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May 2021

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IEEFA.org

Where's the Beef?

Enchant's San Juan Generating Station CCS Retrofit Remains Behind Schedule, Financially Unviable

Executive Summary

Over the last two years, it has become clear that the project by Enchant Energy and the City of Farmington (Enchant) to extend the life of the San Juan Generating Station is in serious trouble. Limited progress has been made. But the project is already significantly behind schedule in securing the full $1.5 billion financing for the project, construction has not started, and project permitting is going to take far longer than Enchant either realizes or is willing to acknowledge.

Enchant has admitted that the project is six to 10 months behind schedule due to plant outages that prevented testing needed to develop the design for the carbon capture retrofit and a delay in obtaining funding. However, Enchant is now acknowledging that construction is unlikely to start before mid-2022, or a year and a half later than its initial projection. Also, after initially claiming the retrofitted plant would be capturing carbon dioxide at the end of 2023, Enchant now admits that only half of the carbon capture island is likely to be in service at the end of 2024, and the entire project won't be complete until mid-2025.[1] Even the project's important Front End Engineering Design (FEED) study is behind schedule due to inadequate funding. Further delays can certainly be expected as the project continues.

It seems clear that unlike renewable and battery storage projects, Enchant has had trouble convincing potential investors that its plan to retrofit San Juan to capture CO_2 is financially viable. In December 2019, Enchant claimed it would close on the full funding for the project by the end of 2020. That did not happen, and Enchant now seems to be changing its funding plan from depending solely on luring investors with federal 45Q tax credits to a mixed plan where roughly two-thirds of the project is funded with low-interest loans from the U.S. Department of Energy (DOE) and the Rural Utilities Service (RUS) of the U.S. Department of Agriculture. Where the remaining one-third of the funding will come from remains unanswered.

Enchant has projected that it will close on this new funding by late this year. But that simply isn't realistic. It took almost three years for the DOE to make a final decision to fund $190 million of the cost of the Petra Nova carbon capture project. As such, it is highly unlikely the DOE and RUS will agree to lend five times as much to Enchant in one-third the time. This is particularly true given that such a large

[1] Farmington Daily Times. As San Juan Mine braces for layoffs, assistance is uncertain and carbon capture hopes fade. March 10, 2021.

degree of federal funding will trigger a potentially time-consuming review under the National Environmental Policy Act (NEPA).

It is also increasingly unclear how interested the DOE will be in funding projects such as Enchant's—that is, retrofits to older, expensive-to-run coal-fired power plants. In a recent interview, Jennifer Wilcox, the department's principal deputy assistant secretary for fossil energy, said: "It's clear that carbon capture may not make economic sense on the remaining existing fleet of coal-fired power plants in the United States."[2]

It's clear that carbon capture may not make economic sense.

Enchant also claims that permitting for the San Juan project will be completed later this year. But that is also unrealistic. Environmental reviews are likely to take years, not months. For example, the Federal Carbon Storage Assurance Facility Enterprise (CarbonSAFE) program expects that the detailed site characterization and environmental review process through which a Class VI permit to inject CO_2 into underground storage will need to be obtained will take three years, including a NEPA review, and that doesn't reflect delays due to public opposition. The two pipelines that Enchant intends to build to transport the captured CO_2 for use in enhanced oil recovery (EOR) and to a site for underground storage will require permitting by multiple jurisdictions and include right-of-way acquisition and river crossing reviews.

Enchant's financial plan appears to be to earn roughly 20% of its revenues from selling the captured CO_2 for EOR, 40% from federal 45Q tax credits, and 40% from selling the electricity produced at San Juan.[3] However, there are serious uncertainties and risks associated with each of these revenue streams.

- How reliable will the revenues from selling the captured CO_2 for EOR be, given the inherent volatility of oil prices? The experience of the Petra Nova carbon capture project, which was mothballed last July due to low oil prices, belies Enchant's assertion that it will be able to secure a stable long-term revenue stream based on selling captured CO_2 for use in EOR in the Permian Basin.

- The federal 45Q tax credit program is simple—the number of tax credits a company receives is solely based on how much CO_2 it produces and captures for use in EOR or places in underground storage. To be financially viable, Enchant will have to run the aging San Juan plant much more than it has—at a projected 85% annual capacity factor vs. the 64% capacity factor the plant has averaged in recent years. Whether Enchant can operate San Juan at such a high level of performance on a consistent basis year-after-year is an open

[2] Washington Examiner. Biden administration looking to capture carbon from gas and manufacturing. May 3, 2021.
[3] Power Finance & Risk. Enchant test investor appetite for CCS with equity raise. August 27, 2020.

and critical question. If the plant doesn't produce enough CO_2, the project will fail.

- Enchant will have to capture 90% or more of the plant's CO_2 for the project's economics to pencil out. Enchant says that the technology it will use has been proven at the Petra Nova project, but that is simply untrue. Petra Nova only operated for three and one-third years before it was indefinitely mothballed—a far shorter time than Enchant is planning to capture CO_2 at San Juan. It is also unlikely Enchant can meet its 90% capture target. Based on information in NRG's March 2020 Petra Nova report to the Department of Energy, it is clear that the project's actual CO_2 capture rate during its three years of operation was in the range of 75%, not 90%.

- Finally, the viability of Enchant's proposed San Juan project will depend on the ability to sell the electricity produced at the plant at a price higher than the cost of generating it. It is extremely doubtful Enchant will be able to do so given that (a) the average cost of producing power at San Juan is higher than the cost of buying power through solar + storage power purchase agreements; (b) the western region of the U.S. has become increasingly dependent on low-cost renewable resources; (c) large amounts of additional renewable and battery storage resources are on the way. If Enchant cannot sell the electricity from San Juan at a profit, the project will fail. There also is uncertainty regarding the amount of transmission capacity Enchant will have access to, another factor that could limit electricity sales from the plant.

One of the most famous advertising slogans ever was in a 1984 commercial from Wendy's featuring a customer at a fast-food restaurant asking "Where's the Beef?" as a complaint about how little meat there was in her hamburger. The same question can be asked about how much progress Enchant Energy is making in its effort to acquire and convert San Juan to capture CO_2. So far, mounting delays in meeting benchmarks, changing plans and unanswered questions raise serious doubts about Enchant's repeated and unsupported claims about the project and its purported benefits. It leaves us all asking, "Where's the beef?"

Enchant's Carbon Capture Project Already Is Significantly Behind Schedule

Enchant's most recent Quarterly Research Performance Progress Report to the U.S. Department of Energy acknowledged that plant outages and Covid-19 have caused an estimated six- to 10-month delay in project and construction schedules.[4] Furthermore, Enchant stated that the project's Front End Engineering and Design (FEED) study could be delayed due to funding issues.[5]

[4] Enchant Energy. Enchant Quarterly Research and Performance Progress Report for the Period October 1, 2020 – December 31, 2020. January 31, 2021, p. 10.
[5] *Ibid*.

