BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW MEXICO'S CONSOLIDATED APPLICATION FOR APPROVALS FOR THE ABANDONMENT, FINANCING, AND RESOURCE REPLACEMENT FOR SAN JUAN GENERATING STATION PURSUANT TO THE ENERGY TRANSITION ACT	)	**Case No. 19-00195-UT**

REBUTTAL TESTIMONY

OF

THOMAS G. FALLGREN

January 13, 2020

NMPRC CASE NO. 19-00195-UT
INDEX TO THE REBUTTAL TESTIMONY OF
THOMAS G. FALLGREN

WITNESS FOR
PUBLIC SERVICE COMPANY OF NEW MEXICO

REBUTTAL TESTIMONY
OF THOMAS G. FALLGREN
NMPRC CASE NO. 19-00195-UT

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS.

A. My name is Thomas G. Fallgren. I am the Vice President of Generation for Public Service Company of New Mexico ("PNM"). My business address is Public Service Company of New Mexico, 2401 Aztec Rd., NE, Albuquerque, New Mexico, 87107.

Q. HAVE YOU FILED PRIOR TESTIMONY IN THIS PROCEEDING?

A. Yes, I filed Direct Testimony in support of PNM's Consolidated Application on July 1, 2019, Supplemental and Direct Errata Testimony on September 20, 2019, Rebuttal Testimony on November 15, 2019 in Case No. 19-00018-UT and Supplemental Rebuttal Testimony on December 12, 2019 also in Case No. 19-00018-UT. The Designation of Testimonies filed by PNM on August 7, 2019 identifies the portions of my Direct Testimony that apply to the second phase of this proceeding, relating to replacement resources for the San Juan coal plant generating capacity that PNM proposes to abandon.

Q. CAN YOU SUMMARIZE WHERE WE ARE IN THIS PROCEEDING, AND WHAT THIS PROCEEDING IS ABOUT, GIVEN THE DIFFERENT PHASES OF THIS PROCEEDING THAT YOU IDENTIFIED ABOVE?

A. This case is about New Mexico's energy future, as guided by the vision embodied in the Energy Transition Act. PNM is charting the course to that carbon-free

energy future, but as we noted in our original Direct Testimony, this will not happen all at once. Rather, this proceeding is about the first step to that energy future, but it is a significant first step. In our Consolidated Application we proposed abandoning our position in the coal-fired San Juan Units 1 and 4, the only remaining operating units at San Juan. We did so consistent with the guidance of the New Mexico Legislature in the Energy Transition Act. Our Consolidated Application also proposed four different resource portfolios to replace the generation PNM will be losing with the retirement of its interest in San Juan Units 1 and 4. Following our Consolidated Application, the case was essentially bifurcated and is being reviewed in two phases. The first phase, in Case No. 19-00018-UT, involved our request to abandon our interest in San Juan Units 1 and 4, and associated cost recovery issues. The hearing on that phase was completed in December 2019.

This second phase, which our Rebuttal Testimony here addresses, focuses on the specific question of the appropriate resource portfolio to replace the generation capacity we will be losing when we complete our abandonment of San Juan Units 1 and 4. As we explained in our Direct Testimony, and as I and other PNM witnesses discuss here in Rebuttal Testimony, it is important that we move forward with the right replacement resource portfolio, based on familiar resource planning imperatives like cost and reliability, but that also considers specific directives in the Energy Transition Act relating to community impacts and environmental concerns. In our Direct Testimony, we put forth four different

replacement resource portfolios in the interest of being as comprehensive as possible, but we made clear that we believed the first scenario, which we refer to here as "PNM Scenario 1," best balances the considerations of cost, reliability, community impact and environmental concerns.

PNM Scenario 1 is also balanced from the perspective of utility-owned assets and Power Purchase Agreements ("PPAs"), and in terms of resource types. It would add new solar, battery, and flexible natural gas resources to PNM's system. Those resources are balanced between utility ownership (350 MW) and PPAs (410 MW). In the same fashion, new utility scale battery resources being introduced to PNM's system for the first time would also be balanced between utility ownership (70 MW) and PPAs (60 MW).

The New Mexico Public Regulation Commission ("Commission") has now received Direct Testimony from a number of intervenors suggesting changes to, or alternatives to, PNM Scenario 1. We have carefully reviewed this intervenor testimony, and if anything, the sum of the proposals serves to reaffirm our belief that PNM Scenario 1 can and should be viewed as a balanced proposal that will best achieve the objectives outlined in the Energy Transition Act. While we appreciate the engagement from many stakeholders on these important issues, the intervenor testimony reflects that some of these stakeholders don't fully understand PNM's system, the reliability requirements we must meet, or the fact that modeling alone does not always capture real-life system operational issues

that PNM must always consider. Based on our responsibility to provide reliable service, and our experience in operating the PNM system, we believe that this first step to New Mexico's energy future is best taken by proceeding with PNM Scenario 1, and therefore reaffirm the request we made in our Consolidated Application and Direct Testimony that the Commission approve and authorize us to proceed with PNM Scenario 1.

Q. WHAT IS THE PURPOSE OF THIS REBUTTAL TESTIMONY?

A. My testimony in this phase of the proceeding addresses Staff and intervenor testimony relating to PNM's proposed replacement resource portfolios, and in particular, PNM Scenario 1. I introduce PNM's rebuttal witnesses and summarize other parties' positions, and PNM's response. I also respond to specific issues raised by Staff and intervenors, including criticism of the process PNM used to determine the resources it included in its Scenario 1 proposal, and criticism of specific resources included in PNM Scenario 1 and related issues. I also refute suggestions that the Commission does not need to determine a replacement portfolio for the capacity being retired at the San Juan coal plant at this time.

Q. PLEASE SUMMARIZE PNM'S REBUTTAL TESTIMONY.

A. In addition to my Rebuttal Testimony, eight other witnesses are filing rebuttal testimony. Below, I provide a brief summary of topics covered by each rebuttal witness. If PNM does not respond to a specific argument or alternative proposal, that should not be interpreted as agreement with that argument or proposal. As a

practical matter, my rebuttal testimony focuses at a higher level on common themes presented in the Staff and intervenor testimony.

Witness	Testimony
Nicholas Phillips	Responds to the modeling scenarios and assumptions developed by various intervenors, as well as Staff recommendations on CCUS and Scenario 2 selection.
Nick Wintermantel	Responds to testimony from CCAE, Sierra Club, and SWG addressing SERVM modeling regarding system reliability and cost.
Gary Dorris	Responds to testimony from SWG and Sierra Club addressing PowerSimm modeling and modeling EIM impacts. Addresses the importance of flexible natural gas plants in the transition to more renewable resources.
William Kemp	Responds to testimony from Sierra Club, CCAE, and SWG, regarding prudent battery sizing and the battery procurement process.
Roger Nagel	Responds to testimony from Sierra Club, CCAE, SWG, and WRA regarding the resource RFP process.
Steven Maestas	Responds to testimony from Sierra Club, CCAE, and SWG by providing background regarding the reliability requirements of the PNM system, including reliability requirements that apply to PNM as a Balancing Authority.
Michael Settlage	Responds to testimony from NM AREA suggesting rate structure changes in this proceeding that are better suited for consideration in a future rate case.
Tom Duane	Responds to testimony from Sierra Club, SWG and CCAE regarding transmission constraints on PNM's system.

Q. WHAT DOES PNM RECOMMEND AFTER REVIEWING THE DIRECT TESTIMONIES FILED BY PARTIES TO THIS CASE?

A. After review of Staff and intervenor direct testimonies in this case, PNM continues to believe that PNM Scenario 1 offers the most balanced path forward. While many parties offered different segments to the replacement resources, and

we value and understand the advocacy of their choice of resources, PNM and the Commission are ultimately responsible to balance all aspects of customer costs, system reliability, and our environment. As such, PNM begins the transition to New Mexico's carbon-free energy future as envisioned by the policy directives in the Energy Transition Act. While many parties have offered modifications or alternatives for the Commission to consider, PNM believes that PNM Scenario 1 best balances cost and reliability considerations, along with specific environmental and community impact considerations specified in the Energy Transition Act, which benefit all New Mexicans. PNM recommends that the Commission approve PNM moving forward with PNM Scenario 1, as outlined in our Direct Testimonies, and further discussed in our Rebuttal Testimonies.

