧 Hydro
- 🔥 Natural Gas
- 🏭 Coal
- MW** 2019 Peak Member Load

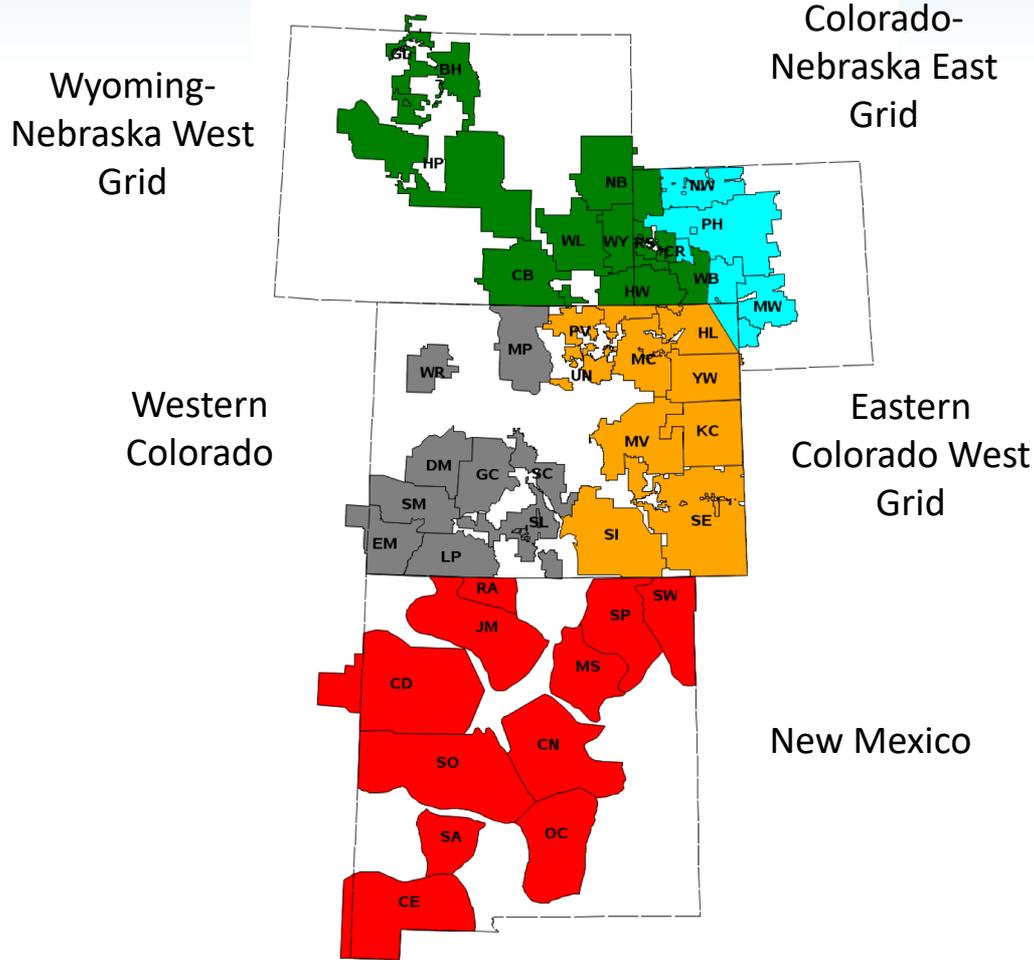
Load & Resource Balance



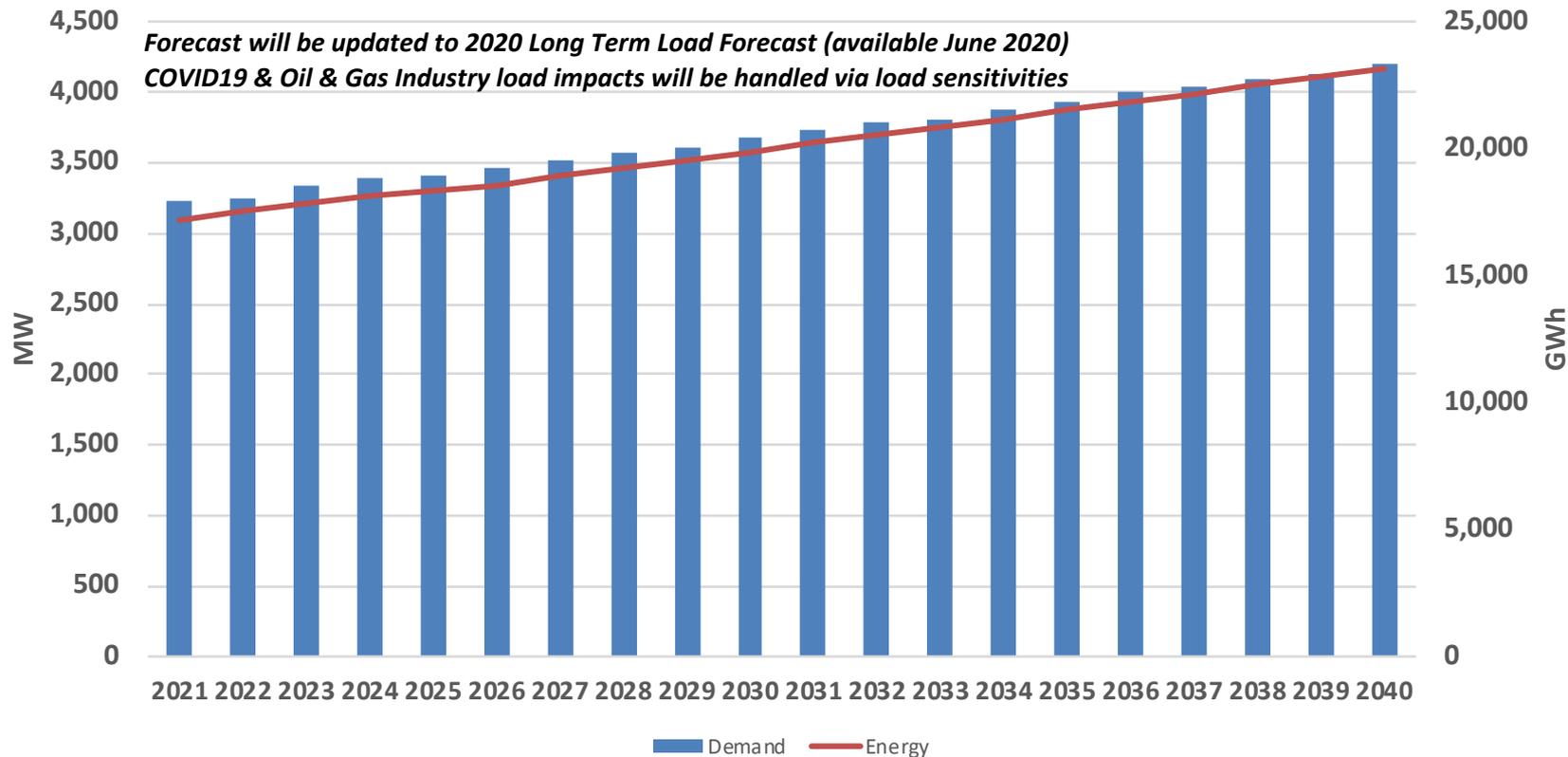
Summer/Winter Peak



Planning Regions



2019 Annual Long Term Load Forecast



Transmission



- Own, lease or undivided interest in 5,665 miles of high voltage transmission

- Wheeling agreements:
 - Public Service Company of Colorado
 - Western Area Power Administration
 - Public Service Company of New Mexico
 - PacifiCorp
 - Others



Resource Overview (2021)

