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Carbon Capture at Four Corners: Technical & Financial Risks and Uncertainties

Rooted in Responsibility & Grounded in Tradition: Examining CCS Technologies on the Navajo Nation

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What Exactly is NTEC Proposing for CCS at their NAVEnergy Hub?

- It is unclear exactly what NTEC is planning for carbon capture.
- For years, NTEC has been talking about retrofitting one or both units at the existing Four Corners plant to add carbon capture equipment.
- Then recently NTEC announced an agreement to explore a joint venture to build a new power plant with an entirely new technology from a company named NET Power that NTEC claimed would capture all of the CO_2 produced at Four Corners or at one of NTEC's mines in the Powder River Basin.
- Both plans involve significant technical and financial risks.

What are the Risks of Retrofitting the Existing Four Corners Plant for Carbon Capture?

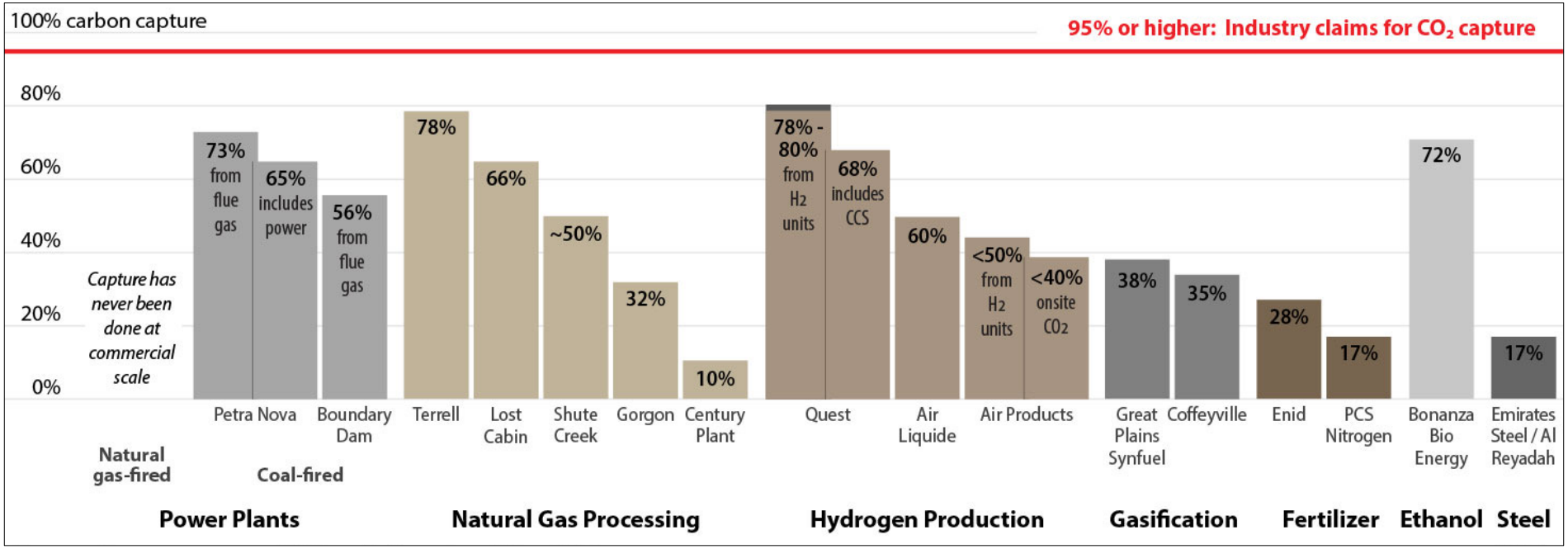
- There is no real-world evidence that after being retrofitted for carbon capture, Four Corners actually would capture ≥95% of the CO_2 it produces, as NTEC claims.
- In fact, neither of the two existing facilities in the world that capture the CO2 from coal plants (Petra Nova in Texas and Boundary Dam in Saskatchewan, Canada) have captured anywhere close to 95% of the CO_2 they produce.
- Four Corners Units 4 & 5 are aging coal-fired units with very high operating and maintenance costs (O&M) and declining operating performance.
- It would be very expensive to retrofit one or both of the Four Corners' units to capture CO_2.

