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Regionalization and the Future of Transmission in the West
Customer Perspective: Changing Customer Loads
Customer Perspective: Changing Customer Loads

Patrick Lee
CEO PXiSE Energy Solutions
November 13, 2019
A Changing Grid Requires New Solutions

Advanced Controls + Energy Storage
Western Australia DERMS

- 8 1-MW natural gas-fueled generators
- 1-MW diesel-fueled generator
- 1 MW solar power generation
- 2 MW/1.25 MWh battery storage

Technical Objective
- Integrate hundreds of customer DERs with utility assets

Customer Motivations
- Decrease electricity generation costs and provide more sustainable electricity
- Provide reliability and stability to the grid across the utility’s vast territory
Customer Perspective: Changing Customer Loads
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Agency of Arizona
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Utility Perspective: Changing Load Profiles
APS OVERVIEW

Company
• Serving AZ since 1886
• AZ largest tax payer
  − $3.4B annual economic impact
• 34,646 square mile service territory

Customers
• 1.2 million (90% Residential)

Peak Demand
• ~7,500 MW
• Summer peaking

Generation and Energy Mix
• About 6,300 MW of owned Capacity
• Approaching 2000 MW of renewables on system
• Diverse energy mix is over 50% clean
SYSTEM LOAD SHAPE CHANGES

SUMMER DAY

Peak

System peak is moving later in the evening

NON-SUMMER DAY

Mid-day energy is plentiful

Previous low load periods

Steep ramp into peak

New low load periods
LOAD SHAPE CHANGES CREATE OPPORTUNITIES

Regional Market Participation

Energy Imbalance Market (EIM) has saved customers over $120M to date – discussions ongoing to move to Day Ahead format (EDAM)

New Customer Programs

Cool Rewards thermostat program & EV charging focused on low price periods. Sustainable Futures to meet customer energy objectives

Creative Solutions

Flexible Resources

Energy storage will discharge clean energy during system peak and may reduce some renewable curtailment

Rate Incentives

Incentivizes relieving strain on the system with rates that reflect system dynamics

Modern Rates

Microgirds

Energy Storage

EV Charging

Storage and Reserve Rewards

Cool Rewards

EIM/EDAM
• The Anschutz Corporation is a privately held diversified company.
• TAC has successfully developed a number of large infrastructure projects:
  • Railways (Southern Pacific)
  • National fiber optic networks (Qwest)
  • Entertainment venues (Anschutz Entertainment Group)
  • Oil and gas infrastructure
  • Pipelines and processing facilities

Southwestern holdings include:
  • LA Live
  • Staples Center
  • Microsoft Theater
  • JW Marriott, and Ritz-Carlton, Los Angeles CA
  • StubHub Center, Carson CA
  • Los Angeles Kings – NHL
  • Los Angeles Lakers - NBA
  • T-Mobile Arena
  • Utah Oil & Gas Assets
  • Death Valley Oasis
  • Grand Canyon Railway
• Highest-quality wind resources in the Western U.S. are in the Rocky Mountain Region in Wyoming
• We lack transmission to connect CA/AZ/NV to this resource
• Economic studies consistently show WY wind plus the cost of transmission provide a net benefit if added to California RPS portfolios

✓ Geographic diversity complements SW loads
✓ Provides strong night-time generation
✓ Reduced GHG emissions
✓ Fewer curtailments and exports
✓ Competitive price
✓ Net savings over other resource alternatives
✓ Facilitates the EIM regional energy exchange
TransWest Express Transmission Project

✓ Interregional **transmission expansion** adding grid capacity and resilience

✓ Environmental and economic **good neighbor**
  - Approved following highest level of federal environmental analysis
  - 1,000+ mitigation measures assure resource conservation, protection

✓ **Federal authorization complete;** local permitting and ROW complete by the end of 2019

✓ Provides the market access to highly reliable, cost-competitive, diverse, complementary renewable energy resources available in Wyoming and Utah
TWE Project
Nevada Substations

Only major connection between CA/AZ/NV and geographically diverse Wyoming wind resource areas

Offers access to important substations already delivering power to CA/AZ/NV through existing transmission

Increased transfer capacity facilitates EIM and facilitates a regional market
Changing Loads – Developer Perspective

Changing Load Profiles
▪ Net load (minus solar) is turning things upside down
▪ Demand-side innovations are changing loads
▪ Electric vehicles & building electrification will change shapes

Changing Customer Profiles
▪ The rise of the corporate buyer
▪ The customer who cares where his power comes from
▪ The customer who generates her own power

Developer Response
▪ Develop in resource areas that compliment these changing profiles
▪ Develop transmission that accesses those areas and promotes intra-regional exchange of energy
▪ Develop new products like storage and shaped products
▪ Offer creative structures that help customers achieve objectives
We’re Building the Future

Jerome Davis, Regional Vice President, Xcel Energy—Colorado
What’s changing?
(What isn’t!)