Q. HOW DOES THIS FIRST STEP PROPOSED BY PNM FIT INTO THE OVERALL GOAL OF ACHIEVING 100 PERCENT CARBON-FREE ENERGY?

A. The Energy Transition Act establishes the energy policy for the State of New Mexico and provides a path for utilities to achieve 100 percent carbon-free energy by 2045. PNM's objective is to meet this goal by 2040. The first step outlined in this proceeding is in alignment with PNM's 2017 IRP analysis regarding the retirement of the San Juan coal plant in 2022, and it also positions PNM well for the longer-term to achieve 100 percent carbon-free energy by 2040. This important first step transitions approximately 20 percent of PNM's generation capacity resources and approximately 30 percent of PNM's energy supply to

cleaner resources. It introduces large-scale energy storage technology into PNM's resource portfolio for the first time in a thoughtful manner, to allow PNM to evaluate and further integrate this promising technology on PNM's system while it continues to become more cost-competitive. To ensure reliability while PNM continues to add and integrate renewable resources onto its system, PNM Scenario 1 includes a limited amount of flexible natural gas resources. Beyond maintaining reliability, PNM Scenario 1 also provides support for communities impacted by the retirement of San Juan Units 1 and 4, as contemplated by the Energy Transition Act. With the implementation of PNM Scenario 1, PNM's resource portfolio will be well-positioned for future steps under the Energy Transition Act, which potentially include the transition out of an additional 20 percent of PNM's generation capacity between 2023 and 2031. PNM Witness Dr. Dorris discusses how PNM's Scenario 1 is consistent with the approaches utilized by other utilities that are also leading the industry in the transition to a carbon-free energy system.

II. SUMMARY OF INTERVENOR DIRECT TESTIMONY

Q. WHAT INTERVENOR PARTIES EXPRESSED SUPPORT FOR PNM SCENARIO 1?

A. The New Mexico Attorney General was generally supportive of PNM Scenario 1. New Mexico Affordable Reliable Energy Alliance ("NM AREA") was also generally supportive of PNM Scenario 1, subject to its request for a conditional

approval of PNM's legacy Incremental Interruptible Power Rate ("IIPR"), for which the Commission has already established a review process in PNM's next rate case. Interwest Energy Alliance ("Interwest") is also generally supportive of PNM Scenario 1, and Interwest Witness Tysseling identifies the economic benefits of greater renewable additions presented by PNM Scenario 1.

Q. WHAT ABOUT OTHER PARTIES WHO HAVE SUGGESTED ALTERNATIVES TO PNM SCENARIO 1?

A. Generally, I would group the direct testimony of these other parties into the following categories:

1) Some intervenors suggest alternative resource selections that focus on particular aspects of this transition such as maintaining the tax base in the Central Consolidated School District ("CCSD"), or more renewable resources. However, these alternative portfolios do not effectively address system reliability requirements and result in higher cost scenarios. PNM Witnesses Phillips, Wintermantel, and Dorris more directly respond to this testimony from Westmoreland Coal Company ("Westmoreland"), Sierra Club, San Juan County/City of Farmington ("San Juan Entities"), Southwest Generation Operating Co., LLC ("SWG"), Coalition for Clean Affordable Energy ("CCAE"), Western Resource Advocates ("WRA") and the Utility Division Staff ("Staff").
2) Some intervenors take issue with the resource selection process and suggest further requests for proposals ("RFPs") or a "wait and see" approach. PNM

Witness Nagel and I both address these testimonies from SWG, the San Juan Entities, WRA, Westmoreland, CCAE and Staff.

3) Some intervenors take issue with PNM's measured approach to introducing batteries to the PNM system. PNM Witnesses Kemp, Maestas, Wintermantel, Phillips, and I address testimonies from SWG, CCAE, and Sierra Club.

Q. WHAT IS YOUR MAIN TAKEAWAY WITH REGARD TO THE VARIOUS ALTERNATIVE PROPOSALS SUGGESTED BY THE INTERVENORS?

A. My primary observation is that the alternatives presented by many intervenors, while providing a wide range of proposals, appear driven by the individual perspectives and objectives of each of the intervenors. Many of the suggested alternative options are outside of those provided in response to PNM's All Source RFP process. Some of the alternative proposed options are not even available or viable today and may not be available or viable in 2022 when the resources will be needed. Many of the proposals also require significant changes in fundamental modeling inputs in order for the model's outputs to fall within reliability parameters. These alternative options presented do, however, speak to the transparency of PNM's replacement resource identification and selection process, as the development and presentation of these alternative options was facilitated by open access to the resource modeling tools PNM utilized to develop its portfolio scenarios. The wide variation, and in some cases, singular focus of the intervenor alternative options also serves to spotlight PNM's Scenario 1 as a reasonable

forward-looking path that best balances cost, reliability, environmental and community impact considerations, as required under the Energy Transition Act.

Q. WHAT ELSE DID YOU NOTE FROM REVIEWING STAFF AND INTERVENOR DIRECT TESTIMONY?

A. As I noted, many of the proposals unfortunately overlooked or simply did not address critical reliability considerations or produced scenarios that are more costly to PNM customers than PNM Scenario 1. Of particular concern are the overly-aggressive suggestions proposing immediate large-scale deployment of batteries. Today PNM has virtually no battery storage on its system. While it is true that some utilities in other states are integrating larger battery programs into their systems, batteries remain a relatively new technology for most utilities, including PNM, and therefore present a new technology risk. The measured, yet still significant, battery deployment proposed in PNM Scenario 1 is more appropriate than the unconstrained full dive in proposed by some parties. PNM Witnesses Kemp and Maestas discuss in their Rebuttal Testimonies the need for PNM to take the more measured approach to battery integration, in order to allow energy storage technology to further develop and to appropriately integrate this new technology into real-world operations. This approach allows for potential price reductions as this technology matures, while enabling PNM to develop expertise in the operation and integration of batteries on its system.

As another example of intervenor proposals that fail to adequately consider system reliability issues, the "no new gas" proponents underestimate how important the proposed Pinon Gas Plant will be in facilitating PNM's overall transition to renewable energy resources without jeopardizing system reliability. As PNM Witnesses Phillips, Wintermantel, Dorris, and Maestas explain in more detail, the seven LM6000 gas generation units that will comprise the 280 MW capacity Pinon Gas Plant will allow PNM to provide greater flexibility and much faster ramp times than most of PNM's current gas-fired generation. This is critical to the ongoing and increasing integration of variable renewable resources as part of PNM's transition under the Energy Transition Act. These LM6000 units can also meet load requirements through extended periods of low renewable production, beyond the capabilities of 2- or 4- hour battery systems, which is also critical for the successful integration of renewable resources. Reliability, including resource integration considerations, is always a primary concern when PNM recommends a portfolio. System reliability and integration considerations are particularly paramount here, as PNM undertakes the phased replacement of significant portions of its existing resources to a carbon-free energy future. Contrary to the implicit assumption of some intervenors that these gas resources will displace renewable resources, the Pinon Gas Plant will actually facilitate the reliable deployment of more renewable resources on PNM's system and can help reduce curtailments of renewable resources under various operating conditions.

I would add that, from a carbon emissions perspective, PNM Scenario 1 is expected to produce a 62 percent reduction from 2005 carbon dioxide levels, which will provide immediate and significant environmental benefits as we commence this transition. As PNM Witnesses Phillips and Kemp discuss in their Rebuttal Testimonies, the "no new gas" scenarios proposed by various intervenors would not significantly further this immediate carbon reduction.

Q. DID ALL THE INTERVENORS PRESENT COMPREHENSIVE PORTFOLIO PROPOSALS?

A. No. Many of these proposals were not comprehensive portfolio proposals, but rather, overly simplistic suggestions that PNM should remove only certain resources from its proposed Scenario 1 portfolio and replace them with different resources of similar capacity. But PNM cannot simply swap out one 50 MW resource for a different 50 MW resource, and just ignore the implication of this change to the overall resource portfolio. This cherry-picking approach will not work and would undermine the core principles of prudent modern resource planning, which embraces a holistic approach to portfolio evaluation. The various resources proposed by PNM in this case have very different attributes that must work in concert with PNM's existing generation fleet, so it is essential to view PNM's proposed portfolio of resources as a whole. This is highlighted in PNM Witness Phillips' Rebuttal Testimony, where a hypothetical replacement of the 280 MW of proposed flexible gas with a Power Purchase Agreement ("PPA") for 280 MW of coal plant retrofitted with Carbon Capture Utilization and

Sequestration ("CCUS") controls would cause the portfolio to exceed the targeted reliability threshold by a factor of three. This is also particularly true with renewable resources, which require a comprehensive approach in order to efficiently integrate those resources into PNM's system. Finally, resource selection must also take into account existing transmission constraints. PNM Witnesses Phillips and Duane also discuss these issues in their Rebuttal Testimonies.

Q. YOU ALSO MENTIONED THAT SOME INTERVENORS SUGGEST THAT PNM TAKE A "WAIT AND SEE" APPROACH. HOW DO YOU RESPOND TO THAT TESTIMONY?