There is Only Very Limited Experience with Carbon Capture

CCS has been around for decades, but there are **only about 30 to 35 active carbon capture projects in the world**. Numerous projects had been cancelled or have failed.

- Coal-fired power plants: There are **only two** in the world capturing any of their CO_2.
- Gas-fired power plants: **No CO_2 is being captured** at an operating commercial-size gas-fired generator.
- Steel plants: **CO_2 has been captured at one plant** in the UAE.
- Concrete plants: **No plant** has captured any CO_2.
- Hydrogen plants: **None of the 3 plants** that produce hydrogen from natural gas has captured more than 68% of the total CO_2 it has created.

There's No Evidence that Existing Commercial-Scale CCS Projects Have Captured Close to 95% of Their CO_2

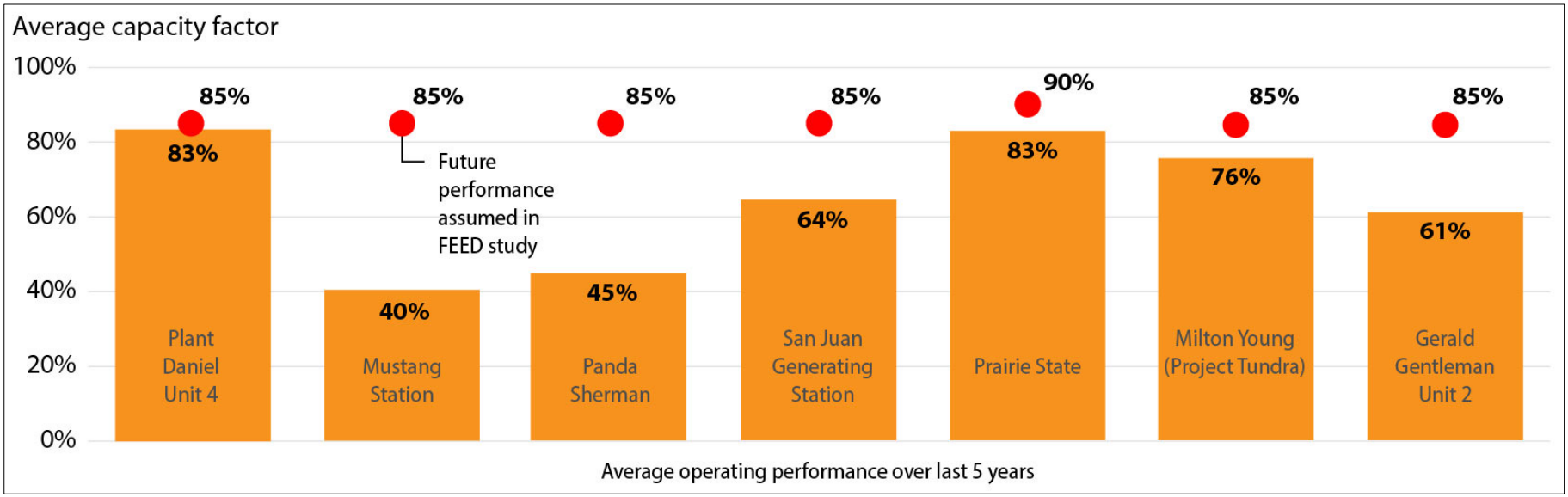


Sources: Company reports, IEEFA analysis: Blue Hydrogen: Not clean, not low carbon, not a solution.