Our customers. Our communities. Our investors. Technology. The market. Our ability to form partnerships and explore collaboration to get things done.
More choices, more services, more options to customize your experience, more ways to save, for everyone from the smallest home to the biggest manufacturer.
Xcel Energy’s carbon-free vision

- **2017**: 38% REDUCTION
- **2030**: 80% REDUCTION
- **2050**: 100% REDUCTION
Achieving the carbon-free vision

Shared objectives
- Protect affordability, reliability
- Reduce carbon
- Advance technology

Plans already underway
- Coal transition
- Economic renewables (Steel for Fuel)
- Energy storage deployment
- Choices for customers

Future initiatives
- Carbon-free 24/7 resources
- Flexible demand
- Long-duration storage
- Strategic electrification
- Financial and regulatory policy support

Encourage and reward investment in efforts that achieve the greatest carbon reductions at the lowest cost
Let’s build the future together!

Jerome.Davis@xcelenergy.com
SRP Generation Resources

• SRP meets retail load with a combination of local, state, and interstate resources

• Topography, land use, infrastructure, fuel availability and system needs contribute to the economic placement of resources

• Solar is currently the most economic renewable resource to meet Valley energy needs
Meeting Long Term Demand

Peak Demand & Capacity (MW)

- Load Requirement
- New Generation Needs Due To Load Growth
- Future Resources in Development
- Existing Resources

- Natural Gas
- Coal
- Renewables
- Nuclear

FY20 FY21 FY22 FY23 FY24 FY25 FY26 FY27 FY28 FY29 FY30

AEC SW Energy Conference | A. Bond-Simpson | November 13, 2019
SRP’s Resource Strategy
Stakeholder/ Customer driven

- Further reduction in coal generation; address implications for employees and communities
- Grow renewables portfolio to reduce CO₂ intensity and manage costs; expand opportunities for customer dedicated projects
- Develop and promote new customer-side demand management programs, focusing on those with peak demand reduction benefits
- Preserve option for new nuclear generation in mid-to late-2030’s with focus on small modular technology
- Develop flexible natural-gas generation options to meet peak demand and integrate renewables
- Seek cost effective battery alternatives before making major commitments to new gas generation
- Expand participation in regional transmission markets
- Pursue pilot projects and research and development efforts for innovative applications of new power generation, load management, energy storage, and electrification
## SRP’s Low-Carbon Resource Path

<table>
<thead>
<tr>
<th>Year</th>
<th>Major features</th>
<th>Reductions from FY05 (%)</th>
</tr>
</thead>
</table>
| 2005 Baseline | • 1,429 lbs/MWh (Intensity - actual)  
• 38.1 billion lbs (Mass - actual) | -- |
| Fiscal Year 2021 Projection (post NGS) | • 870 lbs/MWh (2021 intensity projection)  
• 27.8 billion lbs (2021 Mass – estimate) | ~ 39% Intensity  
~ 27% Mass |
| 2035 Goal: Transform with Solar, Storage and Gas | • 550 lbs/MWh (2035 Intensity Goal)  
• 21.9 billion lbs (2035 Mass estimate)  
• Substantial coal reductions to ~ 400 MW equivalent  
• 1,000 MW by 2025 Solar Plan  
• Add peaking (gas, solar + storage) mid-2020s  
• Additional solar & storage (2025-2035) | ~ 62% Intensity  
~ 42% Mass |
| 2050 Goal | • 143 lbs/MWh (2050 Intensity Goal)  
• 6.6 billion lbs (2050 Mass Estimate) | ~ 90% Intensity  
~ 83% Mass |