- Coal 1529 MW
- Gas/Oil 903 MW
- WAPA 584 MW
- Basin 587 MW
- Wind 471 MW
- Solar 85 MW
- Hydro 27 MW
- Member 136 MW
(Distributed, Renewable)

Escalante retired by end of 2020
Crossing Trails Commercial Dec 2020



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Resource Summary

Resource Retirements

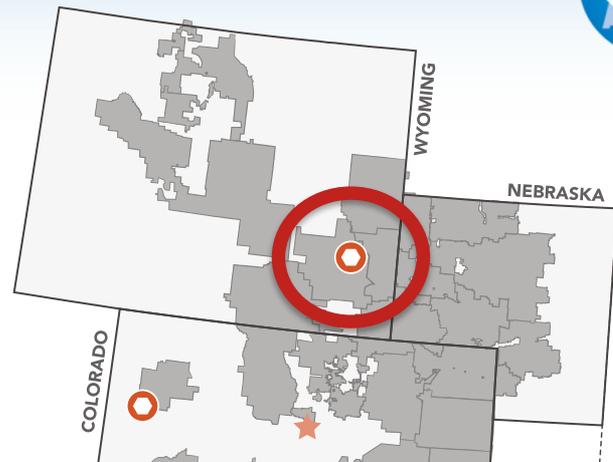


Unit	Fuel	Tri-State Share (MW)	Closure Date
San Juan 3	Coal	41	12/31/17
Nucla	Coal	100	9/21/19
Escalante	Coal	253	12/31/20
Craig 1	Coal	102	12/31/25
Craig 2	Coal	98	By 2030
Craig 3	Coal	448	By 2030