In contrast to Enchant's problems, Covid-19 doesn't seem to have hindered development in the wind and solar sectors. While Enchant was blaming Covid-19 for two to six months of delays in 2020, the U.S. installed 19.2 gigawatts (GW) of new solar PV capacity and 16.9 GW of new wind capacity. According to Jigar Shah, currently head of the Loan Programs Office at the US DOE, total U.S. investments into wind and solar energy in the year were $55 billion.[6]

Yet, the fact that the Enchant project is significantly behind schedule should not come as a surprise as the project has missed almost all the milestones it set out for 2020 and early 2021.

Table 1: Enchant's December 2019 Project Goals for 2020-2021

Month/Year	Goals
January 2020	- $10-$15 million of equity raised - Management team built out - CO_2 off-take agreement and associated transportation and storage completed - [New Mexico Energy Transition Act] amended to extend compliance date by 12 months
June 2020	- EPC [Engineering, Procurement and Construction] contract finalized with Construction Consortium
July-December 2020	- $1.25 billion financing closed
January 2021	- Construction of CCUS Commenced[7]

Source: Enchant Energy, Carbon Capture Utilization & Storage, Project Summary, December 17, 2019.

A review of presentations on Enchant's website from Oct. 27 and Dec. 9, 2020, reveals that the project failed to achieve almost all its milestones in 2020 and, instead, was only involved in negotiations or meetings related to these milestones:

- Initiated power off-take negotiations;
- Initiated CO_2 off-take and associated transportation and storage negotiations;
- Early-stage discussions for carbon storage operator;
- Initiated coal supply negotiations; and
- Initiated carbon capture island federal and New Mexico permitting.

Consequently, the project milestones for 2021 are now listed as tasks that were originally scheduled for completion in 2020 or January 2021:

[6] S&P Global Platts. Investments in US clean energy to total $55 billion in 2020: Generate Capital. November 23, 2020.
[7] Enchant Energy. Carbon Capture Utilization & Storage, Project Summary, December 17, 2019.

- Complete power off-take, CO_2 offtake, and associated transportation and storage agreements;
- Complete coal supply agreement;
- Complete ownership transfer definitive agreements;
- Complete FEED study;
- Finalize EPC contract negotiations with construction consortium;
- Complete carbon capture island permitting;
- Complete project financing; and
- Commence construction of carbon capture island, if granted permission by current and former owners of San Juan.[8]

Most importantly, Enchant did not and, in fact, still has not closed on the financing for the project, a task that, is now listed as scheduled to be completed in late 2021.[9] Nor did construction of the carbon capture facility at San Juan start in January 2021. Nor is there any evidence as to party or parties, if anyone, who will buy the CO_2 captured at the plant and the power generated there, and at what prices.

The company now is essentially starting over on the financing front.

Enchant's inability to meet any of its milestones underscores the project's problematic outlook. Worse, the company now is essentially starting over on the financing front, forced to seek federal support for a project the private sector clearly does not support. That process is almost certain to further delay the project. At the same time, cheaper and cleaner generation resources are coming online across the Four Corners region, undercutting Enchant's already tenuous claims about the retrofit project's viability.

[8] Enchant Energy/City of Farmington. San Juan Generating Station Carbon Capture Project. December 9, 2020, pp. 21-24.
[9] Closing on the financing for the project is listed as occurring in late 2021 in the Oct. 27, 2020, Carbon Capture Update, at Slide No. 22, not in the July to December 2020 period, as Enchant previously claimed in December 2019. No specific month in 2021 was provided for when Enchant now claims that construction of the Carbon Capture Island at San Juan actually will begin.

Where Are the Investors for Enchant's Proposal?

Enchant's original plan was to use federal 45Q tax credits to entice equity investors to fund the proposed carbon capture project.[10] In fact, it announced with some fanfare in June 2020 that it had retained Bank of America as its financial advisor for raising the equity capital and had begun talks with several infrastructure funds.[11]

However, as Enchant reports on its own website in an article from *Power, Finance & Risk*, it appears that equity investors have been skeptical about the San Juan project—especially after the indefinite mothballing of the flagship Petra Nova CCS project.[12]

> *Officials at private equity firms and infrastructure fund managers are interested but wary when asked about carbon capture—their funds would be at play long before tax equity – notwithstanding the recent guidance from the Internal Revenue Service (PFR, 2/20).*
>
> *An investment banker said investments would be made on a project-by-project basis, and would be "geographically constrained" to oil-drilling hotspots.*
>
> *"I think there is a big opportunity here, although 'cleaner coal' has been in the mix for a while and no one has really made it successful as yet," says the head of a European infrastructure fund. "Tax equity sees the 45Q as their saving grace once (if) the PTC/ITC fades, so I know a lot of the tax equity guys are getting up the curve in order to start making investments in 22/23."*
>
> *Tax equity investors, meanwhile, have so far been reluctant to discuss coal-related investments to capture the 45Q credits (PFR, 7/3/19, 7/2).*
>
> *"It's a harder sell when the source of CO_2 is coal, compared to say ammonia or natural gas, since many banks have policies that require them not to invest in coal," said Martha Kammoun, a partner at Bracewell.*
>
> * * * *
>
> *But even with the most sophisticated risk mitigation techniques in place, being among the first investors in a new technology is a bold move.*
>
> *"The first few deals are always very difficult," says a private equity investor, recalling the early days of solar finance. "Sometimes in life, it's better to go second."*[13]

[10] Enchant Energy. Presentation to New Mexico Senate Finance Committee. February 4, 2020, p. 7.
[11] Power Finance & Risk. Enchant tests investor appetite for CCS with equity raise. August 27, 2020.
[12] *Ibid*.
[13] *Ibid*.

Enchant's failure to attract the private investment on which it was initially relying stands in stark contrast to the estimated $55 billion that was invested in wind and solar energy the U.S. in 2020.[14] Clearly, investors are attracted to well thought-through, low-risk projects with proven technologies—all of which Enchant's San Juan project is not.

Without private financing, it now appears as though Enchant has decided to turn to taxpayers and the federal government to fund the speculative venture. According to an October presentation, Enchant is seeking just under $1 billion of its currently estimated $1.5 billion project cost from the DOE and the Rural Utilities Service of the U.S. Department of Agriculture in an unspoken admission that private investors are unlikely to provide the funding needed to build such a risky project. Enchant said in its presentation that it is seeking $906 million of this federal support in the form of low-cost loans from the DOE, with another $90.3 million coming from the RUS.[15] This funding would pay for the cost of the planned carbon capture island at San Juan, deferred maintenance and the CO_2 pipeline. Enchant has not indicated how it will secure the remaining $500 million needed to build the project. And as at other projects employing new technologies, the actual costs of building and running Enchant's carbon-capture project are likely to be much higher than currently estimated.