*Projected values from FP20 forecast*
Program Goals

- Collaborate with commercial customers to reduce carbon emissions and meet respective sustainability objectives
- Offer commercial customers a cost-effective, direct method to increase the renewable portion of their energy profile
- Offer a new way to share the benefits of large-scale renewable resources with SRP customers
Utility Perspective:
Changing Load Profiles
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Gary Gold
Office of U.S. Senator Kyrsten Sinema
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U.S. Bureau of Reclamation
Brenda Burman
Commissioner
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Energy Water Nexus & Drought Contingency Plan
Bureau of Reclamation

• Largest water provider in the 17 western States (479 dams and 348 reservoirs)
• Nation’s second largest producer of hydroelectric power (44 bkh)
• Develops authorized facilities to store and convey new water supplies
• Committed to find ways to balance and provide a mix of water resources needed in response to changing supply and demand
Implementing DCP in Arizona

- These are the reductions and contributions required under the ‘07 Guidelines and the LBDCP:
  - “tier zero” (1090’):
  - Tier 1 (1075’):
  - Tier 2 (1050’):
  - Tier 2b (1045’):
  - Tier 3 (1025’):
    192,000 acre-feet
    512,000 acre-feet
    592,000 acre-feet
    640,000 acre-feet
    720,000 acre-feet
CAP Priority Pools & Shortage

2007 Guidelines
- Other Excess
- Ag Pool
- NIA Priority
- Indian Priority
- M&I Priority

LBDCP
- Other Excess
- Ag Pool
- NIA Priority
- Indian Priority
- M&I Priority
## AZ LBDCP Mitigation Projected Program Summary

<table>
<thead>
<tr>
<th>Pool</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
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<tbody>
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<td><strong>Ag Pool</strong></td>
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<td>**</td>
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<tr>
<td>KAF Tier 1</td>
<td>105</td>
<td>105</td>
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<tr>
<td>KAF Tier 1</td>
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<td>105</td>
<td>**</td>
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<tr>
<td>70 KAF Tier 2a/2b</td>
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<td>Groundwater Infrastructure Program</td>
<td>70 KAF / Yr</td>
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<td></td>
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<td><strong>NIA Pool</strong></td>
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<tr>
<td>Tier 1/2a/2b</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>75%*</td>
<td>75%*</td>
<td>50%*</td>
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<td>Tier 1/2a/2b</td>
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<td>Tier 1/2a/2b</td>
<td>Tier 1/2a/2b</td>
<td>Tier 1/2a/2b</td>
<td>2026 or Tier 3</td>
</tr>
</tbody>
</table>

* Until no supplies

*No CAP Wet Water Mitigation*
The loss of CAP water would result in an approximate 12% increase in ED3’s energy requirements.
Strategic Asset Management Plan

April, 2019 CAP Strategic Asset Management Plan
SANTA CRUZ ACTIVE MANAGEMENT AREA
WATER STORAGE STUDY
Eloy and Maricopa-Stanfield Basin Study

Developing strategies to meet future water demands

Supply and Demand Analysis

The EMS Basin Study will first assess the current quantity, location, and timing of current water supply including:

- Central Arizona Project (CAP) water
- Surface water
- Recycled water
- Stormwater
- Groundwater
- Tribal
- Other uses

and demands including:

- Municipal
- Industrial
- Agricultural

The second step assess the future supply and demands to determine any imbalances using the Central Arizona Project’s Service Area Model (CAP: SAM).

CAP: SAM

Tool for projecting supply and demand in CAP’s three county service area.

- Accounts for complex legal and physical characteristics of users and supplies
- Designed to easily generate “what-if” scenarios

What is the Eloy and Maricopa-Stanfield Basin Study?

Three year, $1,360,000 partnership between Reclamation and the Pinal Partnership to:

- Project supply & demand imbalances (due to climate and other factors), now through 2060
- Evaluate existing and proposed water infrastructure
- Develop and investigate adaptation strategies (structural and non-structural)
- Perform trade-off analysis

Eloy and Maricopa-Stanfield Basins

- Eloy and Maricopa-Stanfield Basin Study area includes two of the five sub-basins within the Pinal AMA

- Pinal AMA has a statutory management goal to preserve existing agricultural economies for as long as feasible, while considering the need to preserve groundwater for future non-irrigation uses

- Agriculture and Agribusiness contribute $2.3 billion to Pinal County service area.