A. Some of the intervenors propose that PNM take a "wait and see" approach before fully implementing PNM Scenario 1, in order that PNM might be able to consider potential alternative resources in the future. Such an approach is also fundamentally contrary to sound resource planning, as it would still create the "cherry-picking" concern I previously addressed, substituting one resource for another outside the considerations of a full resource plan. It could also expose PNM to even greater reliability risks by requiring PNM to defer until the future known resource needs that PNM has identified today, leaving customers to face market and operating risks that are avoided by ensuring replacement resources are already in place during peak load summer months when PNM stops operating the San Juan coal plant. PNM Witnesses Phillips, Kemp, Wintermantel, Dorris, and Maestas each discuss this in more detail in their Rebuttal Testimonies.

By way of example, some parties suggest PNM should hold off on its proposed Pinon Gas Plant, and instead "wait and see" what ultimately happens with San Juan Units 1 and 4, in order to be in a position to consider a hypothetical future PPA to buy power from San Juan if the coal plant is successfully retrofitted with CCUS. While PNM understands that Enchant Energy Corporation ("Enchant Energy") is working with the City of Farmington ("Farmington") on a potential CCUS retrofit venture for San Juan, neither PNM, nor anyone else, knows today if that project will proceed. At the present time, it is widely known in the utility industry that CCUS is still in the development stage in terms of retrofitting large coal plants such as San Juan Generating Station. PNM does not oppose the efforts of Farmington and Enchant to pursue this venture, but given the current status of CCUS technology and related pre-feasibility cost estimates, PNM has significant and well-founded concerns about whether a CCUS retrofit of San Juan could develop into a low-cost option for PNM's customers.

Furthermore, as more fully discussed by PNM Witness Phillips in his Rebuttal Testimony, an equivalent-sized PPA from a CCUS-retrofitted substitute for the proposed Pinon Gas Plant would result in a significant risk of a reliability event and make it more challenging for PNM to integrate additional renewable resources on its system, which would lead to cost increases for PNM's customers. The best course of action going forward would be for Enchant Energy to provide indicative terms and conditions for a PPA, so that PNM can evaluate this potential

resource in the context of the 2020 IRP and determine if the PPA would be part of the most cost-effective portfolio as the Company heads into the next phase of the energy transition.

Finally, a "wait and see" approach is not appropriate because the Energy Transition Act requires PNM to begin charting our customers' energy future today. PNM is proposing to replace the nearly 500 MW of nameplate coal capacity due to the retirement of San Juan Units 1 and 4 — roughly 20 percent of PNM's total generation capacity and approximately 30 percent of the system energy supply —with a balanced mix of 760 MW of generation capacity in PNM Scenario 1.[1] Resource additions of this magnitude take time to implement. As I noted above, PNM's balanced portfolio of replacement resources presented in PNM Scenario 1 is a critical first step toward 100 percent carbon-free energy. The speculative possibility that there could be potential resources available for future consideration should not be grounds for jeopardizing PNM's overall ability to reliably meet customer needs in 2022, or to meet the initial milestone in reaching the longer-term goal of 100 percent carbon-free resources.

[1] I explain in my Direct Testimony (at p. 14) why the proposed intermittent renewable energy resources to be added to PNM's system under PNM Scenario 1 would require a nameplate capacity greater than the 497 MW of nameplate capacity being retired from San Juan Units 1 and 4.

III. RESOURCE SELECTION PROCESS

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

A. In this section I respond to various criticisms of PNM's RFPs and resource selection process. PNM Witnesses Nagel and Kemp address these issues in greater detail in their Rebuttal Testimonies. I touch on these issues here because it is important for the Commission to understand that in evaluating the various resource scenarios advanced by PNM and other parties, PNM's RFP and selection process was comprehensive, fair, and transparent.

A. General Criticisms Regarding PNM's Resource Selection Process.

Q. WHY DO YOU BELIEVE THE CRITICISMS OF PNM'S RESOURCE SELECTION PROCESS ARE UNWARRANTED?

A. Many of these criticisms are simply broad-brush rejections of the competitive selection process, intertwined with assertions that PNM's preferred Scenario 1 replacement resource portfolio is generally flawed. The Commission should reject these kinds of overbroad criticisms and impractical recommendations. PNM's RFP process resulted in 390 proposals that varied greatly in terms of technology, location, size, and financing and ownership considerations. Bid responses, data and results were all made available during the discovery process in this case. PNM spent significant time analyzing individual and combinations of proposals and engaged in extensive modeling with the assistance of outside consultants with industry leading experience. The RFP results reflect competitive

low-cost bids for a range of resources and the reasonableness of the resulting prices has not been challenged. The Commission also required a comprehensive stakeholder process through which PNM conducted meetings and modeling education sessions. In the course of these proceedings, PNM provided resource modeling capabilities at no cost to all stakeholders and responded to more than 2,100 discovery questions from the various parties directed toward the analysis, modeling, and selection processes. PNM Witness Nagel addresses these issues in more detail in his Rebuttal Testimony, and I disagree that PNM's process to identify and select resources was flawed. To the contrary, the complexity of the process required significant time to ensure that the proposed portfolio would be low cost, meets system needs, and complies with the Energy Transition Act. That complex process has in fact produced such a portfolio: PNM Scenario 1.

Q. WHAT IS YOUR RESPONSE TO CRITICISMS THAT PNM SHOULD HAVE UPDATED ITS ANALYSIS OF REPLACEMENT OPTIONS BASED ON ENERGY TRANSITION ACT CRITERIA?

A. The suggestions made by CCAE Witness Comings and SWG Witness Babcock that there is a mismatch between the 2017 All Source RFP criteria and the 2019 resource selection evaluation are inaccurate. PNM expressly considered the Energy Transition Act in its evaluation process and did not finalize resource selections and propose alternative portfolio scenarios until June 2019, after the Energy Transition Act was signed into law. Further, the responses PNM received to our All Source 2017 RFP provided a wide variety of generation and storage

resources that would be suitable to fulfill the requirements of the Energy Transition Act, including increasing renewable resources and reducing carbon emissions over the long term. The types of resources requested in the RFP process did not change as a result of the Energy Transition Act. Rather, the Energy Transition Act informs utilities on how resources (including energy storage systems) should be evaluated and weighted in order to comply with ongoing and increasing RPS and carbon-free standards. As such, there would be no material difference in the types of resources that PNM would receive and evaluate, and PNM would not change the evaluation criteria it applied to the bids. PNM would still apply the statutory obligations for selection contained in the Energy Transition Act. As further explained by PNM Witness Phillips, the replacement resource portfolio for PNM Scenario 1 is also consistent with the 2017 IRP process, which considered high renewable portfolio standards similar to those outlined in the Energy Transition Act.

Q. SWG WITNESS BABCOCK CLAIMS THAT BASED ON THE PASSAGE OF TIME BETWEEN THE BID RESPONSE AND THE FINAL RESOURCE SELECTIONS THE BIDS WERE STALE. HOW DO YOU RESPOND?

A. SWG Witness Babcock is incorrect in his assertion that the bids were stale. The RFP process requested an initial proposal in January 2018 utilized for shortlisting the bids, a price refresh was completed for the short-listed projects in August 2018, and ongoing negotiations with best in class finalists continued through June

2019. This process was intended to, and did, keep the proposals current and competitive.

B. Recommendations to Reissue the Energy Storage RFP.

Q. HOW DO YOU RESPOND TO THE RECOMMENDATIONS THAT PNM BE REQUIRED TO REISSUE THE SPECIFIC ENERGY STORAGE RFP?

A. As a practical matter, PNM cannot go backwards at this point in the resource replacement process, although here I would note that PNM did issue a supplemental RFP specific to energy storage in April 2019 to ensure that PNM would be fully able to consider all battery bids, as I explain later. Beyond this, there are two additional problems with the recommendations to again rebid energy storage systems. First, the suggestion that PNM might get improved pricing in new bids is speculation. In fact, improved pricing would be unlikely because the existing bids incorporate pricing and terms that are based on an initial installation period and expected in-service dates that have not changed. Second, the system constraints such as transmission limitations that accounted for PNM's battery selection in the first place have also not changed.