Federal Subsidies for Carbon Capture Provide Incentives for Production of More CO_2

- Under the current federal policy, plants are **incentivized to become CO_2 factories**, or as some say "go farming for CO_2 subsidies."
- 45Q currently creates an $85/metric tonne of CO2 captured incentive for owners to try to run their plants as much as possible.
- This is because the amount of CO_2 captured depends on two factors:
  - How much CO_2 is produced
  - How much of that CO_2 is captured
  - Consequently, coal plant owners will want (1) to run their plants more (2) to produce as much CO_2 as they can (3) in order to capture more CO_2 and (4) receive more credits from federal & state gov'ts

With Federal Carbon Capture Subsidies Owners Will Want to Run Their Power Plants As Much as Possible

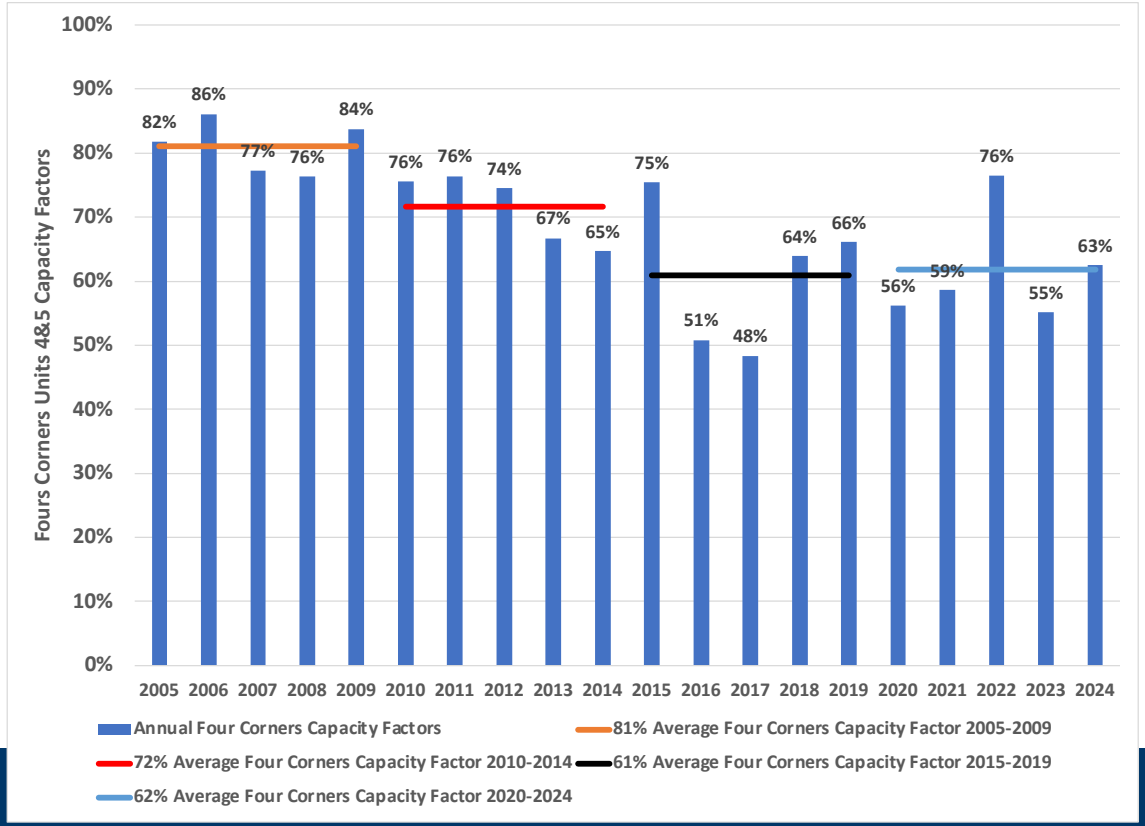


***Capacity Factor**: A measure of how much power the plant actually produces versus how much it would have produced if it had operated at 100% power for all of the hours of the time period being looked at – month, year, or series of years.*

Neither of the Units at Four Corners Can Reasonably Be Expected to Operate At An 85% Annual Capacity Factor

- Four Corners Unit 4 went into service in 1969. Unit 5 in 1970. The Units would be more than 60 years old by the time they could feasibly be retrofitted after 2030.
- For the retrofitting for carbon capture to be financially viable, Four Corners would need to operate for two or three decades or even longer after being retrofitted. That would mean that NTEC would have to try to run Four Corners until the units were 80 or 90 years old, or even older. But no large coal unit has run this long.
- Only 23 large (that is, >195 MW) coal-fired power plant units in the U.S. are 60 years of age or older. Only one of these 23 units has achieved an average capacity factor of higher than 60% since it turned 60 years old.
- Given this industry experience and the downward trend in Four Corners' operating performance since 2010, no one should expect that it would achieve a higher average capacity factor after being retrofitted for carbon capture.