- Significant population growth in the near future

- Potential for water demand to outpace supply

- Colorado River water shortage will cause imminent reductions in surface water and CAP Agricultural Settlement Pool

- Increase in groundwater pumping to make up for loss of surface water supply may lead to an increase potential for land subsidence

Planning for Alternatives

Although the EMS Basin Study is a technical assessment and will not offer policy recommendations or commitments, the development of adaptation strategies to address water supply vulnerabilities is a critical outcome of the study. As these findings could incentivize future adaptation efforts, community input will be strongly sought in this stage of the Basin Study, so as to encourage a wide array of structural and non-structural water management alternatives.

Stay Informed, Get Involved

Central Arizona Canal, north of Florence on AZ-74

Bureau of Reclamation

Valles Drive
Phoenix Area Office

(623) 733-5600

www.BureauReclamation.gov

Stay Informed, Get Involved

Eloy and Maricopa-Stanfield Basin Study

0 2 4 6 8 10 Miles
Water Supply/Demand Imbalance in the Face of Climate Change: How will we prepare?

An Overview of the Lower Santa Cruz River Basin Study
Recharge

Xeriscape

Water Treatment

Wetlands

Irrigation Efficiencies
WaterSMART Program
Energy Water Nexus & Drought Contingency Plan
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Agency of Arizona
Tribal Energy Issues
Tribal Communities Meeting Energy Needs

Southwest Energy Conference
November 13, 2019

Margie Schaff
Margaret Schaff & Associates, LLC
margieschaff@comcast.net 303-443-0182
How are Tribes Involved in the Energy Industry?

- Customers of Energy Companies
- Natural Resource Owners, Developers and Producers
- Power Generation (Small/Large; Fossil Fuels/Renewable)
- Pipelines & Transmission
- Tribal Utilities
- Tribes as Regulators
Tribes as Consumers

- Tribal Sovereignty
- Jurisdiction & Regulation in Indian Country
- Energy Codes and Commissions
- Energy Efficiency
- Climate Resilience
- Microgrids

Tribes as Energy Resource Owners

- Water
- Oil and Gas
- Coal
- Land
- Forestry
- Others!
Some Example Tribal Solar Projects in the SW

- Jicarilla Apache - (Northern NM) Public Service Co of New Mexico - 50 MW solar and 20MW storage
- Moapa Band of Paiutes (Southern Nevada) 250MW to be supplied to LADWP
- Pechanga Band of Luiseno Indians Solar Parking Structure - 2 MW
- Soboba 2 MW Community Solar
- Navajo Tribal Utility Authority 55MW
Example Tribal Utility Websites

- http://www.umpquaindianutility.com/
- https://www.yakamapower.com/
- http://missionvalleypower.org/
- http://www.ahamacav.com/
- http://www.toua.net/
- http://www.gricua.net/
- http://www.crit-nsn.gov/critutilities/
- http://www.hualapaiutility.org/
- http://sdutilities.com/
- http://ctua.net/index.html
Other Example Tribal Utilities

- San Pasqual Band of Mission Indians (CA) - Solar/Storage/Liquid Propane Microgrid
- Big Pine Paiute Tribe of the Owens Valley
- Blue Lake Rancheria - Microgrid collaboration with Humboldt State University’s Schatz Energy Research Center, Siemens, Idaho National Labs
  - 500 kw solar, 950 kWh Tesla Batteries, Siemens Spectrum Power Microgrid Management System
  - Funded with $5m California Energy Commission Electric Program Investment Charge grant

Photo: Courtesy Blue Lake Rancheria
Tribes as Regulators

- **Tribal Sovereignty!** This means we are governments and can pass laws and regulate utilities and energy industries acting on Reservations.

- States have very limited jurisdiction on Indian reservations
  - Where specifically allowed by federal or tribal law.
  - Provides significant flexibility for utilities and tribes to work together without consideration of state law, state public utility commissions, or utility state approved tariffs.
  - Tribes can pass laws, regulations policies and procedures to address utility issues when necessary.