Q. PLEASE EXPLAIN YOUR STATEMENT THAT BID PRICING WOULD LIKELY NOT CHANGE EVEN IF YOU REISSUED THE ENERGY STORAGE RFP.

A. As discussed by PNM Witness Nagel, one of the primary drivers for battery pricing is the installation date. The indicated installation date for batteries (prior to June 30, 2022) has not changed throughout this process. In addition, continuing to issue RFPs without completion of the selection process creates "bidder fatigue," in which some bidders choose not to participate in successive rounds of bidding due to the costs to prepare additional bids, and lack of confidence in when the bidding process will actually result in bid selections. PNM anticipates likely bidder fatigue if an additional RFP was reissued. Importantly, bids from the supplemental storage RFP were not used to replace original bidders during the evaluation process. The Energy Storage Agreement ("ESA") bids were considered equally with potential new Engineering, Procurement and Construction ("EPC") bids. The best of the ESA bids were included as short-listed projects and therefore pricing for these ESA bids was updated as part of the process in August 2018. Therefore, the speculation that PNM would experience significant changes through a rebid process is unfounded.

The second problematic assumption of reissuing our energy storage RFP is it would not be feasible given the time constraints PNM is operating under to implement replacement resources for San Juan Units 1 and 4 in conformity with the Energy Transition Act. As noted earlier, resource additions must be selected and modeled as part of an integrated portfolio. Selectively choosing specific resources and assuming that a replacement resource would meet those same attributes could result in system reliability deficiencies. Nor is there any kind of

guarantee that the resulting combination of resources will achieve lower costs for customers. Therefore, the premise that the Commission could approve only selected resources included as part of PNM Scenario 1 and either wait or swap other resources in just because they appear to be similar is inconsistent with prudent resource modeling and resource selection practices. A pick-and-choose approach to the approval of selected resources would essentially result in no true approval of resources going forward, because PNM would not able to fully analyze the reliability of the portfolio as a whole. As noted previously, a seemingly simple exchange of 280 MW of flexible natural gas for 280 MW of coal with CCUS can significantly change overall system reliability as well as the necessary renewable curtailments, thereby impacting the economic benefit of those renewable resources.

Q. PLEASE FURTHER EXPLAIN YOUR STATEMENT THAT SYSTEM LIMITATIONS THAT SHAPED PNM'S SELECTION OF BATTERY RESOURCES WILL NOT HAVE CHANGED EVEN IF YOU REISSUED THE ENERGY STORAGE RFP.

A. SWG Witness Babcock suggests that reissuing the energy storage RFP could also result in PNM selecting battery resources in the Central Consolidated School District. The flaw in his logic is that PNM cannot simply move a battery from Point A to Point B, as he assumes, without system impacts. Resources cannot be moved to a different location without properly considering system transmission constraints that could make such a change physically unworkable or could

compromise other low-cost resources already utilizing those available transmission lines. Reissuing a new RFP for battery storage as suggested by SWG Witness Babcock that could provide more batteries in the Central Consolidated School District would jeopardize the other low-cost resource selections available in PNM Scenario 1, because there is limited transmission capability from the Four Corners area to the PNM load center. It also negates system benefits that can be achieved from load center placement of energy storage systems.

Q. GIVEN THESE CONSIDERATIONS WHY DID PNM ISSUE THE SUPPLEMENTAL ENERGY RESOURCES RFP IN APRIL 2019?

A. The April 2019 supplemental energy storage RFP ensured that PNM would be able to fully consider all battery options, and the resulting combination of third-party and utility-owned battery systems selected reflects that. Many of the EPC bids received in the All Source RFP were initially eliminated because EPC bidders were required to have a New Mexico contractor's license at the time of bid submission, while ESA providers did not have the same requirement, and many EPC bidders did not possess such a license. The supplemental energy storage RFP ensured a full range of attributes of battery storage that could be evaluated to best serve PNM customers. Both the shortlisted All Source RFP ESA provider bids and the supplemental RFP EPC bids were equally considered and evaluated in the same modeling process to determine the replacement resource mix for PNM Scenario 1.

This was important, because, while batteries themselves are a known technology, the introduction and integration of batteries into utility generation portfolios is still relatively new. The utility industry is trying to develop modeling software that is able to demonstrate and capture the full value of battery storage facilities. Battery storage facilities not only provide energy arbitrage but also ancillary services such as frequency response, spinning reserve, and ramp control. A utility's ability to realize the full potential offered by battery storage facilities is dependent on the operation, control and location of those battery storage facilities. Section 25 of the Energy Transition Act outlines the potential stacking of these battery values to best serve customers. Therefore, PNM's supplemental energy storage RFP, coupled with the All Source RFP, ensured that PNM had a full range of options to evaluate that would allow this full value stacking of battery energy storage facilities to be considered as part of an integrated resource portfolio. As an example, a 2-hour battery that is owned by the utility can provide many ancillary services and therefore provides more system benefits, per installed capital cost, than a 4-hour ESA battery that facilitates only energy arbitrage. PNM Witness Maestas addresses the ancillary service and value that utility-owned batteries can provide in his Rebuttal Testimony.

Q. DO THE ENERGY STORAGE SYSTEMS SELECTED AFTER EVALUATING ALL OF THE BATTERY BIDS REFLECT THE RANGE OF BENEFITS THAT CAN BE GAINED FROM BOTH ESA PROJECTS AND UTILITY-OWNED SYSTEMS?

A. Yes. PNM ultimately selected a combination of ESA and EPC bids that include two lower-cost ESA projects with 4-hour batteries with more limited control and fewer system benefits, and two EPC projects with 2-hour batteries and full utility control and operation to optimize system benefits. These projects also employ different battery technologies, which allows PNM to assess operating characteristics based on battery type. PNM Exhibit TGF-1 (Rebuttal) shows these differences among the PNM Scenario 1 energy storage bids.

Q. WHAT ARE THE ANCILLARY SERVICES YOU REFERENCE THAT CAN BE PROVIDED BY UTILITY-OWNED BATTERY SYSTEMS?

A. The service provided by a utility is mainly thought of as supplying energy to customers when necessary. However, in order to perform this function, there are a number of complex supporting functions that must also be provided to ensure this energy delivery can be completed in a safe and reliable manner. These additional supporting services are referred to as ancillary services and include such items as spinning reserves, frequency response, and ramp control. These service requirements are variable and most often require immediate response capability that is not subject to contractual limitations. While some of these ancillary services can be provided by ESA contracts that allow the utility some level of control over batteries, utility ownership provides the full range of unrestricted utilization of these ancillary services benefits. While ESA projects may have attractive pricing, this pricing is generally the result of the third-party owner's ability to limit charges and discharges, which may also be further

restricted when combined with a renewable energy resource so as not to jeopardize associated tax credits.

Q. YOU ALSO MENTIONED POTENTIAL STACKING OF BATTERY VAULES. PLEASE EXPLAIN WHAT YOU MEAN BY STACKING.

A. Batteries are a somewhat unique resource in that they have a wide range of capabilities. While batteries, especially in an ESA contract, focus on providing energy arbitrage and system capacity benefits, batteries can also provide the ancillary services discussed above and the other benefits as more fully described by PNM Witness Kemp. The combination of these various battery functions is often referred to as "stacking" the battery value functions. The ability to utilize the full functionality of a battery depends on its integration with the rest of the electric system and can depend on such things as its location on the transmission system. The complication of these stacked battery values is that not all of the values can be utilized at the same time and using one of the values (such as discharging for capacity support) can leave other battery value options unavailable (such as the ability to respond to frequency events). Having both the operational flexibility and integration with the electrical system allows utility ownership of batteries to better optimize this full stacking of battery values.

Q. PLEASE RESPOND TO ISSUES RAISED BY INTERVENORS WITH RESPECT TO PNM'S APPROACH TO THE INITIAL INTRODUCTION OF BATTERY RESOURCES.

A. The intervenors are incorrect in their assertion that it was unnecessary or unreasonable to place constraints on the battery selection. I address specific issues relating to new battery resource integration to PNM's portfolio later in my Rebuttal Testimony, including considerations of PNM-owned batteries versus ESAs and site control for battery deployment. PNM Witnesses Kemp and Maestas describe in greater detail these issues in their Rebuttal Testimonies. Here, I want to focus on why it was appropriate to limit the amount of new battery storage in the evaluation phase, and when PNM developed its scenarios.

Q. WHAT WERE THE LIMITS THAT PNM PLACED ON BATTERY STORAGE IN DETERMINING RESOURCES FOR ITS ALTERNATIVE ENERGY TRANSITION ACT SCENARIOS?

A. During the portfolio selection process, PNM determined it would be prudent to limit new battery resources in the San Juan replacement resource portfolio to no more than 130 MW total, with no single battery resource greater than 40 MW. It should be noted that the 130 MWs is in alignment with the unconstrained lowest-cost model portfolio as discussed more fully by PNM Witness Phillips. PNM did this because of important reliability considerations, taking into account PNM's inexperience with battery resource technologies, and the need to establish battery operating protocols, software algorithms, and training for system operators as discussed by PNM Witness Maestas. PNM also took into consideration price risks for customers, based on PNM's experience with declining pricing over time in renewable technology markets.