However, Four Corners Operating Performance Has Been Declining since 2010



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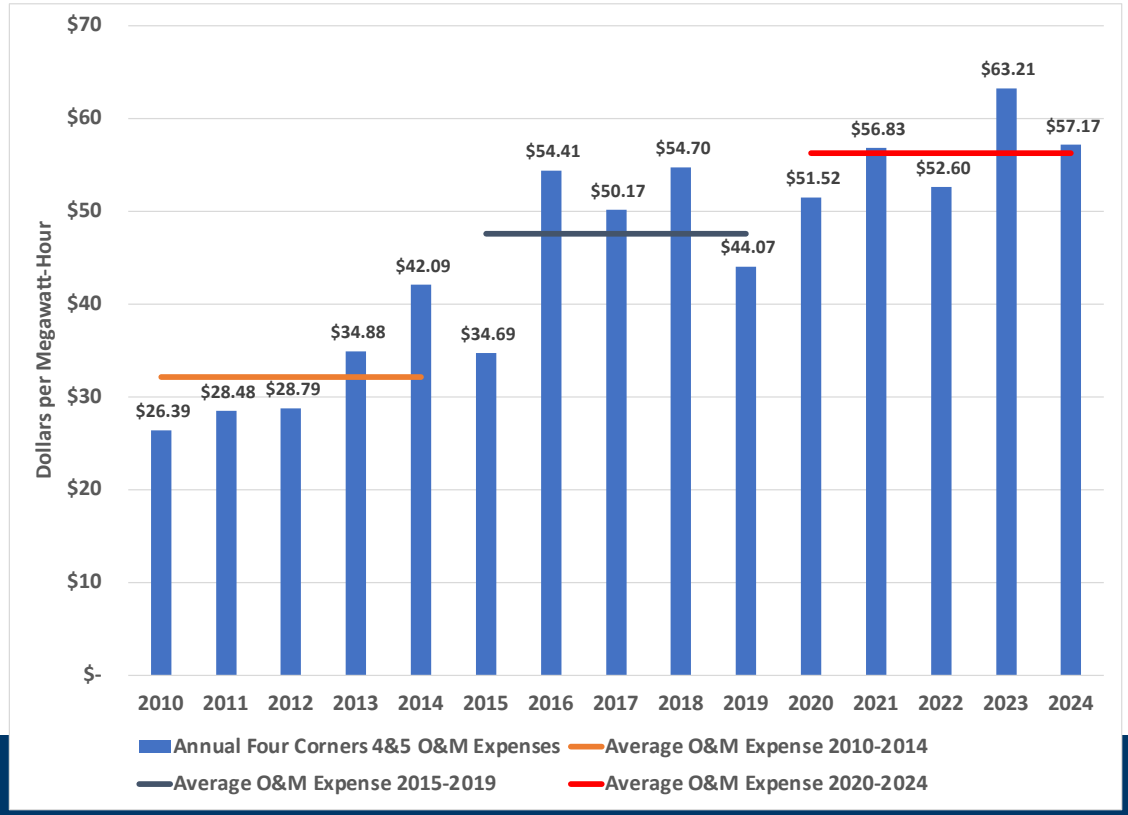