There are a couple of serious problems with Enchant's new financing plan:

1. At a minimum, it already is taking longer to close on the financing for the project, meaning the start of construction will continue to be delayed.

2. It is likely that the DOE and RUS reviews of Enchant's project will be significantly extended by the need to conduct required environmental reviews under the National Environmental Policy Act (NEPA). NEPA reviews can take years, especially, if, as can be expected here, the proposed federal funding is challenged by community and environmental groups opposed to the carbon capture project.

   There are significant questions as to how Enchant will finance the retrofit project.

   For example, the DOE announced a cooperative agreement to fund $190 million of the cost of the Petra Nova project in June 2010. However, the DOE did not make a final decision to provide funding for the project until May 2013 after a NEPA review had been completed. Given that Enchant is asking for nearly five times as much funding, it is highly unlikely that the review can be completed in one-third of the time. It simply is not realistic to expect

[14] S&P Global Platts. Investment in US clean energy to total $55 billion in 2020: Generate Capital. November 23, 2020.
[15] Enchant Energy/City of Farmington, *op. cit.*, p. 22.

that closing on the funding and starting construction will happen in 2021 or any time soon.

3. Changing from private equity financing to governmental funding will shift all, or at least most, of the significant project risks (that is, the project will be more expensive to build, will not operate as Enchant now claims or will be more expensive to capture CO_2) from private investors to taxpayers who will have to bear any losses.

Bottom line, there are significant questions as to how Enchant will finance the retrofit project, and when financing will close. Additional delays in closing on the financing almost certainly will further delay the start and the completion of construction.

Permitting of the Carbon Capture Project Is Likely to Take Significantly Longer Than Enchant Has Claimed

Enchant has said it expects permitting of the San Juan project will be completed later this year.[16] But completing permitting that quickly is overly optimistic, even Pollyanna-ish, considering the number of permits the project will need, some of which are in multiple jurisdictions; the very early stage of Enchant's permitting efforts; and the fact that the permitting of the project will need to allow for public participation, which could result in additional delays resulting from significant opposition.

The language in Enchant's December 9, 2020, presentation describing its permitting activities in 2020 shows how little progress was made through the end of last year, when Enchant had not even submitted its necessary permit applications. Among the "successes" mentioned by Enchant were kick-off and pre-application meetings to introduce the project and subsequent meetings with permitting agencies to discuss plans, as well as the development of supporting documentation for the project.[17]

In addition to the NEPA review that the DOE and RUS will have to conduct, the following other environmental and right-of-way reviews are almost certain to be required.

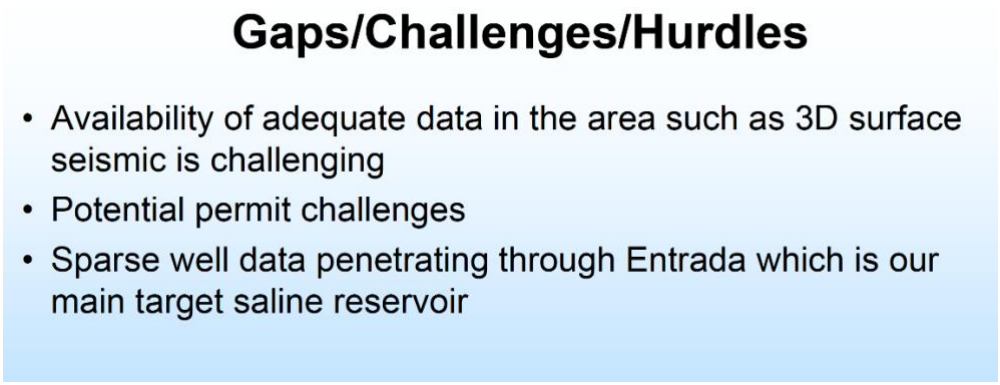
- Enchant's proposed site for sequestering the CO_2 captured at San Juan is a natural gas well on New Mexico State Highway 574, approximately 25 miles northeast of San Juan. The San Juan project is at the very start of site characterization to determine if the Entrada Formation would be acceptable for long term sequestration of CO_2. This analysis will be conducted by the New Mexico Institute of Mining and Technology (NM Tech), which has been given the largest share of the Enchant funding under the Federal Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative.

[16] *Ibid*.
[17] Enchant Energy/City of Farmington, *op. cit.*, pp. 21-24.

- Enchant's plan to store the CO_2 underground will require a Class VI permit from the U.S. Environmental Protection Agency (EPA) which will have to conduct a NEPA review as part of the Site Characterization and CO_2 Capture Assessment under CarbonSAFE.[18] Pursuant to the EPA's Class VI regulations for underground CO_2 injection, permit applicants must:
    - Provide extensive information about the local and regional geology and hydrogeology of the proposed site.
    - Develop and submit information on the region that may be affected by the injection of CO_2 and the leakage risks that might impact the quality of underground sources of drinking water.
    - Submit proposed schematics and construction procedures for the injection well.
    - Submit a proposed pre-operational formation and well testing program.
    - Develop and implement a comprehensive testing and monitoring plan.
    - Submit a plan to plug the injection well in a manner that protects underground sources of drinking water.
    - Submit a Post-Injection Site Care (PISC) and Site Closure Plan that outlines the proposed post-injection monitoring strategies and how non-endangerment of underground sources of drinking water will be ensured during the PISC phase.
    - Develop and maintain an Emergency and Remedial Response Plan that describes actions to be taken to address events that could potentially endanger underground sources of drinking water during the construction, operation and PISC phases.
    - Submit information to demonstrate that they have the financial responsibility to fund corrective actions, injection well plugging, PISC and site closure, and emergency and remedials responses.[19]

At meetings with the U.S. Department of Energy's National Energy Technology Laboratory on August 17-19, 2020, William Ampomah, a Research Engineer/Section Head at PRRC/New Mexico Tech, indicated that while there is interest in deploying CCS technology to continue operating San Juan and that the geology within the San Juan basin has favorable and significant storage capacity, there are some "Gaps/Challenges/Hurdles" for the proposal.

[18] U.S. Department of Energy. Carbon Storage Assurance Facility Enterprise (CarbonSAFE). July 2020.
[19] San Juan Basin CarbonSAFE. About this Project.



Source: William Ampomah. San Juan Basin CarbonSAFE Phase III: Ensuring Safe Subsurface Storage of CO_2 in Saline Reservoirs. August 17, 2020, p. 22.

Ampomah's presentation also mentioned that "New Mexico does not have a precedent for Class VI CO_2 injection so issues of pore space and mineral rights may arise." However, he expressed confidence that the team's expertise from previous CarbonSAFE projects, regional partnerships and industry would overcome any potential barriers.[20]

Other CarbonSAFE projects and carbon capture/sequestration projects have had to undergo NEPA reviews similar to the one that can be expected at San Juan. These include the Petra Nova project at the W.A. Parish Coal Plant, the Lake Charles CCS Project, the FutureGen 2.0 Project and the Kemper County IGCC Project.[21] Other carbon capture projects currently being funded under CarbonSAFE are undergoing similar reviews.