Numerous examples!
Tribal Renewable Power Program
Development and Overview

Dr. Karin Wadsack
Southwest Energy Conference - November 2019
Diversify Tribal Revenue Streams
Create an inclusive transition to a clean Energy Economy
Enhance the exercise of tribal sovereignty
Catalyze diverse investment in Tribal energy projects
Unlock the potential of clean energy in Indian Country
Program Development

Pilot Initiatives
NREL initiated pilot partnerships with Hopi Tribe & Navajo Nation

Listening Sessions
April 2019
3 listening sessions with 19 interested tribes

Grid-scale Analysis
Summer 2019
NREL created analytical model for evaluating potential projects

Partnerships Workshop
October 2019
NREL convened foundations to evaluate and make recommendations

Continuous Evaluation
Solicit feedback from Cohort members on program improvement
**Direct Benefits**

- Technical validation and resource maps
- Access to energy expertise
- Relationship building with offtakers, investors, and government
- Expanded peer professional group
- Internal policy clarification or development
- Educational opportunities

**Indirect Benefits**

- Economic and land-use planning collateral
- Environmental risk mitigation and identification
- Non-energy economic development opportunities
- Additional infrastructure
GILA RIVER INDIAN COMMUNITY UTILITY AUTHORITY (GRICUA)

PLANNING FOR THE FUTURE

NOVEMBER 13, 2019

LEONARD S. GOLD, GENERAL MANAGER
Who We Are…
Gila River Indian Community Utility Authority (GRICUA)
An Entity of the Gila River Indian Community (GRIC or Community)

- Reservation Area = 585 square miles (374,400 acres)
- GRICUA Service Area = 399 square miles (255,360 acres)
- On Reservation population ≈ 11,700
- Total enrollment ≈ 22,600
- 2,567 residential and 803 commercial customers

- Peak: 54 MW’s
- Energy Sales: 250,600,000 kWh’s
History
- 1998
  - GRICUA established by GRIC Council Resolution:
    - to retain ownership of new infrastructure,
    - to address reliability concerns and
    - for Self Governance.
- 1999
  - Plan of Operation approved
  - Initial service area defined as the Wild Horse Pass area
  - GRICUA begins providing service to customers in the Wild Horse Pass area
Mission

➢ To plan for, provide and furnish utility services
➢ To promote and encourage the conservation of electricity
➢ To improve the health and welfare of the residents of GRIC
➢ To acquire, construct, operate, maintain and expand utility services
➢ To promote economic development and employment opportunities
## GRICUA Statistics - Then and Now

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Employees</td>
<td>2</td>
<td>4</td>
<td>22</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Number of Customers</td>
<td>12</td>
<td>20</td>
<td>2,400</td>
<td>2,595</td>
<td>3,370</td>
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<tr>
<td>Billing Done By</td>
<td>GRICUA Staff</td>
<td>Consultant</td>
<td>GRICUA Staff</td>
<td>GRICUA Staff</td>
<td>GRICUA Staff</td>
</tr>
<tr>
<td>Substations (GRICUA &amp; SCIP)</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>8</td>
<td>9</td>
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<tr>
<td>Number of GRICUA Lineman</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Peak Load At Customer Meter - MW</td>
<td>3 MW</td>
<td>6 MW</td>
<td>26 MW</td>
<td>32 MW</td>
<td>54 MW</td>
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<tr>
<td>Energy Sold At Customer Meter - MWh</td>
<td>5,500 MWh</td>
<td>28,100 MWh</td>
<td>118,800 MWh</td>
<td>160,000 MWh</td>
<td>250,600 MWh</td>
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<tr>
<td>GRICUA Owned Facilities O&amp;M</td>
<td>SRP Contract</td>
<td>3rd Party Contract</td>
<td>GRICUA</td>
<td>GRICUA</td>
<td>GRICUA</td>
</tr>
<tr>
<td>SCIP Facilities O&amp;M – 638 Contract</td>
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<td>GRICUA</td>
<td>GRICUA</td>
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<tr>
<td>Respond To Outages</td>
<td>SRP Contract</td>
<td>3rd Party Contract</td>
<td>GRICUA Staff</td>
<td>GRICUA Staff</td>
<td>GRICUA Staff</td>
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<tr>
<td>GRICUA Provides Retail Service In SCIP Area</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>GRICUA Serves All SCIP Reservation Customers</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Purchase Power Contracts</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
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</tbody>
</table>

GRICUA’s service area overlaps with the service area of the San Carlos Irrigation Project (SCIP), an agency of the United States Depart of the Interior, Bureau of Indian Affairs. SCIP owns significant infrastructure within the Community. GRICUA and SCIP negotiated an agreement that allowed for:

- The orderly transition of SCIP on-Reservation customers to GRICUA.
- GRICUA to assume responsibility for O&M of SCIP On-Reservation electric system via a 638 Contract.
- GRICUA staff to respond to all SCIP On-Reservation customer outages.
GRICUA Electric System