Laramie River Station



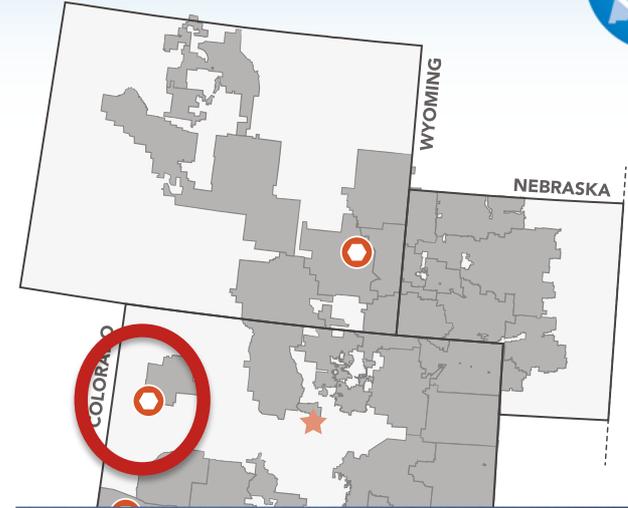
- Southeastern Wyoming
 - Wheatland
- Online: 1982
- 1,710 MW total
- 3 Units
- 464 MW to Tri-State
 - 723 MW: Basin Electric Power
 - 282 MW: Western Minnesota Municipal Power Agency
 - 218 MW: Lincoln Electric System
 - 23 MW: Wyoming Municipal Power



Craig Station



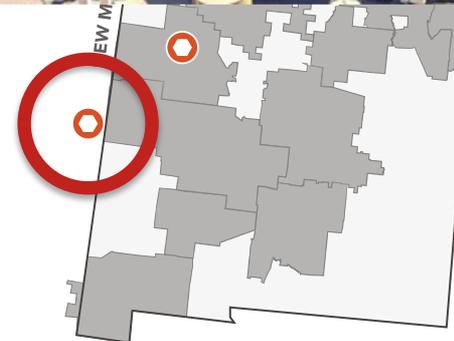
- Northwest Colorado
 - Craig
- Online: 1979 - 1984
- 1,285 MW Total
- 3 units
- 648 MW to Tri-State
 - 243 MW: Salt River Project
 - 161 MW: PacifiCorp
 - 151 MW: Platte River Power Authority
 - 82 MW: PSCo



Springerville Station



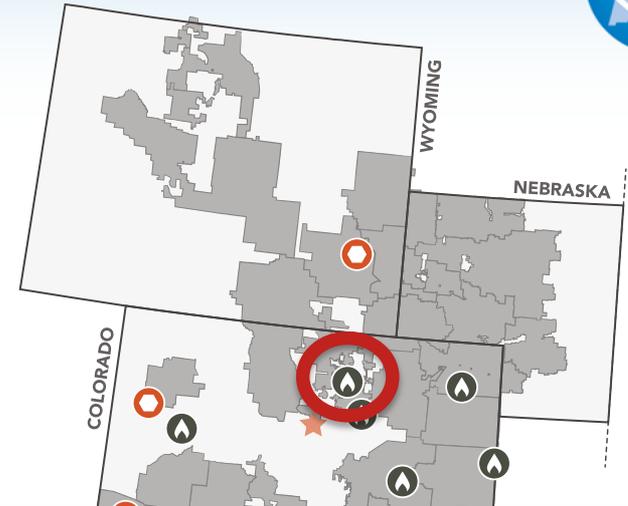
- Eastern Arizona
- Online: 2006 (Unit 3)
- 1,629 MW
- 417 MW to Tri-State
 - 100% of Unit 3
 - 793 MW: Tucson Electric Power (Units 1 & 2)
 - 417 MW: Salt River Project (Unit 4)



