TEP’s Supply-Side Resource Portfolio

JEFF YOCKEY
DIRECTOR, RESOURCE PLANNING
Corporate Overview

- Investor Owned
- Vertically Integrated
- Jurisdictional Regulation
  - Arizona Corporation Commission (ACC)
  - Federal Energy Regulatory Commission (FERC)
Service Territories and Resources

- 424,000 customers
- 1,500 employees
- Avg. years of service: 11

- 162,000 gas customers
- 95,000 electric customers
- 350 employees
- Avg. years of service: 11
Electrically Isolated Until 1942
Connecting to the Western Grid

TEP and APS Connect Systems in 1964

Connecting to Coal 1960s-1980s
### Springerville Generating Station

- **Resource:** Springerville 1
- **Unit Capacity (MW):** 387
- **Ownership Percentage:** 100%
- **TEP Capacity (MW):** 387
- **Year In Service:** 1985
- **Retirement Date:** Dec-2045
- **Fuel Supply:** El Segundo (New Mexico), Dec. 2020
- **Environmental Controls:** SDA, LNB SOFA, FF, ACI, CaBR₂

- **Resource:** Springerville 2
- **Unit Capacity (MW):** 406
- **Ownership Percentage:** 100%
- **TEP Capacity (MW):** 406
- **Year In Service:** 1990
- **Retirement Date:** Dec-2050
- **Fuel Supply:** El Segundo (New Mexico), Dec. 2020
- **Environmental Controls:** SDA, LNB SOFA, FF, ACI, CaBR₂

### Four Corners Power Plant

- **Resource:** Four Corners 4 (TEP)
- **Unit Capacity (MW):** 785
- **Ownership Percentage:** 7%
- **TEP Capacity (MW):** 55
- **Year In Service:** 1969
- **Retirement Date:** Jul-2031
- **Fuel Supply:** Navajo Mine (New Mexico), Jul. 2031
- **Environmental Controls:** WFGD, SCR, FF, WFGD, FF, CaBR₂

- **Resource:** Four Corners 5 (TEP)
- **Unit Capacity (MW):** 785
- **Ownership Percentage:** 7%
- **TEP Capacity (MW):** 55
- **Year In Service:** 1970
- **Retirement Date:** Jul-2031
- **Fuel Supply:** Navajo Mine (New Mexico), Jul. 2031
- **Environmental Controls:** WFGD, SCR, FF, WFGD, FF, CaBR₂

### San Juan Generating Station

- **Resource:** San Juan 1 (TEP)
- **Unit Capacity (MW):** 340
- **Ownership Percentage:** 50%
- **TEP Capacity (MW):** 170
- **Year In Service:** 1976
- **Retirement Date:** Jun-2022
- **Fuel Supply:** San Juan Mine (New Mexico)
- **Environmental Controls:** WFGD, SNCR, FF, ACI
H. Wilson Sundt Generating Station

- Diverse mix of technologies
  - Steam turbines
    - Two units to retire in 2020
  - Combustion turbines
    - Black start capable
  - Landfill gas
  - Solar thermal
- Direct connection to Kinder Morgan pipeline
- “Type 2” non-irrigation water use rights

<table>
<thead>
<tr>
<th>Resource- Counterparty</th>
<th>TEP Capacity (MW)</th>
<th>Year In Service</th>
<th>Retirement Date</th>
<th>Fuel(s)</th>
<th>NOx Controls</th>
</tr>
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<tbody>
<tr>
<td>H Wilson Sundt ST3</td>
<td>104</td>
<td>1962</td>
<td>Dec-2032</td>
<td>Natural Gas &amp; Fuel Oil</td>
<td>LNB</td>
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<td>H Wilson Sundt ST4</td>
<td>156</td>
<td>1967</td>
<td>Dec-2048</td>
<td>Natural Gas</td>
<td>LNB SOFA</td>
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<td>H Wilson Sundt CT1</td>
<td>25</td>
<td>1972</td>
<td>Dec-2027</td>
<td>Natural Gas &amp; Fuel Oil</td>
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<tr>
<td>H Wilson Sundt CT2</td>
<td>25</td>
<td>1972</td>
<td>Dec-2027</td>
<td>Natural Gas &amp; Fuel Oil</td>
<td>None</td>
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</table>
### Natural Gas Combustion Turbines