NEPA review, including the preparation of an environmental impact statement (EIS) under CarbonSAFE, is expected to take three years. However, Enchant's proposal may take longer because there already is organized public opposition to the project. It also is unclear exactly how far along Enchant is in developing the necessary information it must submit to the EPA and whether it will have the financial resources to fund all of the activities required under the EPA's Class VI regulations.

In addition, the project is proposing two multi-jurisdictional pipelines—one from San Juan to the Cortez pipeline and a second to the underground storage site. Both pipelines will require right-of-way acquisition and river crossing reviews with oversight by the Department of the Interior with Bureau of Land Management and Bureau of Indian Affairs involvement, as well as private and state land crossings.

- The current owners of San Juan are planning to shut down the mine in June. Enchant proposes to reopen the mine after completing a major modification of San Juan and adding two long pipelines. For this reason, the Department of the Interior's Office of Surface Mining Reclamation and Enforcement

[20] William Ampomah. San Juan Basin CarbonSAFE Phase III: Ensuring Safe Subsurface Storage of CO_2 in Saline Reservoirs. August 17, 2020, p. 14.
[21] National Energy Technology Laboratory. Environmental Impact Statements.

(OSMRE) must conduct a new or amended EIS for the San Juan Deep Lease Extension to include the retrofitting San Juan for carbon capture. The use of the captured CO_2 for EOR, and geologic storage also were not part of OSMRE's 2018 EIS for the Deep Lease Extension.

- The plant's operating air permit from the New Mexico Environment Department must be renewed if the plant is going to continue operations beyond 2022 if modifications are made to San Juan outside existing permits. In addition, investment in and installation of selective catalytic reduction for pollution controls could be required to comply with the Federal Regional Haze Program under the Clean Air Act for San Juan.

Enchant clearly has a lot to accomplish before the San Juan plant can be retrofitted and operated with carbon capture. It simply is not realistic to expect that this can be accomplished without significant delays to Enchant's planned start of operations in 2024 or 2025. The CarbonSAFE initiative and environmental reviews on their own are likely to take through mid-2024, at least, and that's if everything goes right and there is no opposition, which is highly unlikely.

Enchant clearly has a lot to accomplish before the San Juan plant can be retrofitted and operated with carbon capture.

There Is No Evidence Enchant Will Be Able To Find Long Term Buyers for the Power From San Juan

Enchant has claimed that 34% of the power off-take from San Juan is "committed."[22] Although this is technically correct, it also is misleading. That 34% represents the power needed to run the carbon capture island plus Farmington's share of the power produced by San Juan. There has been no evidence that any other party has committed to buying any of the remaining 550 megawatts (MW) of power the plant generates. So, the question of who will buy the power generated at San Juan, and at what prices, remains unanswered. This is critical because Enchant has estimated that it will earn about 40% of its revenues from the sale of electricity.[23]

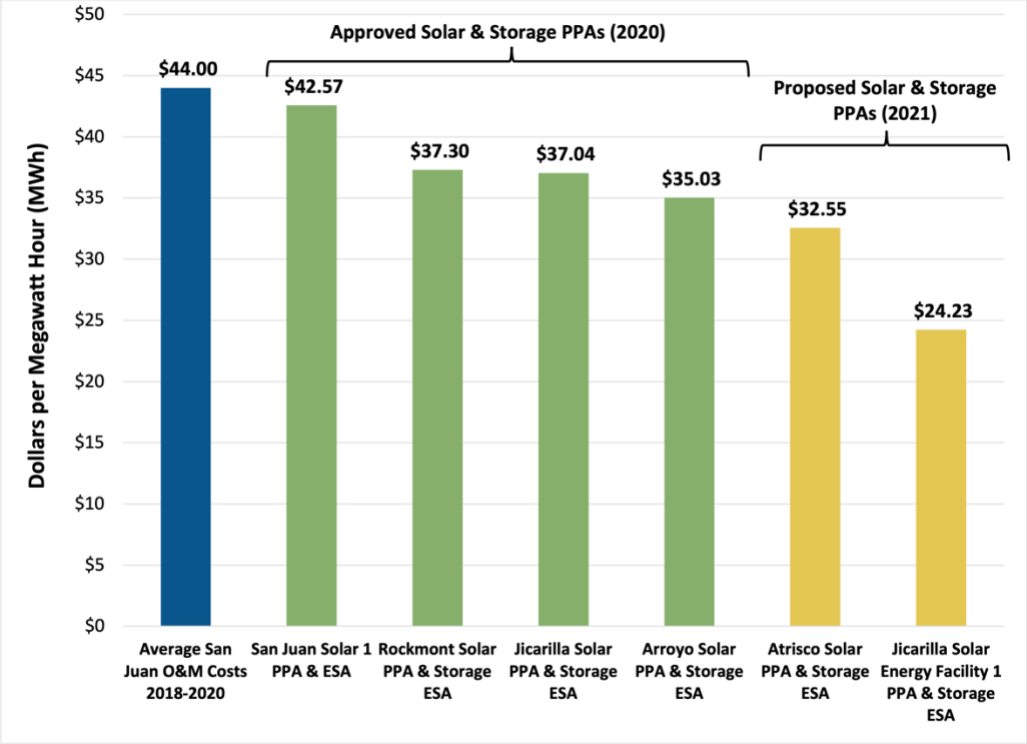
We have argued in past reports that Enchant will find it difficult, if not impossible, to find outside buyers for the power from San Juan because the cost of power from the plant already is very expensive and the cost of alternatives such as solar and battery storage already are low and likely to decline even further in coming years. Recent evidence confirms this conclusion.

Enchant submitted at least two proposals in response to PNM's Replacement Resource RFP—for 75 MW and 125 MW of power from San Juan.[24] Neither proposal

[22] Enchant Energy/City of Farmington, *op. cit.*, p. 21.
[23] Power Finance & Risk, *op. cit.*
[24] Enchant Energy/City of Farmington, *op. cit.*, p. 21.

was accepted by PNM. The reason is clear: The cost of generating power at San Juan will be much higher than the prices PNM will have to pay for the power from renewable resources, as can be seen in Figure 1.

Figure 1: The Recent Cost of Power from San Juan vs. Recent Solar Storage (Power Purchase Agreements (PPAs) and Energy Storage Agreements (ESAs) Signed by PNM or Proposed by the Company for New Mexico PRC Approval



Sources: San Juan O&M costs are from PNM's FERC Form 1 Filings for 2018-2020. The average costs of the solar+ storage PPAs are taken from the Direct Testimony of PNM Witness Thomas Fallgren in NM PRC Cases Nos. 20-00182-UT and 21-00083-UT.