J.M. Shafer Station



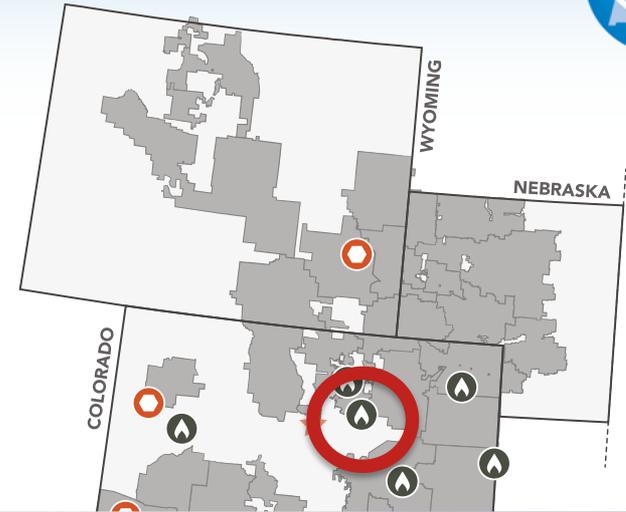
- Eastern Colorado
 - Ft. Lupton
- Online: 1994
- 272 MW
- Natural gas combined cycle
 - 5 x 34.8 MW CTs
 - 2 x 49 MW STs
 - 100% Tri-State Owned



Knutson Station



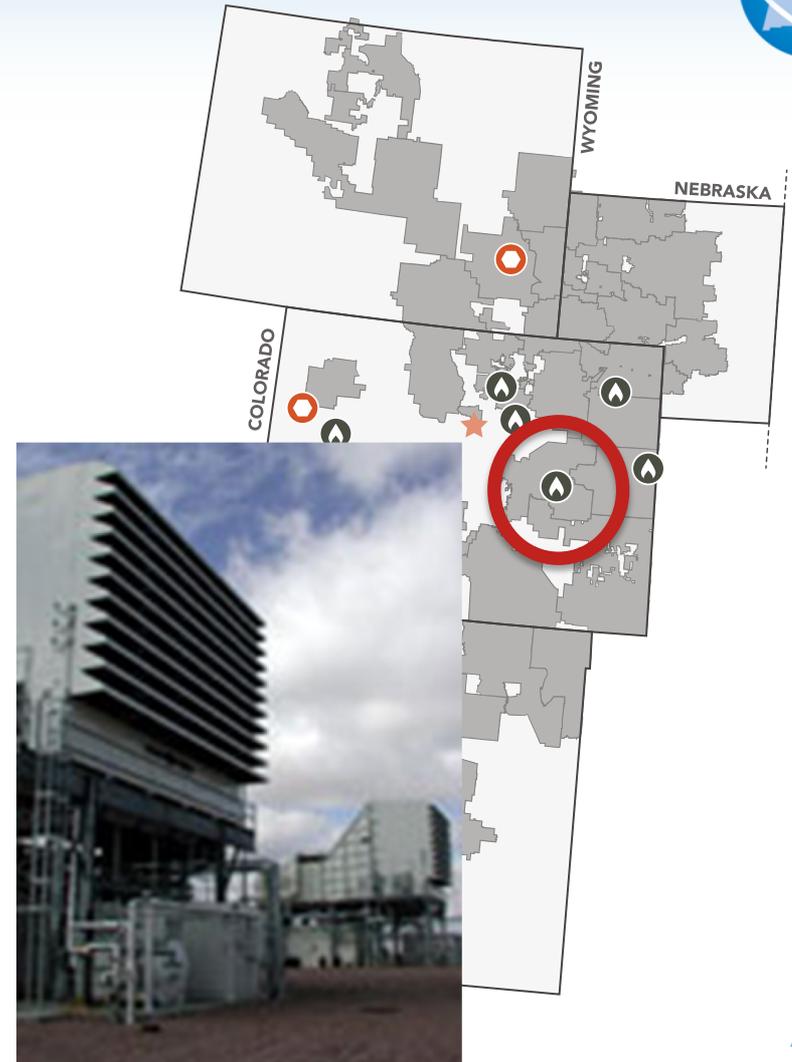
- Eastern Colorado
 - Brighton
- Online: 2001-2002
- 140 MW
 - 2 x 70 MW CTs
 - 100% Tri-State Owned
- Dual fuel capability
 - Natural gas
 - Fuel oil (backup)



Limon Station



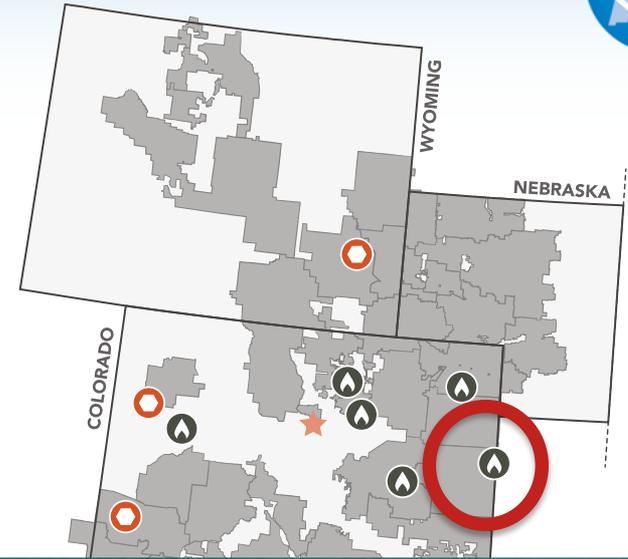
- Eastern Colorado
 - Limon
- Online: 2001-2002
- 140 MW
 - 2 x 70 MW CTs
 - 100% Tri-State Owned
- Dual fuel capability
 - Natural gas
 - Fuel oil (backup)