#### North Loop

<table>
<thead>
<tr>
<th>Resource- Counterparty</th>
<th>TEP Capacity (MW)</th>
<th>Year In Service</th>
<th>Retirement Date</th>
<th>Fuel(s)</th>
<th>NOx Controls</th>
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<tbody>
<tr>
<td>DeMoss Petrie</td>
<td>75</td>
<td>2001</td>
<td>Dec-2046</td>
<td>Natural Gas</td>
<td>DLN1</td>
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<td>North Loop 1</td>
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<td>1972</td>
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<td>None</td>
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<td>North Loop 2</td>
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<td>1972</td>
<td>Dec-2027</td>
<td>Natural Gas &amp; Fuel Oil</td>
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<td>North Loop 3</td>
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<td>1972</td>
<td>Dec-2027</td>
<td>Natural Gas &amp; Fuel Oil</td>
<td>None</td>
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<td>North Loop 4</td>
<td>21</td>
<td>2001</td>
<td>Dec-2046</td>
<td>Natural Gas</td>
<td>Water injection</td>
</tr>
</tbody>
</table>

| **Note:** DLN1 - Dry Low NOx Burner | NA – Not Applicable |
### Natural Gas Combined Cycle

<table>
<thead>
<tr>
<th>Resource</th>
<th>Unit Capacity (MW)</th>
<th>Ownership Percentage</th>
<th>TEP Capacity (MW)</th>
<th>Year In Service</th>
<th>Retirement Date</th>
<th>Fuel Supply</th>
<th>NOx Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gila River Unit 2*</td>
<td>550</td>
<td>100%</td>
<td>550</td>
<td>2001</td>
<td>Dec-2048</td>
<td>Kinder Morgan/Transwestern</td>
<td>SCR</td>
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<tr>
<td>Gila River Unit 3</td>
<td>550</td>
<td>75%</td>
<td>413</td>
<td>2001</td>
<td>Dec-2048</td>
<td>Kinder Morgan/Transwestern</td>
<td>SCR</td>
</tr>
<tr>
<td>Luna Energy Facility</td>
<td>555</td>
<td>33%</td>
<td>185</td>
<td>2006</td>
<td>Dec-2051</td>
<td>Kinder Morgan</td>
<td>SCR</td>
</tr>
</tbody>
</table>

*TEP intends to purchase the unit before the end of this year

| SCR – Selective Catalytic Reduction |
## Renewable Resources

<table>
<thead>
<tr>
<th>ZERO Emissions</th>
<th>Utility-Scale Fixed Solar PV</th>
<th>Utility-Scale Tracking Solar PV</th>
<th>Utility-Scale Wind</th>
<th>Rooftop Solar PV</th>
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</thead>
<tbody>
<tr>
<td>Capacity Factor</td>
<td>23%</td>
<td>31%</td>
<td>27%</td>
<td>23%</td>
</tr>
<tr>
<td>Net Peak Coincidence (individual resources)</td>
<td>34% (declining)</td>
<td>63% (declining)</td>
<td>23%</td>
<td>34% (declining)</td>
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<tr>
<td>2019 Capacity MW_{AC}</td>
<td>46</td>
<td>150</td>
<td>80</td>
<td>240</td>
</tr>
</tbody>
</table>
Preliminary Loads and Resources
2020

MW

2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035
0 500 1000 1500 2000 2500 3000 3500 4000
Coal Resources
Natural Gas-RICE
Firm Capacity Purchases
Energy Efficiency Programs
Natural Gas-Steam
Natural Gas-Combined Cycle
Natural Gas-Combustion Turbines
Net Retail, Firm & Reserves
Utility Scale Renewables/Storage
Distributed Generation
Demand Response
Daily Dispatch Profiles

Example Summer Day Dispatch

Example Winter Day Dispatch
New Resources

- Oso Grande Wind
- Wilmot Energy Center Solar and Battery Storage
- Borderlands Wind
- Reciprocating Internal Combustion Engines at H. Wilson Sundt Generating Station
- Gila River Power Station Unit 2
New Renewable Resources: Wilmot and Borderlands

Wilmot Solar Energy Center
- 100 MW single-axis tracking Solar PV
- 30 MW 4-hour battery
- Interconnects to our local 138kV system
- New substation; support future development
- Operational by end of 2020

Borderlands Wind
- 99 MW in Catron County, NM
- 40 – 2.47 MW GE turbines
- Interconnects to the 345kV system near Springerville Generating Station
- Utilizes existing transmission
- Operational by end of 2020
New Renewable Resources: Oso Grande

- 250 MW of high-quality wind in southeast NM (capacity factor of 45%)
- Capital cost of $370M, or $1,500/kW
- Operational by end of 2020
- Qualifies for federal production tax credit
  - Reduces levelized generation cost from 4.6 to 2.4 ¢/kWh
- Complements solar energy production

Existing Renewables (516 MW) w/ DG + New Renewables (449 MW) = Near Doubling of Capacity
TEP Renewable Energy Generation Profiles

- TEP renewable portfolio without Oso Grande
- TEP renewable portfolio with Oso Grande
- Oso Grande
New Thermal Resources: Sundt Energy Modernization Project