- 10 – Substations
- 95 miles of 69 kV Transmission
- 425 miles of 12 kV Distribution
GRICUA Existing & Future Resources

GRICUA Energy Resources
Pre Utility Scale Solar Project

- Natural Gas: 79.48%
- Solar: 0.14%
- Hydro: 17.80%

GRICUA Energy Resources
Post Utility Scale Solar Project

- Natural Gas: 71.47%
- Solar: 8.16%
- Hydro: 17.80%
GRICUA’s Home Today

48 kW Covered Parking
Lifetime Energy = 409,220 KWh
Lifetime CO2 Saved = 311.1 tons
• John Lewis, Chairman

• Felicia Kaufman, Vice-Chairwoman

• Neil Banketewa, Treasurer

• Belinda Nelson, Secretary

• Pamela Thomas, Board Member
Questions?

Please contact
GRICUA General Manager Leonard Gold
at (520) 796-0600 or manager@gricua.net.

Gila River Indian Community Utility Authority
6636 W. Sundust Rd., Box 5091
Chandler, AZ 85226
www.gricua.net
Tribal Energy Issues
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Impact and Future of EIMs as Regional Markets
AN INTRODUCTION TO SOUTHWEST POWER POOL

CARL A. MONROE
OUR MISSION: HELPING OUR MEMBERS WORK TOGETHER TO KEEP THE LIGHTS ON ... TODAY AND IN THE FUTURE.
RTO, RC AND WEIS FOOTPRINTS
THE VALUE OF SPP

- Transmission planning, market administration, reliability coordination, and other services provide net benefits to SPP’s members in excess of more than $2.2 billion annually at a benefit-to-cost ratio of 14-to-1.

- A typical residential customer using 1,000 kWh saves $7.63/month because of the services SPP provides.
Impact and Future of EIMs as Regional Markets
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Conference Reception
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James Ogsbury
Western Governors’ Association
THE GOVERNORS

Gov. Doug Burgum, North Dakota
Gov. Kate Brown, Oregon
Gov. David Ige, Hawai‘i
We the People

insure domestic Tranquility, provide for the com
and our Posterity, Abolish and establish the

We the People

Section 1. All legislative Powers herein granted shall be vested in a Congress of the United States, and

Section 2. The House of Representatives shall be composed of Members chosen every second Year by the People of the several States, and shall be divided into as many Groups, each Group to consist of as many Members as they shall return from each State...
States are NOT stakeholders
SHARED STEWARDSHIP
CHEATGRASS
VEGETATION MANAGEMENT
POST-DISASTER RECOVERY
COLLABORATIVE CONSERVATION
REIMAGINING THE RURAL WEST
CONNECTIVITY
COMMUNITY
Contact Lauren DeNinno (ldeninno@westgov.org) with questions
Future of Energy Innovation
Arizona Thrives:
Working together to change the conversation

Photo: Tyler Bolken/Creative Commons
<table>
<thead>
<tr>
<th>Clean Air</th>
<th>Clean Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td>Clean Portfolio</td>
</tr>
<tr>
<td>EVs</td>
<td>Energy Efficiency /Built Environment</td>
</tr>
<tr>
<td>Reduce Auto Emissions</td>
<td>Industry &amp; Commercial Transportation</td>
</tr>
<tr>
<td>Increase Tree Cover/ Natural Solutions</td>
<td>Forest Health/ Biomass</td>
</tr>
</tbody>
</table>
Build a case for action, a framework and coalition that supports collaboration across sectors and engages Arizonans in creating a future where attaining cleaner air and access to reliable and affordable clean energy fuels a growing, prosperous economy.
Southwest Energy Conference
Decarbonization

Gerry DaRosa
Director, Energy Innovations
Decarbonization – How can we accomplish this?

Timely decarbonization requires that we rapidly expand deployment in 3 areas:

• Clean energy
• Energy efficiency / conservation
• Carbon capture / sequestration

Policy changes are critical to enable implementation.
Direct Air Capture

- Utilizes anionic exchange resin that adsorbs CO2 when dry and releases it when wet
- Passive introduction of CO2 to resin
- Tiburio design has few moving parts
Encapsulated Phase Change Material

Phase change material
- Stores energy – allowing peak shaving
- Exploits diurnal temperature swings – allowing reduction in electrical use
- By encapsulating into building material, the number of applications expand
2017 U.S. Greenhouse Gas Emissions by Gas (Percentages based on MMT CO2 Eq.)