Q. WOULD IT HAVE BEEN REASONABLE TO CONSIDER UNLIMITED ENERGY STORAGE REPLACEMENT RESOURCES IN LIGHT OF PNM'S INEXPERIENCE WITH UTILITY SCALE BATTERIES?

A. No, and I want to emphasize that utility scale batteries don't function as simply "on and off" technology, nor do they function independently from the rest of PNM's system. Battery integration requires an ever-increasing level of complex integration with the overall PNM system. While solar-plus-battery combination options can facilitate the low-cost introduction of batteries as described by CCAE Witness Desu, this level of battery integration is generally limited to a fairly constrained value of energy arbitrage. At lower integration levels this provides an initial economic benefit for batteries, but does not unlock the full battery values available and necessary as the percentage of battery penetration increases on the system. To realize the full value of a battery on the PNM system, the control system for the battery must be fully integrated with the existing PNM system and marketing functions. A comprehensive control system must not only consider the battery charge and discharge state, it must also factor in system spinning reserve needs, frequency response, charge condition relative to forecasted wind or solar production, existing and future market conditions, and overriding reliability algorithms that retain overall system capacity needs necessary to meet system reliability requirements. Development of operational knowledge, system algorithms and operator experience with battery systems is critical prior to a larger scale battery deployment.

Q. HOW DID PNM DETERMINE THE APPROPRIATE LEVEL OF INITIAL BATTERY STORAGE TO ADD TO ITS SYSTEM WHEN EVALUATING PORTFOLIOS?

A. As discussed in the Direct Testimonies of PNM Witness Wintermantel and Phillips, preliminary modeling identified that the optimal level of battery deployment for PNM's system was between 150-170 MW of battery storage. This initial modeling consisted of one large 150 MW battery and another smaller 20 MW, both paired with solar projects for ITC purposes. The solar battery pairing led to a reduction in cost, but also restricted the use of the battery and presented a high single battery site technology risk.

As discussed in my Direct Testimony at pages 21 to 24, and as further addressed by PNM Witness Kemp in his Rebuttal Testimony, PNM identified that based on the size of PNM's system and experience level with batteries, that for the initial battery deployment, PNM should consider a maximum project size of 40 MW. As further discussed by PNM Witnesses Wintermantel and Phillips, the results of PNM's refined modeling that incorporated the 40 MW project size cap resulted in an optimal level of battery deployment for PNM's system between 100-130 MW, a level very much aligned with the original modeling but comprised of four batteries: two paired with solar projects and two stand-alone batteries that could be operated more flexibly. The 130 MW level of deployment is aligned with PNM Witness Kemp's recommended introductory limit established at 5 percent of PNM's Balancing Area Authority overall estimated

peak load in 2022. As a measure of PNM retail load this value would be closer to 6.4 percent. PNM felt this was appropriate because batteries are a new technology for PNM and this represented a high level of penetration of batteries relative to current industry experience and PNM's experience in particular, as I describe below.

Q. CAN YOU PROVIDE AN OVERVIEW OF PNM'S EXPERIENCE WITH BATTERIES, AND THE ENERGY STORAGE ON PNM'S SYSTEM TODAY?

A. Yes, and this is something I want to emphasize. While other utilities like Florida Power & Light may have some initial experience with batteries on their systems, as discussed in the Direct Testimony of Sierra Club Witness Goggin, PNM has virtually none. Currently, the only battery on PNM's system is a 1 MW/1 MWh lead-acid battery set coupled with a ½ MW solar field. The battery-solar facility was part of an EPRI pilot project. PNM has gained limited experience from this small battery project on how to use batteries; principally to smooth and match the output of the solar resource to meet the needs of the lower-voltage neighboring distribution system. Due to the small size of this battery and lack of its integration with the full PNM system, PNM has not gained knowledge on how to integrate a larger-size battery to meet the system NERC/WECC reliability needs, nor how to best optimize the stacking values that a battery can bring. This stacking is a topic all utilities are struggling with as batteries are an emerging technology, as I discussed previously.

Q. CAN YOU ALSO TALK ABOUT BATTERY CONTROL SYSTEM ISSUES?

A. Yes. Battery advancements in the utility industry have to this point largely focused on battery chemistry and constructability. The initial control systems have typically focused on a set timed charge and discharge schedule. Best practices management of battery control systems is fairly characterized as still evolving. Even with control systems largely focused on battery protection to this point, there have still been battery failures due to the lack of coordination of these control systems with the larger grid. These failures can result when the battery system was designed for a certain charge and discharge frequency, for instance no greater than once per day, but then actual grid requirements call for multiple full and partial discharges over a shorter time period. Also, as I previously discussed, battery controls to this point have largely focused on the battery itself and not the question of how best to integrate batteries to optimize their value in meeting the larger grid requirements as I discussed above and as further discussed by PNM Witness Kemp.

Q. HOW DO THESE CONSIDERATIONS SHAPE PNM'S THINKING ABOUT HOW BEST TO BEGIN INTEGRATING BATTERIES INTO ITS SYSTEM?

A. PNM needs to take a measured approach to adding energy storage to its portfolio, and that is why PNM is proposing an initial amount of new battery storage capacity at 130 MW, with no more than 40 MW in any one location, in evaluating

battery proposals. PNM needs the flexibility to work with battery providers to modify and continue to advance the control systems associated with these battery installations to optimize batteries' value in future RFPs. PNM cannot, as its first move into batteries, have them account for 20-25 percent of the total nameplate capacity of our resource mix, as some intervenors recommend. Such a proposal would be akin to having required utilities to immediately implement a portfolio to meet 20-25 percent RPS at the beginning of the development of renewable resources. Had PNM taken this approach when it first introduced renewable resources to its system, it would have significantly reduced PNM's ability to take advantage of price and technology improvements in renewable resources over time. To ensure that PNM continues to provide reliable service, PNM needs to learn how to manage batteries and integrate them into its portfolio to determine how best to maximize their advantages before making a larger commitment.

Q. IS THIS MEASURED APPROACH TO ADDING NEW BATTERY RESOURCES BASED IN PART ON PNM'S PAST EXPERIENCE IMPLEMENTING OTHER NEW TYPES OF GENERATION RESOURCES?

A. Yes it is. This measured approach is also consistent with recommendations provided by industry experts including those at Sandia National Laboratories. PNM took this same measured approach with the integration of solar resources by bringing in limited amounts at first, learning how to best integrate them into the PNM system, and adapting as the technology continued to evolve. This measured

approach also serves PNM well from a cost perspective, like PNM's approach for solar generation, where costs continued to decline over time. If you look at PNM today, we have one of the best solar fleets in the nation. That is primarily attributable to the fact that PNM approached solar integration responsibly by adding incremental units over time, and that is the same approach that PNM is trying to take with battery storage.

Q. HOW DO YOU RESPOND TO INTERVENOR ARGUMENTS THAT SOME OTHER UTILITIES ALREADY HAVE MUCH MORE THAN 130 MWS OF BATTERY STORAGE ON THEIR SYSTEMS?

A. Those utilities are not PNM, and they serve different systems. While batteries may have seen broader deployment elsewhere, this does not change the fact that this technology is new to PNM and will require some time to fully integrate and understand from an operational perspective, as discussed by PNM Witness Maestas. In addition, looking only at the gross battery storage capacity on a given utility's system doesn't tell the whole story, unless you know the full scale of that utility's generation resources. When viewed as a percentage of the total resource nameplate capacity for those utilities, none of them maintain a battery portfolio that comprises anything close to 20-25 percent of their overall system capacity as recommended by some intervenors. PNM Witness Kemp discusses this further in his Rebuttal Testimony. PNM is doing its part to help this technology advance but is doing so in a controlled and responsible manner, which benefits both the customer and the utility. Further, PNM has made clear that battery storage is

integral to meeting increasing renewable and zero carbon mandates over time. That said, PNM's initial, measured addition of battery resources here is appropriate as PNM takes this first step under the Energy Transition Act.

Q. HOW DO YOU RESPOND TO CCAE WITNESS DESU'S ARGUMENT THAT PNM IGNORED THE BRATTLE GROUP'S ESTIMATE FOR THE OPTIMAL DEPLOYMENT LEVEL OF BATTERY ENERGY STORAGE ON ITS SYSTEM?