Burlington Station



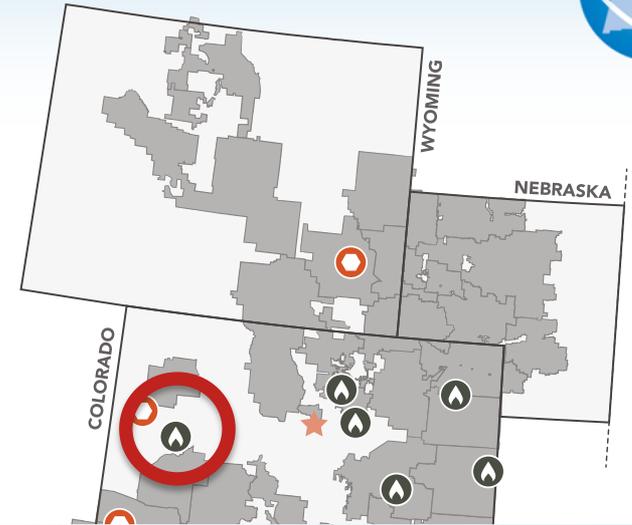
- Eastern Colorado
 - Burlington
- Online: 1977
- 100 MW
 - 2 x 50 MW CTs
 - Fuel: No. 2 Diesel
 - 100% Tri-State Owned



Rifle Station



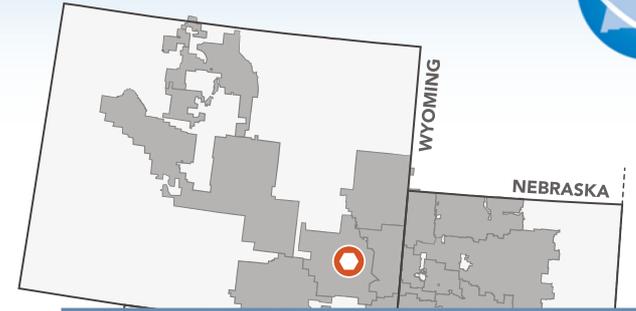
- Western Colorado
 - Rifle
- Online: 1986
- 85 MW
- Natural Gas Combined Cycle
 - 3 x 15 MW CTs
 - 1 x 40 MW ST
 - 100% Tri-State Owned



Pyramid Station



- Southwestern New Mexico
 - Lordsburg
- Online: 2003
- 160 MW
 - 4 x 40 MW CTs
 - 100% Tri-State Owned
- Dual fuel capability
 - Natural gas
 - Fuel oil





Power Purchases



- Colorado River Storage Projects (CRSP)
 - Facilities located in the Colorado River Basin
 - Power deliveries to Tri-State in CO and NM
 - 247 MW winter allocation (Oct – Mar)
 - 231 MW summer allocation (Apr – Sep)
 - New contract signed in 2018 extending CRSP deliveries through 2057



- Loveland Area Projects (LAP)
 - Facilities located in the Missouri River Basin
 - Power deliveries to Tri-State in NE, WY and CO
 - 285 MW winter allocation
 - 353 MW summer allocation
 - New contract signed in 2015 extending LAP deliveries through 2054



- Two wholesale contracts with BEPC
 - Contract terms through 2050
 - Approx. 350 MW for Tri-State member system load in the Eastern Interconnection
 - Approx. 250 MW delivered to Colorado and Wyoming
 - For member loads in Western Interconnection
- Both contracts were restructured in 2017



Renewable Power Purchases



Kit Carson Wind

- Eastern Colorado
 - Near Burlington
- 51 MW PPA
 - Began operation in 2010
 - 20 year term
 - Expires 12/1/2030
- 34 GE wind turbines
 - 1.5 MW
- Developed by Duke Energy Renewables



Colorado Highlands Wind



- **Northeastern Colorado**
 - Near Fleming
- **91 MW PPA**
 - Began operation in 2012
 - 67 MW Phase 1: December 2012
 - 24 MW Phase 2: September 2013
 - 20 year term
 - Expires 12/31/2032
- **56 GE wind turbines**
 - 42 1.6MW
 - 14 1.7MW
- **Developed by Alliance Power and GE Energy Financial Services**



