Subcommittee on Clean Coal and Carbon Management

The Future of the U.S. Coal Fleet: Retrofit, Retire, or Change the Business Model?

Monday, February 10, 2020
NARUC
Subcommittee on Clean Coal & Carbon Management

“The Future of the U.S. Coal Fleet: Retrofit, Retire, or Change the Business Model?”

Michelle Bloodworth
February 10, 2020
The Grid is Becoming Less Fuel Secure

Gas and Renewables Will Comprise Over 85% of U.S. Electric Generating Capacity by 2040 (GW)

Gas and Renewables: 1,237
Coal and Nuclear: 206

Coal Was Essential During Extreme Events

Polar Vortex
MISO was forced to follow emergency procedures to maintain grid operations on the coldest days in January 2019 because wind turbines were not able to produce electricity and a major gas compressor failed in Michigan.

Bomb Cyclone
During the worst of the storm in January 2018, the eastern U.S. would have suffered severe electricity shortages, likely leading to widespread blackouts, without the coal fleet.

Meeting incremental electricity demand during the Bomb Cyclone

- Coal: 63%
- Oil: 25%
- Other: 12%
Wind performance in SPP highlights the importance of having coal when it’s needed.

Wind output drops 88% (13,304 MW) within 22 hours.

Source: SPP.
New Sources Are More Expensive Than the Existing Coal Fleet

<table>
<thead>
<tr>
<th>Existing Nuclear</th>
<th>Existing NGCC</th>
<th>Existing Coal</th>
<th>New NGCC</th>
<th>New Solar</th>
<th>New Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>$33</td>
<td>$36</td>
<td>$41</td>
<td>$50</td>
<td>$88</td>
<td>$90</td>
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</tbody>
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Levelized Cost of Electricity for New and Existing Resources (National Average, $/MWh)
Farmington, New Mexico
Mayor Nate Duckett
Dr. Dave Goldtooth, Superintendent of Central Consolidated School District, New Mexico

www.Enchantenergy.com

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• The Navajo Nation is the largest reservation in the United States, covering more than 27,000 square miles and extending from Arizona into Utah and New Mexico - with a population of approximately 173,667 people. (The size of West Virginia).
Navajo Nation Poverty

- “The systemic poverty that pervades in Navajo Nation is nothing short of a national travesty.”

  o On the reservation, an estimated 32% of all homes lack electricity, 31% do not have indoor plumbing, and 38% lack running water. In America. In 2019.

  o The Navajo Nation is home to the poorest of the 10 largest Indian tribes. The poverty rate among the Navajo is three and a half times the national mean. The lowest median family income, $13,940. The Navajo also had the lowest per capita income, $4,788.

  o More than 75% of Navajo school age children live in poverty. 100% of Navajo seniors over age 85 live in poverty.

  o Approximately only ½ of Navajo students graduate high school.

*Vincent DeGennaro, Jr., internal medicine physician providing medical services to Navajo residents, https://www.kevlimd.com/blog/2013/05/the-systemic-poverty-in-navajo-nation-is-a-national-travesty.html
Navajo Workers

- Navajo workers support not just their immediate families, but support their extended families: Each salary derived from mine and plant salaries supports on average 20 to 30 people.

- Unemployment in Navajo Nation officially sits at 11% — nearly triple the U.S. average — but this number doesn’t account for the 56% of adult Navajos who aren’t considered to be part of the labor force at all. Taking those people into account, the unemployment rate is pushing 70%.