- 10 reciprocating internal combustion engines (RICEs) at Sundt Generating Station
- 182 MW of fast-start, fast-ramping capability
- Cost-effective, reliable means of integrating high levels of renewable energy
- Capital cost of $160M, or $850/kW
- Operational by 1st quarter of 2020
- Replacing 162 MW of aging generation (circa 1960)
RICE System Benefits

Renewable Integration

Reliability Must Run Benefit
RICE Emissions Benefits
Energy Imbalance Market

- EIM Benefits Analysis by E3, November 2018
  - Update to study performed in 2016
  - Since then additional utilities have committed to EIM
  - Studied 2022

- Results
  - TEP benefits as a seller and a buyer
  - Total expected base benefits of $13M per year

- TEP to begin participating April 2022
### TEP’s Resource Transition

**Projected Targets**

Renewable Energy as Percentage of Retail Sales (Utility Scale + Rooftop Solar)

<table>
<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>Type</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>Battery Storage</td>
<td></td>
<td>20 MW</td>
</tr>
<tr>
<td>2018</td>
<td>Gila River Unit 2</td>
<td>Utility Scale</td>
<td>550 MW</td>
</tr>
<tr>
<td>2019</td>
<td>Community Solar</td>
<td></td>
<td>5 MW</td>
</tr>
<tr>
<td>2020</td>
<td>Sundt Units 1-2</td>
<td>Solar DG</td>
<td>160 MW</td>
</tr>
<tr>
<td></td>
<td>Reciprocating Engines</td>
<td></td>
<td>182 MW</td>
</tr>
<tr>
<td></td>
<td>Borderlands</td>
<td></td>
<td>99 MW</td>
</tr>
<tr>
<td></td>
<td>Oso Grande</td>
<td></td>
<td>247 MW</td>
</tr>
<tr>
<td>2021</td>
<td>Future Renewables and Energy Storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>San Juan Unit 1</td>
<td></td>
<td>170 MW</td>
</tr>
<tr>
<td>2019</td>
<td>Sundt Unit 4</td>
<td></td>
<td>130 MW</td>
</tr>
<tr>
<td>2017</td>
<td>San Juan Unit 2</td>
<td></td>
<td>170 MW</td>
</tr>
<tr>
<td>2019</td>
<td>Navajo Units 1-3</td>
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<td>168 MW</td>
</tr>
<tr>
<td>2020</td>
<td>Wilmot Solar Solar</td>
<td></td>
<td>100 MW</td>
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<tr>
<td></td>
<td>Storage 30 MW</td>
<td></td>
<td></td>
</tr>
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<td>San Juan Unit 1</td>
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<td></td>
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<tr>
<td>2031</td>
<td>Four Corners Power Plant</td>
<td></td>
<td>-110 MW</td>
</tr>
</tbody>
</table>

**Future Renewables and Energy Storage**

- Utility Scale: 728 MW
- Solar DG: 1026 MW
- Total: 1754 MW

**2015 - 2031**

- **2015**: Sundt Unit 4 - 130 MW
- **2017**: San Juan Unit 2 - 170 MW
- **2019**: Navajo Units 1-3 - 168 MW
- **2020**: Wilmot Solar Solar 100 MW Storage 30 MW
- **June 2022**: San Juan Unit 1 - 170 MW
- **2031**: Four Corners Power Plant - 110 MW
TEP’s Decade of Resource Transition

- **2013**: 1541 MW Coal
  - Coal Resources, 84%
  - Natural Gas & Purchased Power, 3%
  - Renewables, 3%

- **2018**: 1241 MW Coal
  - Coal Resources, 60%
  - Natural Gas & Purchased Power, 27%
  - Renewables, 13%

- **2023**: 903 MW Coal
  - Coal Resources, 50%
  - Natural Gas & Purchased Power, 25%
  - Renewables, 25%

- **19% Reduction in Coal Capacity**: 300 MW
- **41% Reduction in Coal Capacity**: 638 MW
Overview of Gila River Unit 2

- Acquisition strategy developed in early 2016 in association with meeting compliance under the Clean Power Plan.
- TEP and Salt River Project partnered in effort to acquire the asset from a bankrupt merchant generator (\$500M Savings vs. New Build).
- Low turndown and fast ramping capabilities part of TEP’s near-term strategy to cost effectively integrate higher level of renewables.
- 50% reduction in CO$_2$ emissions versus the equivalent generation from coal.
- Key part of TEP’s CO$_2$ reduction strategy going forward.

Gila River Power Station – Unit 2

- 20-Year Tolling Power Purchase Agreement
- TEP has Purchase Option for \$300/kW
- **Operator:** Salt River Project
- **Location:** Gila Bend, Arizona
- **Unit Capacity:** 550 MW