A. The Brattle Group study did not focus on the initial optimal battery deployment level for PNM's system. Rather, that study centered on identifying transmission congestion relief benefits that PNM might realize by deploying batteries on its system. The Brattle study (which was included as PNM Exhibit TGF-3 to my Direct Testimony) does not contain any PNM-specific initial battery sizing recommendations. Brattle updated this study in August of 2019, and it is attached as PNM Exhibit TGF-2 (Rebuttal). The informational presentation that Brattle provided PNM as part of this briefing (which was also included in PNM Exhibit TGF-3 in my Direct Testimony), explicitly states that Brattle's analysis was only a "screening assessment"[2] and that Brattle's analysis "could be refined to identify the optimal mix of batteries for a given level of deployment."[3] Learning from the introduction of batteries on the PNM system as a result of the San Juan

[2] PNM Exhibit TGF-3 at Page 9 of 45.

[3] *Id.* at Page 24 of 45.

replacement portfolio, PNM will be better informed and better able to develop future battery RFPs for the next steps in this transition.

C. Suggestions that PNM Should Have Given Greater Consideration to Short-term PPAs or Market Solutions.

Q. SWG WITNESS BABCOCK STATED THAT PNM SHOULD HAVE GIVEN GREATER CONSIDERATION TO SHORT-TERM PPAS AS SAN JUAN REPLACEMENT RESOURCES. WHAT IS YOUR RESPONSE?

A. As one such prospective PPA provider, SWG Witness Babcock's testimony is not surprising. Regardless, SWG greatly oversimplifies the issues with any such short-term solutions by not considering overall system complexity and needs. Replacement resource issues need to be considered in the context of the larger energy transition contemplated by the Energy Transition Act. We are only in the first phase of this process. PNM will be transitioning other resources in coming years, and if PNM is required to include short-term PPAs in our initial replacement resource planning under the Energy Transition Act, that can create "lumpier" additions in the future, and can also result in mismatches of resource additions with system needs. PNM believes it is prudent to make a controlled and reasonable transition, and that staging of resource additions is, therefore, critical.

In any event, the premise of this criticism is unfounded, as PNM had very little to consider or evaluate in terms of short-term PPAs.

Q. WHAT SHORT-TERM PPA PROPOSALS DID PNM RECEIVE IN RESPONSE TO THE ALL SOURCE RFP?

A. PNM received one short-term PPA bid in the All Source RFP, which was related to the Valencia Energy Facility ("VEF") owned by SWG. SWG Witness Babcock contends that PNM did not fully consider this alternative shorter-term option. That is incorrect. VEF is currently in PNM's portfolio pursuant to a PPA set to expire in May 2028. PNM evaluated the VEF proposal as a possible replacement resource in the same manner it evaluated all replacement resource bids, even though the VEF proposal did not technically meet the eligibility requirements of the RFP. This proposal was considered a short-term resource (8 years) and leveraged an existing resource power purchase agreement. As VEF is the highest cost dispatchable resource on the PNM system, this higher cost to run VEF to allow the additional capacity made this proposal uneconomical. PNM Witness Wintermantel included this resource in the Tier 2 resource modeling and it did not result in a lower net present value. Based on that analysis, PNM concluded that this opportunity would not be low-cost, and the VEF resource was therefore not included as part of PNM's preferred replacement resource portfolio, PNM Scenario 1.

Q. WHAT ABOUT SWG WITNESS BABCOCK'S ASSERTION THAT PNM COULD HAVE ACQUIRED SHORT-TERM CAPACITY FROM THE LUNA ENERGY FACILITY?

A. This is unfounded speculation. SWG Witness Babcock assumes with no factual support that 125 MW of capacity from the Luna Energy Facility might become available when a current El Paso Electric PPA for the output from Luna expires in 2021. It is PNM's understanding that the agreement is set to continually renew each year after the initial term expires. To our knowledge, neither party to this agreement has given any indication that this arrangement will be terminated in the near future. As such, there is nothing to suggest that this capacity would become available as a near-term option.

In addition, as discussed in the Rebuttal Testimony of PNM Witness Duane, short-term capacity from the Luna facility would require additional firm transmission capacity from El Paso Electric and Tucson Electric at an added cost to deliver power from Luna in southern New Mexico to PNM's load center in northern New Mexico. The same is true with respect to the three Arizona generating resources discussed by SWG Witness Babcock in his testimony. In addition, the resources suggested by SWG Witness Babcock would not provide the same flexible dispatchable portfolio as provided for in PNM Scenario 1. For these types of PPAs, firm transmission capacity would need to be obtained from multiple transmission providers to ensure delivery, which increases the cost. Luna, along with these Arizona generating resources, simply did not provide viable alternatives. Finally, none of these supposed alternatives were made available to PNM in response to PNM's All Source RFP, and none of these entities approached PNM outside the RFP process to present these speculative

resource options. Relying on "wait and see" speculation that unavailable or unidentified resources not available now, or not bid into an RFP, might somehow become available later in a timely and economical fashion is impractical, unreliable, overly risky for customers, and would undermine a competitive RFP process.

Q. DID PNM CONSIDER MARKET PURCHASES AS PART OF A RESOURCE PORTFOLIO SOLUTION, SUCH AS THE EIM MARKET?

A. As discussed by PNM Witnesses Phillips, Dorris, and Maestas, the EIM market is an energy-only imbalance market available only within each hour. PNM is not allowed to rely on the EIM market for resource capacity requirements. PNM must meet a PNM-supplied resource adequacy requirement each hour prior to EIM participation. Contrary to some perspectives, the current EIM is not a marketplace to procure firm dispatchable capacity over PNM's summer peak period to meet resource deficits. As discussed further by PNM Witnesses Wintermantel, Phillips, and Maestas, PNM appropriately considered market availability of resources that provided for reliable firm capacity options within the transmission constraints of the PNM system.

IV. RESPONSE TO "NO NEW GAS" ARGUMENTS

Q. PLEASE SUMMARIZE THE INTERVENOR POSITIONS ARGUING FOR NO NEW GAS RESOURCES.

A. SWG Witness Babcock contends that the installation of any new carbon-emitting resources is at odds with the long-term goals of the Energy Transition Act. Sierra Club Witness Goggin also argues that any new gas, like the proposed Pinon Gas Plant, could become a stranded asset. He notes that PNM's analysis shows that the expected capacity factor of the proposed Pinon Gas Plant aeroderivatives drops off in future years.

Sierra Club Witness Goggin recommends that the Commission should require PNM to adopt a portfolio with no new gas capacity additions. Sierra Club Witness Goggin further states that even if the Commission adopts a portfolio with no new gas capacity additions, gas will still be PNM's largest source of generating capacity.

CCAE Witness Desu states that the reduced cost of batteries has already led to the cancellation of proposed natural gas projects by other utilities, and as such, the risk of new natural gas plants becoming stranded assets is high.

San Juan Entities Witness Schiffman suggests that, while not proposing this option at this time, San Juan Units 1 and 4 retrofitted with CCUS could at some

point displace the seven LM6000 units at the planned Pinon Gas Plant. He therefore suggests that PNM's resource planning should include flexibility in its approved procurement plan to allow for a future San Juan PPA. He also claims that, because PNM will not need to add replacement capacity until 2022, PNM can plan, but not actually acquire, new gas-fired generation at this time, and bridge to gas-fired generation later if needed.

Q. WHAT IS PNM'S GENERAL RESPONSE TO THESE "NO NEW GAS" ARGUMENTS?

A. Based on my review of the testimonies filed in this case, it appears that a primary goal of some stakeholders is to greatly accelerate the timeframe under the Energy Transition Act for utilities to attain 100 percent carbon-free energy, even though PNM has already announced its goal to be carbon-free by 2040 – 5 years earlier than the 2045 date required under the Energy Transition Act. With this state energy policy set, it appears all stakeholders are now moving in the same direction toward a more sustainable New Mexico energy future. There are, however, disagreements on how, and how quickly, this transition needs to occur. PNM Scenario 1 allows this transition to occur in a controlled manner that considers both customer costs and system reliability and also preserves system flexibility while anticipating future technological improvements. Taking advantage of efficient, flexible and low-cost natural gas technology in the early phase of this energy transition provides planning opportunities and room for improved technologies in later phases and increases the likelihood that a carbon-

free portfolio is in place by 2040. The Rebuttal Testimonies of PNM Witnesses Kemp and Dorris address these issues in more detail. The Energy Transition Act's requirement to achieve 100 percent carbon-free energy must fully consider system reliability and customer cost impacts. The gas resource proposed in PNM Scenario 1 facilitates this energy transition in a low-cost manner, ensures system reliability is maintained, and ensures that the path to 100 percent carbon-free energy is achievable and that all stakeholders can continue moving in the same direction toward this goal.

The arguments by Sierra Club Witness Goggin that PNM's proposed LM6000s decreasing capacity factor indicates concern for stranded costs is inaccurate. This noted capacity change actually demonstrates how the LM6000s facilitate higher renewable penetration over this time period by continuing to meet the reliability standards for the system through this transition. PNM Witness Dorris explains in more detail the importance of these gas resources in meeting system reliability requirements, the role these gas turbines may eventually play in a carbon-free portfolio, and the consistency of PNM's resource selection with other carbon-free early adopter utilities.