Carousel Wind



- Eastern Colorado
 - Near Burlington
- 150 MW PPA
 - Began operation in 2015
 - Commercial Operation in 2016
 - After completion of Burlington to Wray transmission line construction
 - 25 year term
 - Expires July 31, 2041
- 87 GE wind turbines
 - 81 1.715MW
 - 6 1.79 MW
- Developed by NextEra Energy Resources



Twin Buttes II Wind



- Southeastern Colorado
 - Near Lamar
- 75 MW PPA
 - Began operation in Dec. 2017
 - 25 year term
 - Expires December 31, 2042
- 36 Gamesa G114 wind turbines
 - 30 2.1MW
 - 6 2.0MW
- Developed by Avangrid Renewables



Cimarron Solar



- Northeastern New Mexico
 - Cimarron
- 30 MW PPA
 - Began operation in November 2010
 - 25 year PPA
 - Expires 12/1/2035
- Fixed array
- Thin film panels
- Developed by First Solar and acquired by Southern Company



San Isabel Solar



- Southern Colorado
 - Near Trinidad
- 30 MW PPA
 - Began operation in December 2016
 - 25 year PPA
 - Expires 12/31/2041
- Single axis tracking array
- Developed by juwi and acquired by PSEG



Alta Luna Solar



- Southwestern New Mexico
 - Deming
- 25 MW PPA
 - Began operation in January 2017
 - 25 year PPA
 - Expires 1/31/2042
- Single axis tracking array
- Developed by Turning Point Energy and acquired by DE Shaw Renewable Investments





Small Hydro PPAs

- Tri-County Water / Ridgway 8.0 MW
 - Terminates 9/30/2023
- Vallecito 5.6MW
 - Terminates 6/24/2024
- Mancos Water Conservancy .26 MW
 - Terminates 2/8/2035
- Williams Fork 3.5 MW
 - Terminates 12/31/2026
- Boulder Canyon, Orodell, Sunshine, Maxwell, Kohler 6.3 MW
 - Terminates 6/1/2028
- Garland Canal 2.9 MW
 - Terminates 12/31/2024



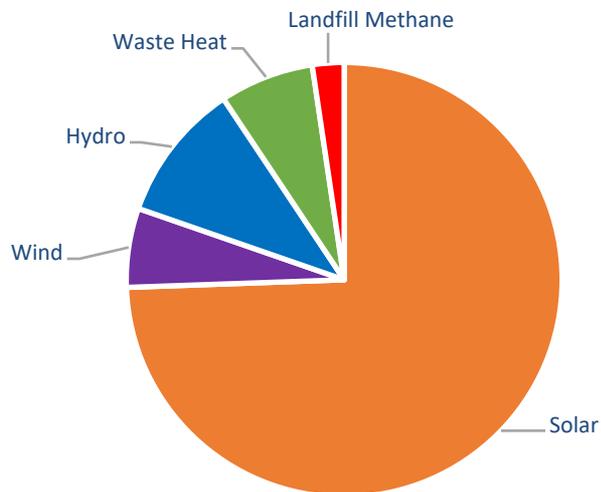
Member Generation



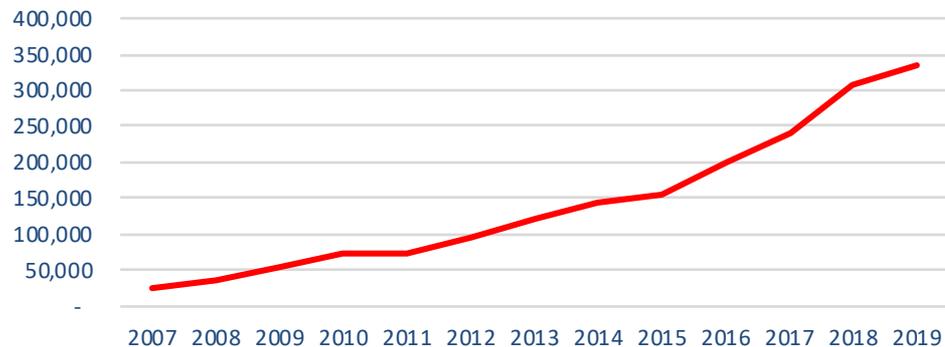
Operating or Under Development as of 12/31/2019