Figure 1 shows the significant decline in prices in the solar and storage PPAs just in the last two years.

Moreover, the cost differential between San Juan and the average prices of the solar & storage PPAs is much larger than Figure 1 would suggest.

1. The average San Juan operating and maintenance cost per megawatt-hour (MWh) shown in Figure 1 was for the three-year period 2018-2020. The solar+storage PPA prices are for 20-year periods beginning in 2022 or 2023.

2. While the solar+storage PPA prices are fixed, with no escalation and no possibility of being reopened, the cost of generating power at San Juan can

be expected to increase substantially over time, as it has in the past.[25] This is especially true given that the two remaining units at San Juan already are 38 and 44 years old and can be expected to experience increasing costs and declining operating performance as they age further.

3. The San Juan operation and maintenance costs shown in Figure 1 do not include any costs related to the operation of the carbon capture island or the impact of the new parasitic load associated with that island on the cost of producing power at the plant.

4. Figure 1 does not reflect the cost of annual capital expenditures (capex) that are needed to keep coal-fired generators operating efficiently or that would be needed for the carbon capture island. The solar+storage PPAs do not expose customers to the risk of paying for similar capex.

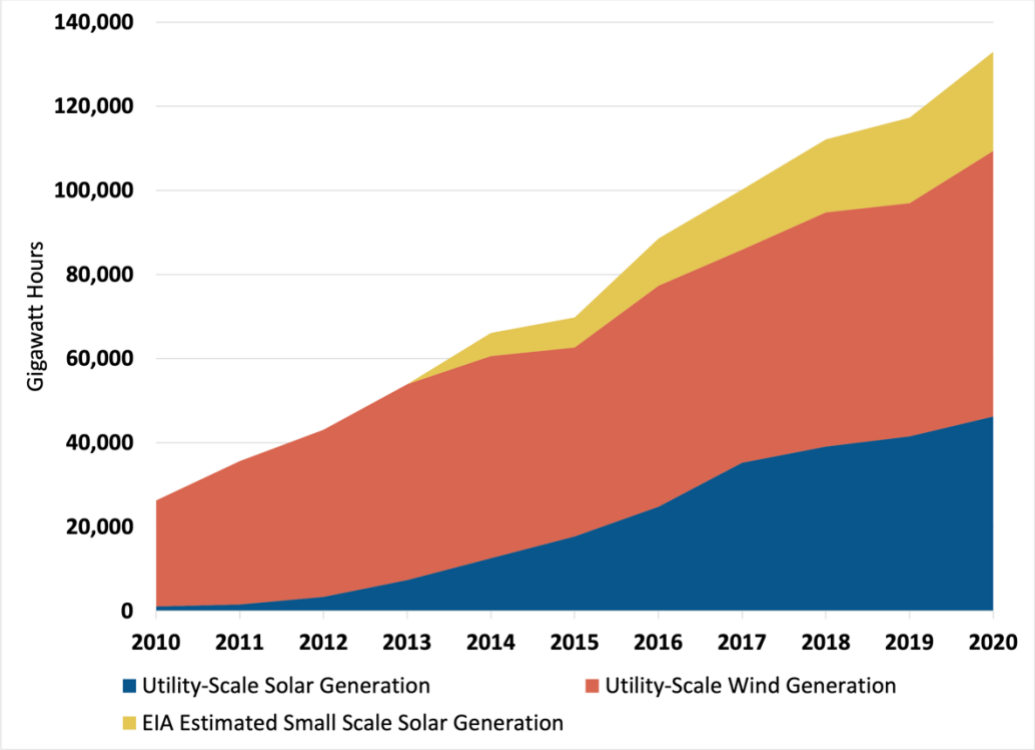
5. The solar+storage PPAs also do not require PNM to pay for any fixed or variable administrative costs. Enchant and Farmington would have to cover these costs unless they could pass them along to potential San Juan power customers.

Most importantly, the two bars on the right of Figure 1, that is, the most recent solar+storage PPAs, have the lowest prices. This is not surprising given that solar PPA prices have been declining for years and battery storage prices are expected to follow the same downward trajectory.

Wind and solar generation in the western U.S. mountain and mainland Pacific coastal states have grown dramatically in recent years.

[25] New Mexico Public Regulation Commission. Direct Testimony of Thomas G. Fallgren, Case No. 20-00182-UT. September 28, 2020, p. 17.

Figure 2: Growth in Solar and Wind Generation in Western U.S. States



Source: EIA Electric Power Monthly data base.

And much more competition for San Juan from renewable generation and battery storage is coming regionally as states push utilities to boost their renewable generation and as energy markets favor the economic competitiveness of solar, wind and battery storage.

For example, Thomas Fallgren, a PNM witness who appeared in proceedings before the New Mexico Public Regulation Commission, has recently testified that last September, "PNM received 205 proposals representing, in aggregate, over 15,000 MW of generating capacity and over 9,200MW/30,000MWh of storage capacity in the following technologies: Solar PV, wind, battery storage, hybrid renewable plus battery, gas turbines, reciprocating gas engine generators and coal with carbon capture."[26] The overwhelming share of the generating capacity was most likely from renewable projects, with some from natural gas-fired facilities.

California mandates that 60% of electricity sales in 2030 come from renewable resources and that all the state's electricity come from carbon-free resources by

[26] New Mexico Public Regulation Commission. Direct Testimony of Thomas G. Fallgren, NMPRC Case No. 21-00083-UT. January 8, 2021, p. 35.

2045.[27] As part of its transition to renewables, California is expected to add 2,260 MW of new solar and 1,168 MW of storage resources in 2021 alone.[28]

Colorado is pushing a roadmap to 100% renewable energy by 2040 and Nevada passed legislation last year requiring the state's utilities to meet a 50% renewable energy standard by 2030. In late 2019, the Nevada Public Utilities Commission approved NV Energy's Integrated Resource Plan that includes three solar projects totally nearly 1,200 MW and 590 MW of energy storage capacity, all of which is expected to be online by 2024.[29]

Even in states with less aggressive policy mandates, market pressure and cost concerns are forcing utilities to transition away from fossil fuel generation. For example, Arizona's Salt River Project (SRP) has announced plans to add 1,000 MW of new solar resources by 2025.[30] Similarly, Arizona Public Service's (APS) 2020 integrated resource plan (IRP) calls for adding 2,894 MW of capacity by the end of 2024—575 MW of demand-side management; 193 MW of demand response; 408 MW of distributed energy resources; 962 MW of renewable resources; and 750 MW of energy storage.[31] Also, Tucson Electric Power's (TEP) 2020 IRP adds 2,457 MW of new wind and solar resources, including 457MW coming online by 2021.[32]

It is impossible to imagine that an expensive and aging San Juan will be able to compete effectively against this tsunami of lower-cost demand-side projects, renewable resources and battery storage.