- 81.6% CO₂
- 2.6% HFCs, PFCs, SF₆, and NF₃ Subtotal
- 10.2% CH₄
- 5.6% N₂O

2017 CO₂ Emissions from Fossil Fuel Combustion by Sector and Fuel Type (MMT CO2 Eq.)

- Relative Contribution by Fuel Type:
  - Petroleum: 29.5%
  - Coal: 44.7%
  - Natural Gas: 25.8%

- Sector Emissions:
  - U.S. Territories: 41 MMT CO₂ Eq.
  - Commercial: 233 MMT CO₂ Eq.
  - Residential: 294 MMT CO₂ Eq.
  - Industrial: 811 MMT CO₂ Eq.
  - Electric Power: 1,732 MMT CO₂ Eq.
  - Transportation: 1,801 MMT CO₂ Eq.

Future of Energy Innovation
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Utility Safety in the Wake of PG&E
Utility Safety in the Wake of PG&E
(b) An action may be brought by the Attorney General, the district attorney, or the local or state agency that issued the permit to excavate, for the enforcement of the civil penalty pursuant to this section in a civil action brought in the name of the people of the State of California.
Some cautionary points for those who have exposures to projects involving excavation(s).

Any operator of a service (gas, phone, electrical, etc.) or excavator who negligently violates this article is subject to a civil penalty in an amount not to exceed ten thousand dollars ($10,000).

Any operator or excavator who knowingly and willfully violates any of the provisions of the Safe Dig Act of 2016 is subject to a civil penalty in an amount not to exceed fifty thousand dollars ($50,000).

(o) “Operator” means any person, corporation, partnership, business trust, public agency, or other entity that owns, operates, or maintains a subsurface installation.

In addition, contractors that are found being negligent in following the guidelines established by Dig Safe Act 2016 can be subject to review by the State Contractors Licensing Board and have their license revoked.
Real World Consequences
Causes, Impacts and Costs
Strikes Involving Underground Utility Assets

• In the United States it is estimated there is a utility strike event 1,440 times per day
• Underground utility conflicts and relocations are the #1 cause of project delays for street and road construction
• 4,000,000 (est.) Utility Strikes Annually

Common Ground Alliance
Do you quantify the direct cost of utility strikes on a regular basis? 57% Respondents 43%
Do you track and quantify other costs (indirect and/or social) incurred during service strikes? 29% 300 71%
Do you have a separate program or project for determining and recording the location of underground utilities? 14% 300 86%
Does your field crews use a formal utility detection system? 14% 300 86%
Do you think underground utilities would still be damaged during excavation if your staff used a detection system? 0% 300 100%

Statistical Analysis
Strikes where pre-excavation scans were conducted and those cases showing that utility had been detected prior to the strike. 255 52%
Strikes where utility plans/drawings (as-builts) had been reviewed prior to excavation and those cases supporting the utilities were shown on the plans. 187 3,348 48%
Strikes where plans/drawings (as-builts) showed the utility and those cases respondents reporting that the location of the utility was inaccurately plotted. 89 84%

<table>
<thead>
<tr>
<th>Utility</th>
<th>Direct Cost</th>
<th>Indirect Cost</th>
<th>Total Cost</th>
<th>Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>$1,455,000,000</td>
<td>$509,250,000</td>
<td>$1,964,250,000</td>
<td>17%</td>
</tr>
<tr>
<td>Gas</td>
<td>$727,500,000</td>
<td>$254,625,000</td>
<td>$982,125,000</td>
<td>9%</td>
</tr>
<tr>
<td>Telecom</td>
<td>$600,000,000</td>
<td>$210,000,000</td>
<td>$810,000,000</td>
<td>7%</td>
</tr>
<tr>
<td>Fibre-Optic</td>
<td>$4,200,000,000</td>
<td>$1,470,000,000</td>
<td>$5,670,000,000</td>
<td>50%</td>
</tr>
<tr>
<td>Water</td>
<td>$1,470,000,000</td>
<td>$514,500,000</td>
<td>$1,984,500,000</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td>$8,452,500,000</td>
<td>$2,958,375,000</td>
<td>$11,410,875,000</td>
<td>100%</td>
</tr>
</tbody>
</table>
1980-2018 Year to Date U.S. Billion-Dollar Disaster Event Frequency (CPI-Adjusted)