- A significant amount of the Nation’s coal production facilities are located on Native American reservations. Coal Mines and coal fired plants are the primary employers on Navajo and many other reservations. Shut-down of coal mines and plants will have a disproportionate impact on Native Americans.
1. Shut Down of Navajo Generating Station: 2019
2. Shut Down of Escalante Generating Station: 2020
3. Shut Down of San Juan Generating Station: 2023
4. Shut Down of Four Corners Generating Station: 2032
Based on independent third party review conducted by Four Corner's Economic Development:

- Loss of at least 1,500+ Direct workers including contractors, which figure does NOT include additional third-tier community job loss due to the reduction of worker-spending on goods and services within the local economy
- Loss of over $50 million annually in state and local tax revenues
- Loss of over $100 million in private wages
- Wipes out middle class in impoverished area
- Accelerated Erosion of Community and Families
- Loss of important educational property tax revenues
- Loss of Sizeable Corporate Charitable Donations to aid in social programs and educational scholarships
### Impacts to Navajo Nation & Central Consolidated School District

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<tr>
<th>Navajo Generating Station has already closed, Escalante is set to close in 2020, San Juan Generating Station is slated to close in 2022, and Four Corners Power Plant closure is set for 2032.</th>
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<td>CCSD is comprised of over 90% Navajo Children - with some of the worst poverty rates in the country</td>
</tr>
<tr>
<td>SJGS and Four Corners are 80% of the Property Tax Revenues for CCSD. These funds are critical to the education of CCSD children</td>
</tr>
</tbody>
</table>

About 80% of the Navajo Nation’s annual budget comes from revenues associated with extractive industry and supplies a majority of Navajo workers with good paying jobs, which has created a viable middle class.
To achieve a Win, Win, Win for the community the Team is conducting ongoing community listening tours and outreach to:

- Central Consolidated School District
- San Juan College
- Surrounding Communities
- Navajo Central and Local Governments
- Charitable Groups
- Economic Development Groups
- Environmental Advocates
Farmington Receives 100% Ownership of the Plant

- PNM and other owners of SJGS have agreed to exit the plant by 2022.

- This means that PNM and other exiting owners will regulatorily abandon the plant and that Farmington and Enchant will operate the plant as a non-utility merchant plant

- City of Farmington is the last remaining owner of the plant.
Farmington Partners with Enchant
Enchant Partners with Top-Tier Global Leaders
Mitsubishi Heavy Industries as the Technology provider,
and Kiewit Power Constructors Co. and Sargent & Lundy as the combined Engineering, Procurement and Construction Contractor
Enchant & Farmington Partner with Westmoreland on Coal Supply
Enchant Installs Carbon Capture Project and Operates SJGS
Transmission of electricity under PPA to customers; excess power to be traded at Palo Verde and other regional Hubs.
Operations

10% of CO₂ emissions return to the atmosphere (investigating technology for “Direct Air Capture” to use in agriculture)

638 MW of low emissions power available to back up renewables in region

90%+ of CO₂ emissions are captured, transported to depleted oil fields, and then permanently stored deep underground

San Juan Coal Mine

Captured CO₂ can also be injected and sequestered directly into injection sites and not used for EOR. The Project is working with NM Tech to evaluate this opportunity.
Close to a Century of Proof
Amine-based CO2 removal process has been used since the 1930s to treat natural gas streams. Thousands of Amine units are currently in operation in the US.

Essentially, amine is chemically attracted to and naturally binds to CO2, which allows the CO2 to be removed from emissions.
DOE Multi-Million Dollar Project Award and Los Alamos Study

- $2.69 Million DOE Grant
- Los Alamos Labs has published a report supporting the Project

"The study concluded that the technology, to be supplied by Mitsubishi Heavy Industries Engineering Ltd., is well proven and can capture up to 90% of carbon emissions at San Juan, which is Enchant Energy’s goal. The technology is already deployed at Petra Nova in Texas, which is the only commercial carbon capture plant currently operating in the U.S."

"Recent research by the Computational Earth Science group at Los Alamos National Laboratory has demonstrated that using CO2 for carbon capture, utilization and storage (CCUS) can be commercially viable under the recently revised 45Q tax regulation."