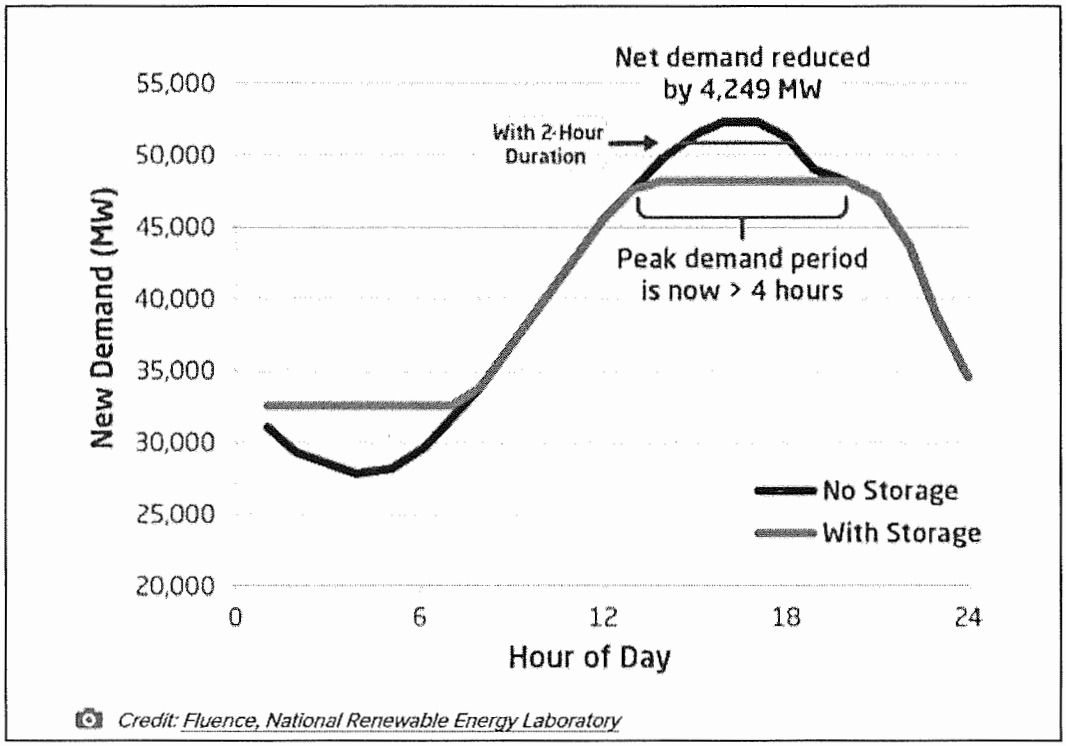
Q. YOU HAVE DISCUSSED THE IMPORTANCE OF RELIABILITY FREQUENTLY IN THIS TESTIMONY. HOW DOES PNM ENSURE THE RELIABILITY OF ITS SYSTEM THROUGH ITS GENERATION RESOURCE PLANNING?

A. A diverse portfolio of resources is necessary and important to maintain system reliability. In general, PNM needs three types of resources to achieve the goal of being 100 percent carbon-free by 2040:

- Short-duration capacity (i.e., 2-4 hour lithium ion batteries);
- Medium-duration capacity of 4-12 hours (i.e., flow batteries, pumped storage, compressed air, etc.); and
- Long-duration capacity that provides from approximately 12 hours to 200 plus hours of support.

While lithium ion batteries are the primary energy storage being added to electrical systems today, they have a limited ability to meet longer duration capacity needs. As shown in the illustrative chart from CAISO included below as PNM Figure TGF-1 (Rebuttal), as the addition of energy storage on a system increases, the need to expand the time duration capabilities for these energy storage resources also increases. That is why as described by PNM Witness Maestas the initial proposed batteries provide the highest value on a per MW basis for the PNM system and further battery additions require longer and longer duration.

PNM Figure TGF -1 (Rebuttal)



As PNM looks to the next steps in this energy transition, additional lithium ion batteries will almost certainly be needed; however, the need for medium range storage options such as flow batteries, pumped hydro, or compressed air facilities will quickly become important in this overall approach to 100 percent carbon-free energy.

The last longer-duration capacity requirement to maintain system reliability requirements cannot be reasonably supported by battery technology available today. An example might be requiring a 160 hour or longer battery storage source as an equivalent alternative to a gas unit, which would be cost prohibitive. Modern flexible low-cost natural gas is available to meet this need right now and

is the cornerstone that allows PNM to push forward with the transition to more renewable resources while the industry continues to pursue future technology advancements to meet this longer duration capacity need. PNM Witness Dorris identifies how PNM's Scenario 1 is consistent with other early adopters of carbon-free portfolios that also provide for flexible gas units to allow for this transition while meeting low cost and reliability goals.

Q. WHY AREN'T PNM'S CURRENT GAS-FIRED GENERATION UNITS SUFFICIENT TO CONTINUE TO ALLOW INTEGRATION OF RENEWABLE RESOURCES INTO PNM'S SYSTEM?

A. PNM Witnesses Phillips and Maestas go into detail on this issue in their Rebuttal Testimonies regarding the need for increased flexibility to support increased renewable resources, but in short, guided by the Energy Transition Act, PNM is proposing to add significant renewable resources to its system in PNM Scenario 1, including 350 MW of new solar. PNM's current gas-fired resources, including three current LM6000 gas units at La Luz and Lordsburg, steam turbines (Reeves), heavy frame units (Rio Bravo and VEF) and combined cycle units (Afton and Luna) provide low cost energy through economic dispatch (with higher-cost units such as Rio Bravo and VEF dispatched at the bottom of the stack) yet lack the overall system flexibility needed to support a much higher percentage of renewable resources on the system. By contrast, the additional efficient LM6000 units planned for the Pinon Gas Plant could be ramped and brought online in ten minutes and kept in production as needed to bridge

renewable resources. The new LM6000s plus the three existing LM6000s would then provide the necessary overall system flexibility to meet the system reliability needs. As the transition to higher renewables continues, there will be an increasing need for resource flexibility that is currently only met by appropriate gas resources.

Q. COULD ADDITIONAL BATTERIES FULFILL THE ROLE OF THE PLANNED NEW LM6000 GAS GENERATION UNITS?

A. Only in small part and not as cost-effectively as the proposed gas units. Batteries are not currently able to meet the increasing resource duration demands noted above. Batteries do have flexibility, at least in terms of ramp time, however, they lack the duration of the LM6000 gas units. Once a battery is fully discharged it no longer can provide system needs, whereas a LM6000 can still provide service long after battery storage would be depleted. As I noted above, PNM requires a long-term capacity resource that provides system support of greater than 12 hours to 200 or more hours. Batteries, even longer duration flow batteries, cannot currently fill this need. Wind and solar are intermittent resources, and wind forecasting in particular is an imperfect science as discussed more by PNM Witness Maestas. When wind and solar are unavailable for sustained periods, batteries are insufficient to ensure that PNM has enough available generation capacity, both in terms of adequate charge and duration, to reliably provide service, 24/7.

Batteries would be a poor choice to fulfill this long-term capacity need for another reason. Even assuming they had sufficient duration profiles, which they do not, PNM would need to keep the batteries in a near-constant state of full charge to fulfill this long-term capacity need. Not only would this lead to diminished performance of the batteries and shorten their life expectancy, it would also mean that the batteries would not be available to provide other ancillary services to meet the system reliability requirements. This could also cause reliability issues on PNM's system.

Q. DO THE PROPOSED GAS UNITS VIOLATE THE SPIRIT OF THE ENERGY TRANSITION ACT, AS SOME INTERVENORS SUGGEST?

A. No, quite the opposite. As I explained above, the new LM6000 gas units will help PNM integrate more renewable resources on our system, consistent with the policy of the Energy Transition Act. Additionally, without the ability of the LM6000s to provide the longer-term reliability component for the system, further transition to more renewables would be limited.

Q. DOES PNM AGREE THAT THE EMERGENCE OF BATTERY STORAGE OPTIONS INCREASE THE RISK OF NEW NATURAL GAS FACILITIES QUICKLY TURNING INTO STRANDED ASSETS?

A. No. As discussed above, lithium ion batteries will be meeting the short-term reliability needs of the system, while the natural gas facilities provide the backbone of the longer-duration reliability needs. Further, to address concerns

over stranded costs, PNM modeled the economics of the gas units assuming an 18-year depreciable life (through 2040), and they remain a low-cost choice for customers. Although PNM used an 18-year depreciation schedule for natural gas for modeling purposes to confirm that this was the right decision from a resource selection process, that does not mean these resources will necessarily be abandoned in 2040. As PNM looks out on the horizon to the last 10 percent of the path to becoming 100 percent carbon-free, one future possibility for these facilities would be to convert them to clean energy combustion turbines, as PNM Witness Dorris explains in his Rebuttal Testimony.