[27] California Public Utilities Commission. Renewables Portfolio Standards Program. 2021.
[28] S&P Global Market Intelligence. Outlook 2021: CAISO to add nearly 4 GW more capacity, mostly solar, storage. May 3, 2021.
[29] Greentech Media. NV Energy Gets Green Light for Massive Solar-Battery Projects. December 5, 2019.
[30] Salt River Project. SRP Plans 1,000 Megawatts of New Solar Energy by 2025. November 15, 2018.
[31] Arizona Public Service Company. Arizona Public Service Company's 2020 Integrated Resource Plan. June 26, 2020, p. 135.
[32] Tucson Electric Power. TEP 2020 Integrated Resource Plan. June 26, 2020.

There Is a Significant Risk San Juan Won't Be Able To Produce Enough CO_2 To Be Financially Viable

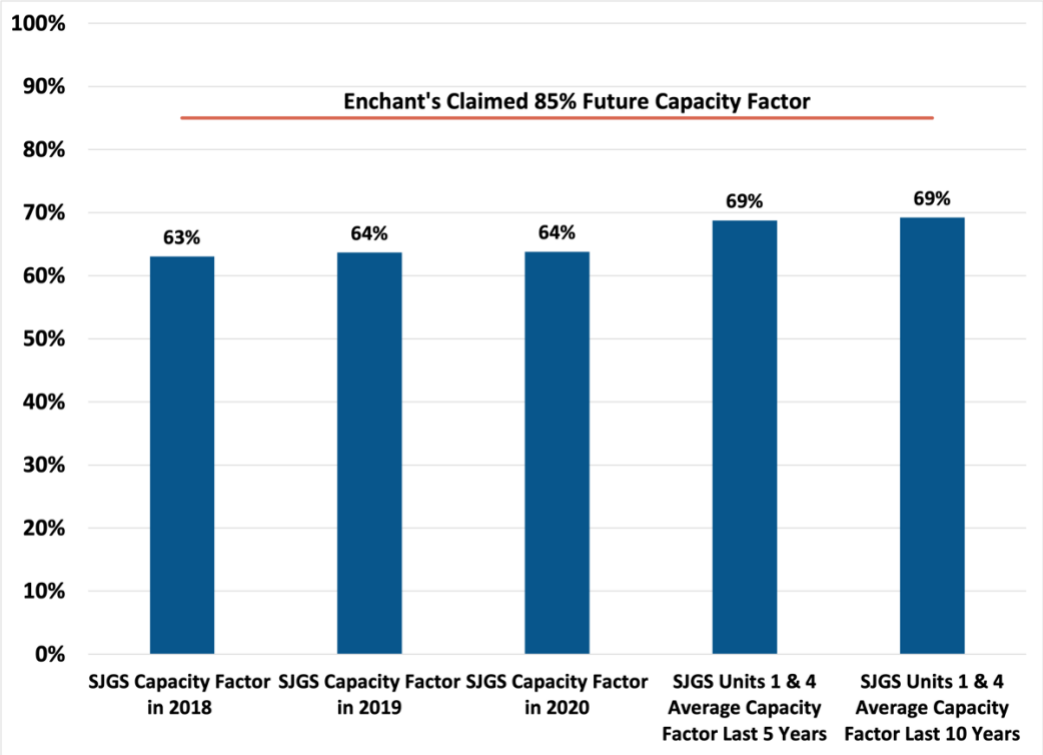
Paradoxically, San Juan will have to produce more CO_2 after being retrofitted for carbon capture than it has in recent years. This is because the amount of CO_2 produced at a coal plant is directly related to how much it operates. Thus, Enchant will have an incentive to operate the plant as much as it can to produce as much capturable CO_2 as possible and maximize the number of federal 45Q tax credits they will be eligible to receive and their potential profits. They will do this even if it means that the retrofitted San Juan coal plant will displace carbon-free renewable resources.

Paradoxically, San Juan will have to produce more CO_2 after being retrofitted for carbon capture.

A power plant's capacity factor compares how much energy (in megawatt-hours) the plant produces in the month, year or series of years, with how many megawatt-hours it would have generated if it had operated at full power for all the hours in the period. A higher capacity (as a percentage) is better; a lower capacity factor is worse.

As with other proposed carbon capture projects, Enchant's business model critically depends on the assumption that, magically, after being retrofitted for carbon capture, San Juan will start to operate at an 85% annual capacity factor, or higher, which would be some 21 percentage points higher than the plant has operated in the last three years.

Figure 3: San Juan's Recent Operating Performance vs. Enchant's Unrealistic Expectations for the Future



Source: EIA Form 923 data and the Sargent & Lundy pre-feasibility study for the San Juan Carbon Capture Project.

Regardless of what period you look at—the last three years, five years, or 10 years—San Juan's operating performance has been far lower than Enchant assumes it will achieve in future years after being retrofitted for carbon capture. In fact, San Juan Units 1 and 4, the two remaining units at the plant, have only achieved a combined 85% capacity factor in six individual months in the last five years and in a total of 12 individual months in the last 10 years.

If San Juan continues to operate about as well as it has in recent years, the financial viability of Enchant's proposed carbon capture project will be fatally undermined because the plant won't produce and capture enough CO_2. The federal 45Q tax credit program is straightforward: The more CO_2 produced and then either stored or reused via EOR, the more money earned. In other words, the total number of credits that a company earns is a function of how much CO_2 it produces and how much of the CO_2 it produces is captured. The program currently allows a plant owner to earn tax credits for the first 12 years after the retrofit goes into service.

If a future San Juan does not achieve an average 85% capacity factor, Enchant will not have any hope of capturing the 5.8 million to 6.0 million metric tons of CO_2 a year that it needs for its plan to succeed.

The Experience at Petra Nova Undercuts Enchant's Claims That Carbon Capture Technology is Commercially Proven

Proponents of carbon capture, including Enchant, claim without any supporting operational evidence that the technology has been proven and that proposed projects will be able to capture 90% or more of a plant's CO_2 emissions day in and day out over a 12-year period.[33] These claims bear little relationship to the performance to date at Petra Nova and Boundary Dam, the only two coal-fired carbon capture power plants in the world. After all, Petra Nova only operated for less than 3 ½ years, far less time than Enchant is projecting for its San Juan project. And Boundary Dam has only been capturing CO_2 for six and one-half years.

Proponents of carbon capture claim without any supporting operational evidence that the technology has been proven.