136 MW
65 Projects
21 Member Systems

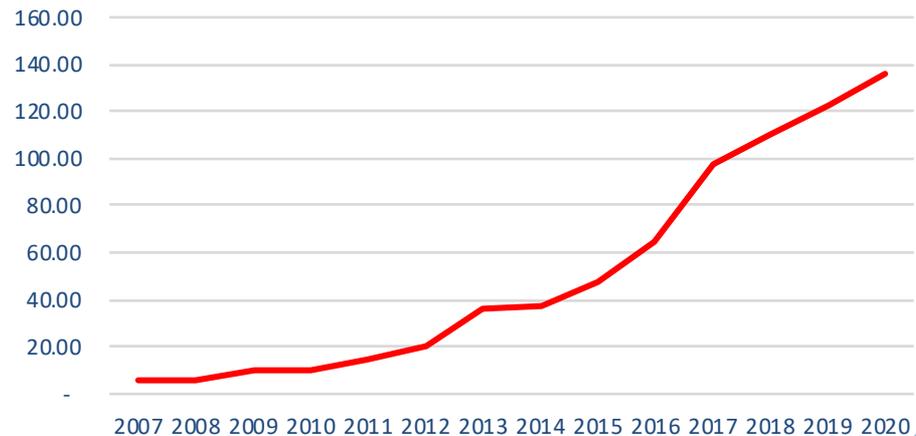
Projects By Technology



Actual Annual Energy Production (MWh)



Nameplate Capacity under Contract (MW)



Renewable Additions ~1GW:

Results of 2018 and 2019 RFPs



Year	Resource	Technology	MW
2020	Crossing Trails	Wind	104
2021	Niyol	Wind	200
2023	Spanish Peaks	Solar	100
2023	Escalante	Solar	200
2023	Spanish Peaks II	Solar	40
2023	Coyote Gulch	Solar	120
2023	Dolores Canyon	Solar	110
2023	Axial Basin	Solar	145



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Resource Planning Process

Resource Planning Defined



- A plan to meet forecasted energy and demand obligations with existing resources, new resources, and/or market purchases while respecting environmental and transmission constraints in the most economical, reliable manner

Key Considerations



- Intermittency of Renewable Resources/Related Integration
- Imbalance Market entry – 2021
- Evolving technologies and related forecasting
- Production Tax Credit (PTC) for wind & Investment Tax Credit (ITC) for solar expiration
- Environmental Legislation Requirements
- Community impact of planning decisions



Key Assumptions

Assumptions



- Resource Planning Period
 - 2021 to 2040
- Resource Acquisition Period
 - 2021 to 2030
- Planning Reserve Margin (PRM) 15%*

*A loss of load probability study is currently being conducted to validate current PRM assumptions

Capacity Credit



Technology	Capacity Credit
Thermal – Coal	100%
Thermal – Gas*	100%
Wind**	14%
Fixed Array Solar	8%
Single Axis Tracking Solar**	35%
Solar plus Batteries**	35% plus 100% for battery
Wind plus Batteries**	35% plus 100% for battery
Stand Alone Batteries	100%
Pumped Storage	100%

*For combustion turbines rating at relevant altitude applies

** An Effective Load Carrying Capability study is being conducted and will result in an update to solar and wind capacity credits.

Renewable Standards



- New Mexico Renewable Portfolio Standard
 - 40% Renewable by 2025
 - 50% Renewable by 2030
 - Zero Carbon Target by 2050
- Colorado Renewable Energy Standard
 - 20% Renewable by 2020

GHG Reductions



- CO HB 19-1261 Statewide GHG Reduction Goals
 - 26% reduced from 2005 Baseline by 2025
 - 50% reduced from 2005 Baseline by 2030
 - 90% reduced from 2005 Baseline by 2050
 - Additional requirements for utilities
 - Rules are under development by the Air Quality Control Commission and are expected to be finalized by end of 2020



Modeling



Modeling Process

Input: Loads, Fuel Prices, Power Prices, Contract Profiles & Unit Characteristics

ABB Capacity Expansion

Portfolio Planning Model

Optimal Expansion Plan

ABB Portfolio Optimizer

Hourly Production Cost Model

Generation & Market Transactions

Financial Forecasts

Apply Accounting Standards & Financial Goals

Rate Forecast
PVRR

Present Value Revenue Requirement

Key Inputs & Timing



Data Item	Monthly	1xYR	2xYR	Ad Hoc
Short Term Load Forecast	X			
Long Term Load Forecast		X		
Distributed Generation Forecast	X	X		X
Commodity Prices – Electric, Gas	X		X	
Coal Prices		X		X
Emission & Water Limits		X		X
Unit Characteristics	X	X		X
PPAs Profiles and Characteristics				X
Transmission Rights & ATC		X		X