"Los Alamos National Laboratory"

New approach to extracting fossil fuels has benefits

August 30, 2018 • By Hari Viswanathan and Richard Middleton"
The Technology is Proven

- **Petra Nova**
  - Retrofit of 240 MW unit in multi-unit coal-fired power plant near Houston
  - Completed December 2018 after 30-month construction period on time and under budget
  - Capturing 1.4 million metric tons per year with 90% capture rate for over 2 years
  - Technology from Mitsubishi Heavy Industries
- **Boundary Dam**
  - Retrofit of 110 MW unit in multi-unit coal-fired power plant in Saskatchewan, Canada
  - Currently capturing 2,400 tons per day equivalent to 878,000 metric tons per year
  - Commissioned in October 2014
  - Technology from CanSolv division of Shell
- **San Juan Generating Station**
  - Retrofit 2 coal-fired units with combined 847 MW of electric generation capacity with CCUS equipment
  - Will capture 8 million metric tons per year starting in 2023 or earlier if possible
Federal Bi-Partisan and International Support:

Applying the Amine process to power plants was developed over ten-year period with support from Obama DOE, Canadian Department of Energy, and Trump DOE.
Carbon Capture Technology is Gaining Momentum: *large scale has global impact*

- Proportionate share of emissions globally - can be leader to create global change and support climate change
- Somebody needs to take carbon capture to the next level – why not us?
- Perfect situation for carbon capture retrofit with the greatest circumstances for success:
  - proximity of the Kinder Morgan CO2 Pipeline
  - $500 million in state-of-the-art pollution control equipment
  - economies associated with mine-mouth coal
  - ready CO2 market
  - regional need for reliable, economic baseload power
The Buzz About the Enchant/Farmington CCUS Project

“Carbon capture and storage (CCS) technologies must be part of the portfolio of solutions to decrease emissions from energy-intensive sectors and existing infrastructure, as well as remove CO2 already present in the atmosphere.”

“To achieve net-zero, mitigating emissions will not be sufficient. Removing CO2 from the atmosphere will be needed, and the deployment of negative emissions technologies is gaining traction.”

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“Capturing carbon dioxide from the fossil-fuel industry is key to slowing dangerous global warming, energy chiefs said in Davos, as climate concerns dominated the annual business forum more than ever before.”

“Oil and gas producers are under mounting pressure to help prevent a damaging rise in temperatures, and carbon capture is increasingly becoming investors as a tool to curb emissions.”
WIN: Community

SJGS: 1,500+ Jobs Stay in the Community
Preserve existing and promote new construction and permanent jobs

SJGS: 1.5 million+ annually in state and local tax revenues are preserved by using Carbon Capture to extend life of plant

SJGS: $1.3 Billion+ Federal and Private Investment of Carbon Capture construction.

International Pioneer:
New Mexico becomes a global leader in Carbon Capture and develops workforce to apply Carbon Capture Technology in other high CO2 emitting plants across the United States.
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WIN: Education

Tax Revenues Fund Schools

Protects the Well-Being of the Community

Additional Learning Opportunities and Career Paths
Together with Four Corners, SJGS and the Mine represent over 80% of the tax base for CCSD. PNM plans to close Four Corners in 2032.

Keeping the plant and mine open keeps important tax revenues in the community for the education of our children.
Additional Learning Opportunities and Career Paths

Installation of Carbon Capture Technology provides additional learning opportunities and career paths for our children so they can raise their families with family right here at home.
Protects the Well-Being of the Community

The Project Benefits the Community environmentally, economically and socially

The Project will include community stakeholders and will work with CCSD, Chapters and other educational and governmental entities

The Project will help avoid disruption to families and the education of our children
WIN: Environment

CLEAN PLANT
Approximately $500 Million in Pollution Control Scrubbers Installed at the Plant in 2015 Already Make the Plant one of the Cleanest in the Country.

CLEANER PLANT
Reduces New Mexico emissions by estimated 6 million metric tons of CO2 per year. This represents the removal of emissions from over 1 million cars per day!!

CLEANEST PLANT
The Emissions from SJGS with Carbon Capture are about 2/3 LESS than Emissions from natural gas backup to wind or solar.

CUTTING EDGE
GLOBAL STEWARDSHIP:
Carbon capture technology, which is generally agreed to be necessary to fight global climate change, will be advanced through its largest deployment to date at SJGS.
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