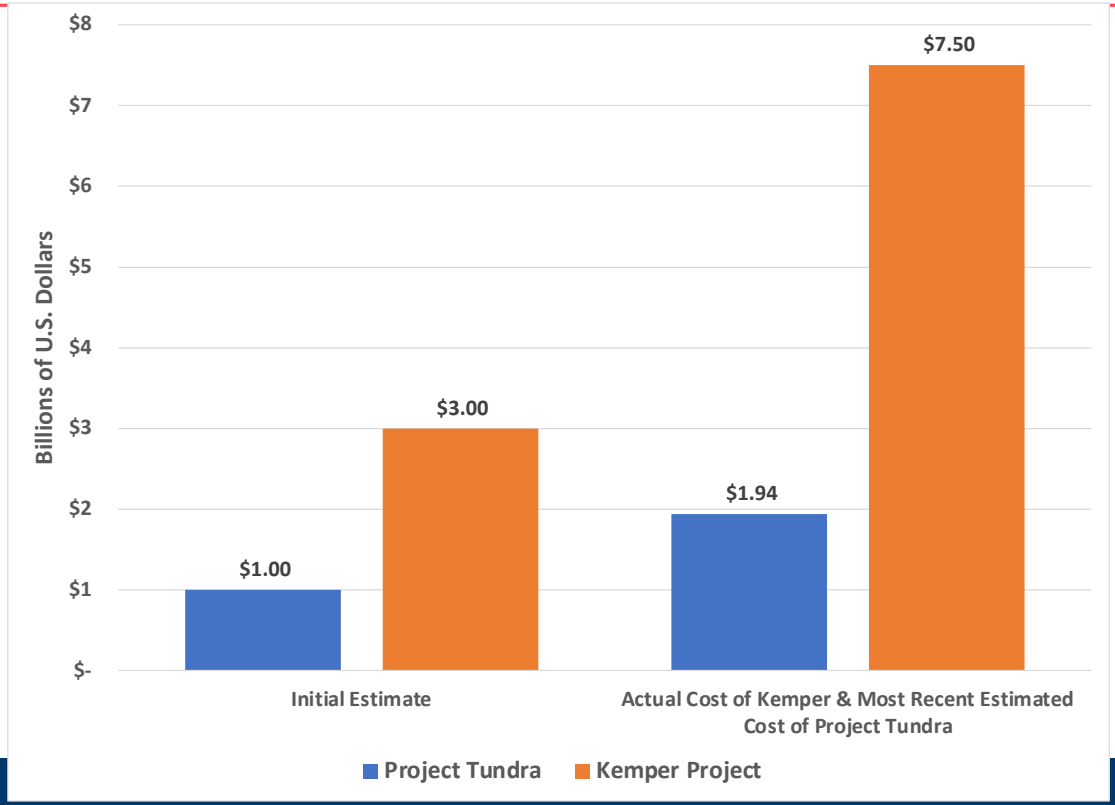
At The Same Time Four Corners' Average Operating And Maintenance (O&M) Costs Have Been Going Up