Expansion Plan Potential Resources



- Gas Generators
 - Reciprocating
 - Aeroderivative
 - Combined Cycle
 - Combustion Turbine
- Utility Scale Wind & Solar
- Utility Scale Wind & Solar combined with Batteries
- Stand Alone Batteries
- Pumped Storage
- Demand Side Management

Inputs for Expansion Planning



Load Forecasts

Commodity Pricing

PPA Profiles &
Characteristics

Transmission

Unit Characteristics

Member Generation
Forecasts

By Technology for Expansion Plan Units

- PPA Projected Costs including Integration
- Build Costs
 - Capital
 - Fixed O&M
 - Variable O&M
- Capacity Credit Value

For Existing Units

- Decommissioning Costs
- Fixed Costs
- Retirement Date
- Capacity Credit Value

Key Outputs in Expansion Plan*



- Proposed Units
 - Technology Type
 - Installation Date
 - Size
- Total Expansion Plan Cost
 - Build costs & O&M Costs
 - PPA costs
- Annual Planning Reserve Margin

*Transmission Capex final numbers determined outside of ABB Capacity Expansion



■ OBJECTIVE:

- Determine the optimal output for each resource for every hour of the planning period:
 - Existing Resources
 - Expansion Plan Resources
 - PPAs
- Determine the Least Cost Dispatch within Operational Constraints

Inputs for Portfolio Optimizer



Load Forecasts

Commodity Pricing

PPA Profiles &
Characteristics

Transmission

Unit Characteristics

Member Generation
Forecasts

Expansion Plan Units

- For each unit
 - Technology
 - Size
 - Location
 - Timing
 - Characteristics

For Existing Units

- Retirement Impacts from Expansion Plans

Key Outputs of Portfolio Optimizer



- Hourly Dispatch
 - Existing Generation
 - New Generation
 - PPAs (Ex. WAPA Hydro)
 - Market Sales and Purchases
- Hourly Transmission Use
- Fuel Usage
- Hourly Costs
 - Generation – Variable O&M, Startup and Fuel Costs
 - PPA – Energy Cost

Scenarios



- To Analyze Various Factors, Scenario Analysis is an Accepted and Well Known Planning Method
- Typical Scenario Definition Includes an Integrated, Internally Consistent Forecast of:
 - Member Load Growth (High, Median, Low)
 - Gas and Market Power Prices

Scenarios



- Each Scenario is Analyzed and the Results Detail the Following:
 - Economic Result - Present Value of Revenue Requirements (PVRR)
 - Emissions
 - Water Use
 - Generation Requirements – Retirements and Additions

Scenarios



- Potential # of Scenarios 10 to 12
 - June to Sept – Base Case and Alternate Scenarios
- Potential Scenario Types
 - Carbon Reduction
 - Sensitivities around Load Forecast:
 - Demand Side Management/Energy Efficiency
 - Beneficial Electrification
 - Partial Requirements
 - Market Sensitivities – High/Low Gas Prices
 - Public Input

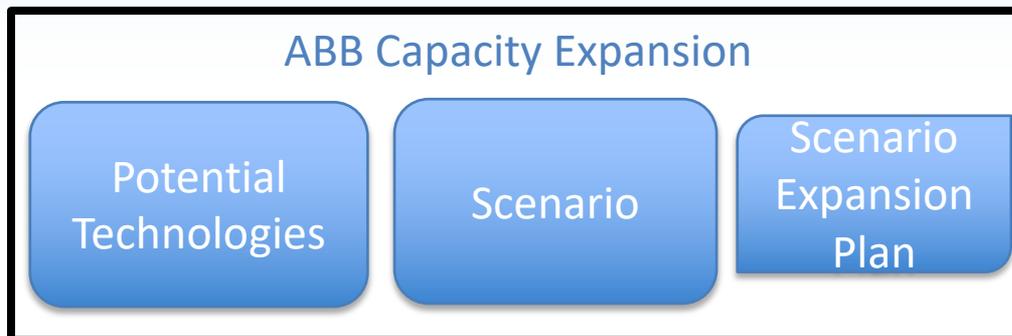


Process Flow – IRP

Repeated Process for Multiple Scenarios:

- Reference Case
- Sensitivities
 - Load Growth
 - Gas Pricing
- Renewable Levels
- Carbon Reduction

1 Scenario = Many Weeks of Effort





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Next Steps

Next Steps



- Public Meeting Notice will be posted at:
 - <https://www.tristate.coop/stakeholder-outreach>
- Email questions and comments to:
 - resourceplanning@tristategt.org



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