Statistics valid as of April 6, 2018.
Utility Safety in the Wake of PG&E
Coffee & Networking Break

clear
Agency of Arizona
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Energy and National Security
Defense Critical Electric Infrastructure
DCEI

Doug Little
Senior Advisor
DOE – Office of Electricity (OE)
November 14, 2019
DCEI - Background

- **Fixing America’s Surface Transportation (FAST) Act (Public Law 114-94-Dec 4 2015):**
  - Defines DCEI: Any electric infrastructure that serves a facility
    - Critical to the defense of the United States
    - Vulnerable to a disruption of the supply of electric energy provided by an external provider
  - Requires Secretary of Energy, in consultation with Federal agencies and owners and operators of infrastructure, to designate DCEI

- **Identification of DCEI a key building block to leveraging interagency roles/resources/authorities to strengthen security and resilience of electric power grid**
Goals

➢ DOE led (DoD supported) effort to strengthen security and resilience of the electric power grid supporting Mission Assurance Priority Installations

➢ DHS led (DoD supported) effort to strengthen security and resilience of other commercial infrastructure sectors supporting Mission Assurance critical functions

➢ DOE/FERC technical assistance (and if appropriate programs) for enhancing energy resilience at these facilities
DCEI - External electrical supply hardening

➢ **Approach to DCEI**
  ➢ **Lead the DCEI effort:** Lead a team involving DoD, DHS, FERC, Utilities, other stakeholders as appropriate.
  ➢ **Assess Systems:** Review the Grid’s electric supply system.
    ➢ Conduct physical and cyber security assessments.
    ➢ Conduct critical interdependency analyses.
  ➢ **Offer technical advise/programmatic support to DoD:** Only if called for by DoD - Review electric system inside the DCEI facility to propose energy resilience upgrades to fulfill the Mission Assurance objective.
    ➢ Facilitate expectations - 3 to 5 days onsite generation Vs. Grid supply recovery time.
  ➢ **Define mechanisms:** For efficient and effective recovery from a physical or cyber event.
  ➢ **Prioritize near term and long term solutions:** Propose interim measures before the final improved design is implemented.
    ➢ What coordination and information exchange should be encouraged between Critical Infrastructure facilities and Utilities.
DCEI – Request for Data

➢ Information DOE anticipates requesting from Mission Assurance Priority Installations includes:
  ➢ DCEI - Critical electric load need in MWs.
  ➢ DCEI site voltage support need in MVARS.
  ➢ Single point of failure analysis – DOE assistance if required.

➢ Information requested by DOE
  ➢ May already be known / have been collected (!)
  ➢ Must be designated U/FOUO.
  ➢ DOE has designated this type of information with a Critical Electric Infrastructure Information (CEII) designation.
  ➢ CEII Designation
    ➢ Statutory designation and procedures for how shared information will be protected.
    ➢ Information will be stored in a secure manner.
    ➢ The information supplier can only view their submissions.
    ➢ Only a few pre-authorized persons can view all of the data.
DOE – Tactical & Strategic thinking

- **Protect it from getting out in the public space – Security (CEII**)**
  - Convert it into actionable information – Informed decisions
    1. Traditional & proven system hardening approaches.
    2. Integration of new age electrical supply sources.

**A. Battery Storage**
- Add battery storage to the on site DCEI renewables.
- Add battery storage just outside the fence connected to the grid.

**B. Micro Grids**
- Install micro-grids with electricity generation either inside or outside the DCEI fence line.
- Micro-grid connected either to the Utility supply lines that feed DCEI and/or directly to the DCEI mission assurance facilities.

**C. Cyber & other solutions**
- Cyber monitoring

**CEII – Critical Electric Infrastructure Information**
Operational Technology (OT) - Programmable systems or devices that interact with the physical environment (or manage devices that interact with the physical environment). These systems/devices detect or cause a direct change through the monitoring and/or control of devices, processes, and events. Examples include industrial control systems, building management systems, fire control systems, and physical access control mechanisms. (NIST SP 800-53 r5)
“The foundation of Air Force readiness and lethality is an integrated network of resilient installations that enable advanced-generation, multi-domain operations...”

- Infrastructure Investment Strategy (I2S), Dec 2018

An adversary could disrupt, degrade, or deny a mission by targeting the foundational assets that underpin the “system of systems.”
Energy and National Security
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