It Will Be Very Expensive To Retrofit Four Corners for Carbon Capture



Average CO2 Capture Costs Will Be Higher if Capital Costs Go Up Further and/or Capture Rates Are Lower

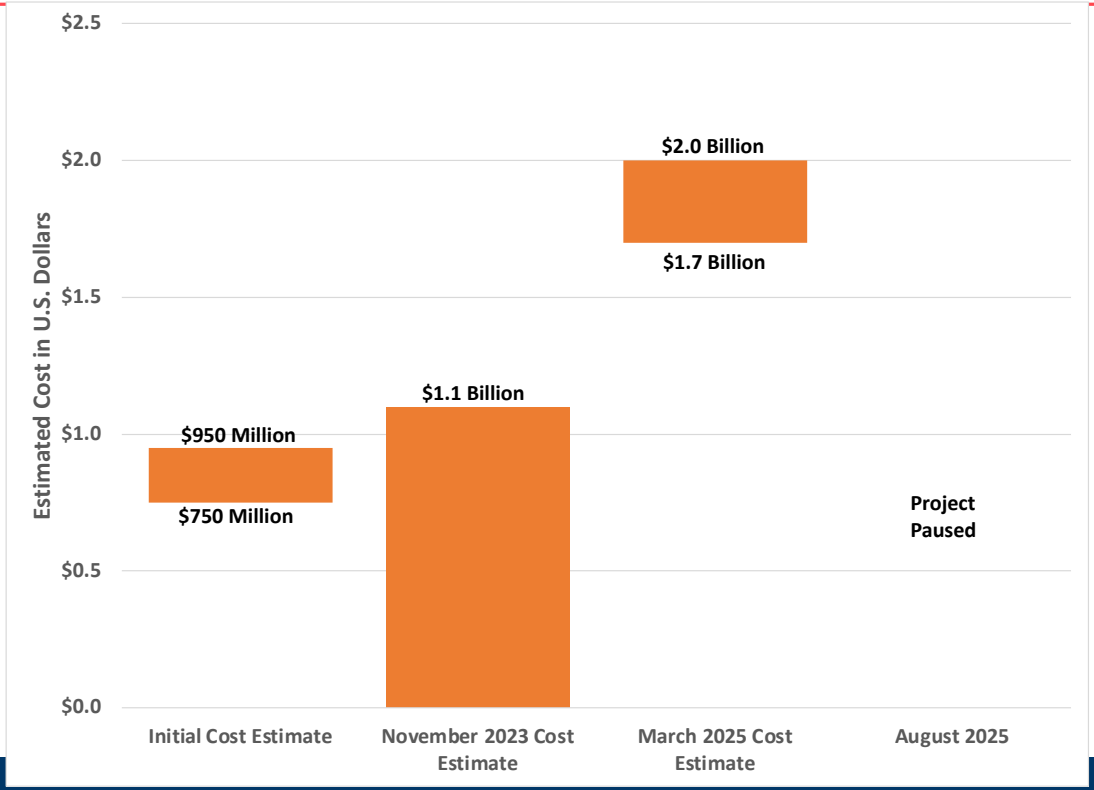
The Risks of that NTEC Faces Using Unproven NET Power Technology In A New Plant at Four Corners

- The much-hyped technology, from a company named NET Power, has only been tested on small scale for limited period
  - ~35 megawatt (MW) development facility at La Porte site in Texas 0has run for only ~1,500 hours in 2018-2021.
  - This testing is continuing after new and upgraded equipment added.
- There is a significant risk that scaling up technology to the 1,000 MW (net) plant being evaluated by NTEC will be a problem.
- Based on this small scale no one knows how effective this new technology will be at capturing CO_2 when used at a commercial-scale power plant.

The Risks that NTEC Faces Using NET Power's Technology at Four Corners

- Project Permian has been planned to be first commercial-scale (300 MW) plant using NET Technology.
- But the project's announced construction cost has doubled since 2022.
- And the project's schedule slipped by 4 years between 2022 and March 2025.
- Now the project has been "paused" for an uncertain amount of time.
- In May of this year, a shareholder lawsuit was filed against NET Power and several of its executive officers, charging that they had failed to disclosed material risks to potential buyers of the company's stock.
- There's also no evidence that two other proposed commercial-scale power plant projects using the NET Power technology – one in Illinois and the other on the Southern Ute Reservation in Colorado – are moving forward.
- And it is still not known how effective this technology will be at capturing CO_2 and what a plant using the technology will cost to build or how long it will take.

The Risks that NTEC Faces Using NET Power's Unproven Technology at Four Corners – Rising Construction Costs



Using the NET Power Technology To Capture CO_2 from Four Corners Could Be Even More Problematic

- The NET Power technology that NTEC is evaluating is designed for use at a natural gas power plant.
- However, it theoretically could be used at a coal-burning power plant if the coal is first gasified and the resulting syngas is burned.
- Coal-gasification has been tried in the past decade-and-a-half at two power plants in the U.S. – the Kemper Project in Mississippi and the Edwardsport Project in Indiana.
- The coal-gasification portion of the Kemper Project failed to operate reliably even though it had functioned well during small scale testing. As a result, the Project has operated just on natural gas and has failed to capture any CO_2. As a result, The gasification and carbon capture portions of Kemper were demolished several years ago.
- Edwardsport was not designed to capture any CO_2 but it also has had problems with coal gasification. As a result, instead of running full-time on syngas, Edwardsport has used natural gas for a significant percentage of its power.

For More Information

- Contact David Schlissel at David@schlissel-technical.com
- View Reports, Presentations and Expert Testimony on CCS at www.schlissel-technical.com
- View materials on CCS produced by the Institute for Energy Economics and Financial Analysis at www.ieefa.org