Petra Nova Did Not Capture 90% of the CO_2 During Its Short Operating Life

Petra Nova used the same carbon capture technology from Mitsubishi Heavy Industries America that Enchant plans to use at San Juan. Petra Nova was originally designed to capture at least 90% of the CO_2 from the flue gas in a 240MW slipstream from Parish Unit 8. Put another way, Petra Nova was expected to capture an average of 1.4 million metric tons (1.54 million short U.S. tons) each year, on average, or about 33% of the total annual emissions from Unit 8.[34] However, Petra Nova failed to achieve this goal, due to a series of operating problems, including some with its carbon capture technology.

In fact, Petra Nova captured only 3.54 million metric tons of CO_2 during its first three years of operation, or about 662,000 fewer than projected—despite the fact

[33] Enchant Energy/City of Farmington, *op. cit.*, p. 13. Similarly, Petra Nova has stated publicly that the facility achieves 90% capture of the processed fuel gas without seeing any actual operational data supporting this claim. See: Los Alamos National Laboratory. Preliminary Assessment of Post-combustion Capture of Carbon Dioxide At The San Juan Generating Station. December 2019, pp. 9-11.

[34] U.S. Department of Energy. W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project, Final Public Design Report. February 17, 2017. Also: EIA. Petra Nova is one of two carbon capture and sequestration power plants in the world. October 31, 2017. Also: U.S. Department of Energy. W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project Summary. September 2012.

that Parish Unit 8 actually generated more power and almost certainly produced more CO_2 than in previous years.[35]

Based on information in NRG's March 2020 Petra Nova report to the Department of Energy, it is clear that the project's actual CO_2 capture rate during this three-year period was in the range of 75%, not 90% (although it probably did achieve 90% capture on an intermittent basis).[36] That certainly does not establish that carbon capture has been "proven" or "demonstrated" over the long term.

This 75% range for Petra Nova's capture rate also does not reflect the CO_2 emissions from the combustion turbine that provided the power needed to run the project's carbon capture systems. When those are included, Petra Nova's effective CO_2 capture rate drops to somewhere in the range of 60% or lower.

In addition to assuming that San Juan would capture 90% or more of the CO_2 it produces, Enchant claims that the plant will operate at an 85% annual capacity factor after it is retrofitted. This would be far better (a) than the plant has performed in recent years and (b) Petra Nova operated before it was mothballed at the start of May 2020.

In fact, during its first three years of operation (the only period for which outage data is available), Petra Nova experienced some 356 full days (including equivalent full days) of unplanned outages due to issues with the carbon capture facility, the dedicated combustion turbine that powered the capture facility, the plant from which Petra Nova was capturing CO_2 (W.A. Parish Unit 8), the CO_2 pipeline, the oil field where the captured CO_2 was used for EOR and the weather.[37] These are the types of outages that any carbon capture project like Enchant's can be expected to experience. Petra Nova also was shut down for 52 days of planned outages. This suggests that the full Petra Nova carbon capture system had an effective capacity factor of about 63% from 2017 to 2019, far lower than the 85% capacity factor that Enchant assumes a retrofitted San Juan will achieve.

[35] Parish Unit 8's annual capacity factor rose from 68% in the two years before the start of operations at Petra Nova to 72% in the three-year period 2017-2019 after Petra Nova began capturing CO_2.
[36] U.S. Department of Energy. W.A. Parish Post-Combustion CO_2 Capture and Sequestration Demonstration Project, Final Technical Report. March 31, 2020, p. 47.
[37] U.S. Department of Energy, *op. cit.*, p. 41.

The Mothballed Petra Nova Project Also Shows the Financial Risk of Relying on Revenues From Enhanced Oil Recovery

Enchant is betting that CO_2 sales for EOR activities will account for 20% of the project's revenues, with another 40% coming from the existing federal 45Q tax credits.[38] But this may be difficult if not impossible to achieve, given the market uncertainties associated with using captured CO_2 for EOR.

NRG originally said the CO_2 captured at Petra Nova would be used to increase oil production at its West Ranch field to 15,000 barrels/day (b/d) from less than 1,000 b/d. However, daily production from the beginning of 2017 through the mothballing of the plant on May 1, 2020, only rarely topped 5,000 b/d.

On July 28, 2020, NRG, the operator and 50% owner of Petra Nova, announced it had suspended the capture of CO_2 and mothballed the project due to low oil prices. NRG's announcement must represent a flashing red warning sign for anyone considering retrofitting a coal plant for carbon capture or investing in such a project due to the significant market risks associated with using captured CO_2 for EOR.

But even before NRG's announcement, it was clear that the Petra Nova project has not been as profitable as NRG expected, if it has been profitable at all. By the time the project was mothballed in July 2020, the company already had taken impairments of almost all its $300 million equity investment in its subsidiary Petra Nova Parish Holdings.

In fact, in the four years before Petra Nova was mothballed, NRG had recorded three separate impairment charges related to the plant and Petra Nova Parish Holdings, the subsidiary that operates the facility. These charges totalled $310 million.

Given the inherent volatility of oil prices and current futures prices, the project may not be financially viable.

The first charge, taken in 2016 before the project was even complete, was $140 million. At the time, NRG cited declining oil prices.[39] NRG took a second impairment of $69 million in its investment in Petra Nova in 2017 based on a revised view of oil production expectations.[40] The last impairment, for $101 million, was taken in 2019.[41]

The profitability of retrofitting San Juan for carbon capture and using the captured CO_2 for EOR will be affected by actual and expected oil prices and by the competition

[38] Power Finance & Risk, *op. cit.*
[39] NRG Energy, Inc. Form 10-K. February 28, 2017.
[40] NRG Energy, Inc. Form 10-K. March 1, 2018.
[41] NRG Energy, Inc. Form 10-K. February 27, 2020.

among different CO_2 sources. Given the inherent volatility of oil prices and current futures prices, the project may not be financially viable despite Enchant's claims.

The Boundary Dam Carbon Capture Project Also Has Failed To Capture 90% of the CO_2 it Produces

Boundary Dam 3 is now the only other coal-fired power plant in the world that captures CO_2 although it does not use the same capture technology that Petra Nova used and that Enchant says it will use at San Juan. When it went into service in October 2014, SaskPower projected that Boundary Dam 3 would capture 1 million metric tons of CO_2 each year. However, the plant has only captured an average of slightly more than 615,000 metric tons annually.

Data published by SaskPower suggests that Boundary Dam 3's average CO_2 capture rate in the six-year-plus period between October 2014 and March 2021 fell somewhere around 48% to 50%.[42]

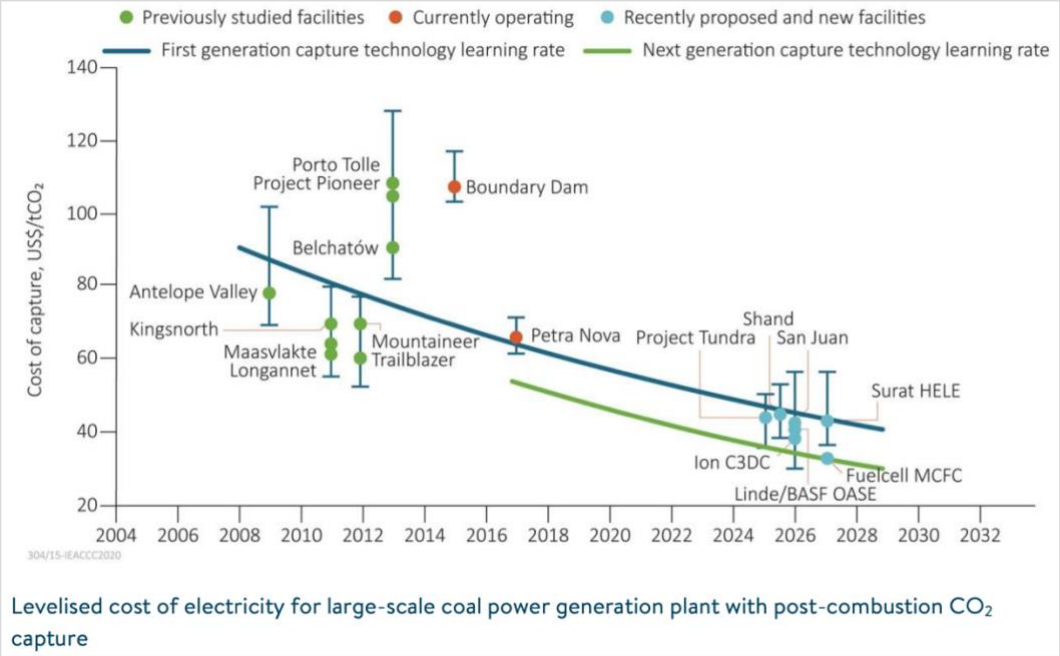
Contrary to Enchant's Claims, the Cost of Capturing CO_2 Has Not Declined by 30% Since Petra Nova and 65% Since the Boundary Dam Project

Without providing any supporting evidence, Enchant has claimed that the cost of CO_2 capture has decreased by 30% since Petra Nova and 65% since the Boundary Dam project.[43]

Proponents of carbon capture use a chart from the Global CCS Institute's *2019 Global CCS Status Report* to show that there are declining costs associated with carbon capture technology maturation based on "industry reports that show a downward trend in coal technology costs." This chart is reproduced below as Figure 4.

[42] SaskPower. BD3 Status Update: March 2021. April 14, 2021.
[43] Enchant Energy/City of Farmington, *op. cit.*, p. 7.

Figure 4: Misleading Claim of Downward Trend in Carbon Capture Costs



Source: IEA Clean Coal Centre - Carbon Capture Utilisation and Storage - Status, Barriers and Potential, Greg Kelsall, July 2020, p. 12.

Unfortunately, this figure is misleading in several ways and paints a false picture of carbon capture costs.

First, the only two potentially accurate capture costs shown in Figure 4 are the $60 to $65 cost for Petra Nova and the $100-plus cost for Boundary Dam. We say "potentially actual" because no actual operating costs have been released for Petra Nova or Boundary Dam 3. All the other carbon capture costs shown in the figure are merely estimates either for past projects that have not been built or for future projects that have not been built yet and may never be built.

Consequently, Figure 4 really only shows that proponents of future carbon capture projects are forecasting or assuming that the cost of capturing CO_2 at their projects will be lower than what they think Boundary Dam and Petra Nova have cost. But there is no hard construction and operating cost experience to back up their assumptions and, as such, there is no declining trend in the cost of carbon capture, as Figure 4 misleadingly implies.

Second, the range of costs shown for the various projects in Figure 4 are levelized costs of capturing carbon that in all, or at best, nearly all cases also are merely based on estimates and do not represent actual operating cost data.

Third, the levelized costs shown in Figure 4 assume that each project achieves an 85% capacity factor. In reality, Petra Nova only achieved only about a 63% capacity factor during the years 2017-2019. There has been no public information that we have seen on the actual operating performance of Boundary Dam Unit 3 since it was

retrofitted for carbon capture, but it is clear from monthly operating reports published by SaskPower that it has not come close to an 85% capacity factor. Consequently, the actual levelized cost of carbon capture at both facilities is likely higher (and probably significantly higher) than this figure suggests.

Any EOR activity also would require the permitting and the construction of a 28-mile pipeline to transport the CO_2 from San Juan to the Cortez pipeline owned by Kinder Morgan, which would then transport the captured gas to the Permian Basin.

The current uncertainty about EOR is not unique. For example, a November 2018 IEA report noted that there had been an 18 percent decline in oil production from North American EOR between 2014 and 2018.[44] The report cited several obstacles that have hindered EOR, pointing in particular to its cost disadvantage versus fracking.

The current uncertainty about EOR is not unique.

Uncertainties Cloud the Outlook for Geologic Storage of Any CO_2 Captured at San Juan

Although the upheaval in the oil and gas sector makes geologic storage appear less risky, there are plenty of potential pitfalls with this option as well.

Most importantly, there is no firm public data on the costs of compressing, transporting, injecting and monitoring the CO_2. Given the substantial costs for capturing the carbon in the first place, carbon sequestration-related costs need to be as low as possible to keep the project's overall costs in bounds. Unfortunately for Enchant and developers of other CO_2 sequestration projects, such costs may be higher than anticipated. In 2020 congressional testimony, former Energy Secretary Ernest Moniz told the Senate Energy and Natural Resources Committee: "While the geologic capacity is available and the technology is known, there are economic and social challenges. The costs of drilling, compressing, injecting and monitoring are estimated to be in the range of $20-$25 per ton of CO_2."[45]

If the costs of geologic storage are anywhere near that high, Enchant's project and similar sequestration-based CO_2 capture projects simply will have no chance of funding their initiatives via the $50-per-ton tax credit, forcing additional costs onto investors or the companies involved.

[44] IEA. Whatever happened to enhanced oil recovery? November 28, 2018.
[45] Energy Futures Initiative. Statement for the Record, Ernest J. Moniz, 13th Secretary of Energy, Before the Senate Energy and Natural Resources Committee. July 28, 2020, p. 8.

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David Schlissel, Director of Resource Planning Analysis for IEEFA, has been a regulatory attorney and consultant on electric utility rate and resource planning issues since 1974. He has testified as an expert witness before regulatory commissions in more than 35 states and before the U.S. Federal Energy Regulatory Commission and Nuclear Regulatory Commission. He also has testified in state and federal court proceedings concerning electric utilities. His clients have included regulatory commissions in Arkansas, Kansas, Arizona, New Mexico and California. He has also consulted for publicly owned utilities, state governments and attorneys general, state consumer advocates, city governments, and national and local environmental organizations. Schlissel has undergraduate and graduate engineering degrees from the Massachusetts Institute of Technology and Stanford University. He has a Juris Doctor degree from Stanford University School of Law.