Q. CAN YOU ALSO ADDRESS INTERVENOR TESTIMONY SUGGESTING THAT PNM SHOULD HOLD OFF ON THESE NEW GAS GENERATION UNITS BECAUSE PNM MAY BE ABLE TO PURCHASE POWER FROM SAN JUAN IN THE FUTURE?

A. Yes. As a preliminary matter and concern I would note that the possibility of a future PPA with a CCUS-retrofitted San Juan, as suggested by the Farmington and San Juan County, was not offered into the RFP process. Without concrete pricing and operating information evaluated through a competitive bid review, there is no reason for PNM or the Commission to gamble on whether customers would have to pay substantially more for a CCUS retrofit PPA than is achieved through the portfolio in PNM Scenario 1.

Q. DO YOU HAVE ADDITIONAL CONCERNS WITH THE FARMINGTON/SAN JUAN COUNTY POTENTIAL PPA PROPOSAL?

A. Yes. First, it is not a given that this San Juan CCUS retrofit venture with Enchant Energy will actually proceed. While I appreciate that Farmington and San Juan County are optimistic about the viability of the carbon capture retrofit as a commercial venture, as discussed by San Juan Entities Witness Schiffman, the venture faces numerous hurdles.

Second, any such potential PPA would not align with the timing of PNM's resource needs. Farmington's response to a Commission Bench Request suggests that the project would not come online, assuming it does at all, until June 2023. PNM is seeking to abandon its participation in San Juan Units 1 and 4 by June 2022, and this will create a significant and immediate resource need. PNM cannot forego capacity additions in hopes that a CCUS option may develop by sometime in the second half of 2023 or thereafter. This approach is imprudent, especially when there is no guarantee that this resource will develop at all and the pricing for such an uncertain, speculative future project is unknown.

Third, committing to take output from CCUS-retrofitted San Juan Units 1 and 4 would interfere with PNM's ability to take low cost renewables (the Arroyo and Jicarilla solar projects) from that same region, due to limited transmission availability. San Juan Entities Witness Schiffman has indicated that they will have over 600 MW of generation capacity available and PNM simply does not

have the transmission capability to bring that volume of energy to its northern load center while also maintaining transmission capacity for the Arroyo and Jicarilla solar projects.

Finally, as I discussed earlier, even if PNM was directed to only replace the 280 MW of flexible gas plants with 280 MW of a coal plant retrofit with CCUS, this would result in significant system reliability concerns and risk significant curtailments to renewables, thereby diminishing the economic value of renewable resources.

Q. CAN YOU EXPLAIN FURTHER WHY PNM CANNOT PLACE ITS NEW GAS PROPOSAL ON HOLD TO SEE WHAT DEVELOPS WITH THE SAN JUAN COAL PLANT?

A. Yes. As I previously indicated, PNM needs to develop our replacement resources now, as PNM is asking to abandon our interest in San Juan Units 1 and 4 effective June 2022. The Enchant/Farmington CCUS retrofit venture will be online, if at all, no sooner than 2023. Even if the timing were different, I don't believe some of the intervenors urging us to "wait and see" understand the lead time necessary for deployment of new generation assets. For example, Westmoreland Witness Griffey asserts that LM6000 resources have a short deployment lead time, 8 to 12 months, implying that there is no need to decide on such resources now. While that may be an accurate timeframe to add another unit to an established gas plant site, the lead time for the new LM6000 gas plants at the Pinon Gas Plant site will

require a two-year process that includes interconnection, permitting, gas transmission line extensions, turbine procurement, site construction, and commissioning. Please see PNM Exhibit TGF-3 (Rebuttal) for an outline of the required timeline for the Pinon Gas Plant. The signed contract terms specific to the Pinon Gas Plant are also contained in PNM Exhibit TGF-13 attached to my Direct Testimony and PNM Exhibit TGF-1 (Supp. 9-20-19) attached to my Supplemental and Direct Errata Testimony. Similarly, the Arroyo and Jicarilla projects have lead times that are tied to qualifying for tax credits that are critical to realizing the attractive pricing associated with these PPA/ESA projects.

Q. WILL THERE BE OPPORTUNITIES IN THE FUTURE TO TAKE ADVANTAGE OF A RETROFITTED SAN JUAN, IF THAT PROJECT IS COMPLETED?

A. Yes. PNM's energy transition under the Energy Transition Act will be an ongoing process and as I noted above, the next steps of this transition are not far off. Ultimately, if the proposed feasibility studies prove out and San Juan Units 1 and 4 are retrofitted with CCUS and can return to commercial service, there will be ample opportunity for Enchant Energy to submit a bid through a competitive RFP process during the next phase of this transition. The better approach as stated in PNM Witness Phillips' Rebuttal Testimony is for Farmington or Enchant to provide indicative pricing and allow PNM to evaluate this technology as part of the ongoing 2020 IRP process.

Q. PLEASE ADDRESS THE RECOMMENDATION OF STAFF WITNESS SOLOMON THAT PNM SHOULD BE REQUIRED TO MAKE A SUPPLEMENTAL FILING TO ADDRESS THE PROPOSED ENCHANT/CITY OF FARMINGTON VENTURE.

A. For all these same reasons I discussed above, the Commission should reject Staff Witness Solomon's recommendation that PNM should submit a supplemental filing, essentially restarting the regulatory process - to address the ramifications of the proposed Enchant Energy/Farmington/San Juan CCUS venture. PNM has modeled the new retrofit project parameters and available data as discussed previously by PNM Witness Phillips in Case No. 19-00018-UT and summarized again in this phase of the proceedings, and the Company's analysis shows that a CCUS retrofit project would impose unreasonable costs and operational risks on customers. The evidence simply does not support Staff's recommendation, and Staff has not provided any analysis or information that would indicate customers would benefit from a costly pursuit of a new coal CCUS retrofit facility.

Q. PLEASE ADDRESS STAFF WITNESS SOLOMON'S RECOMMENDATION THAT PNM SCENARIO 2 IS PREFERRED OVER PNM SCENARIO 1.

A. As described in PNM Witness Phillips' Rebuttal Testimony and my Rebuttal Testimony in Case No. 19-00018-UT, PNM proposes retiring the San Juan coal plant and procuring replacement resources pursuant to PNM Scenario 1 primarily because this approach would best provide cost savings to PNM's customers while

providing for system reliability. In Staff Witness Solomon's Direct Testimony in Case No. 19-00018-UT, he states on page 11 that "the primary factors to be considered in determining a portfolio or resource mix under the Public Utility Act are cost and service reliability." PNM evaluated this retirement and replacement resource selection based on long standing practices that cost and reliability are the primary drivers of resource selection, with other public interest considerations such as environmental benefits or community support benefits being considered when cost and reliability are relatively equal among feasible alternatives. This is why PNM continues to support PNM Scenario 1 as the preferred alternative, as opposed to Staff's preference for PNM Scenario 2 in which they appear to have altered their consideration of primary factors they outlined in the previous part of this proceeding. While PNM Scenario 2 would increase community benefits, it would also result in higher costs to PNM customers. PNM Scenario 1 remains the better overall portfolio.

V. RESPONSE TO CRITICISMS OF BATTERY RESOURCES IN PNM'S SCENARIO I

Q. WHAT ARE THE MAIN CRITICISMS OF THE BATTERY RESOURCES INCLUDED IN PNM SCENARIO 1?

A. Several of the intervenors appear to assume that the selection of utility-owned battery resources to be developed through EPCs automatically means the selection process must have been flawed. In addition, several parties contend that there

should be no size limitations on individual or total battery resources in the selected portfolio.

As I discussed previously, ESA and utility ownership of batteries were equally considered and evaluated through the competitive RFP process. The objective of the process, including the supplemental energy storage RFP, was to explore the opportunity to provide the highest overall value for batteries on the PNM system that allowed the stacking of the various battery benefits. Battery selection in PNM Scenario 1 resulted in approximately equal amounts of ESA and utility ownership of batteries, which provides the added benefit of PNM learning through utilization of both of these approaches. The intervenors have conducted extensive discovery on this issue and have not pointed to any evidence that demonstrates the evaluation process was flawed, or that the selection did not result in a balanced group of battery resources that are strategically deployed and provide a range of benefits to customers that could not have been achieved by arbitrarily eliminating EPC bids.

Q. WHAT IS THE REASON FOR THE 2-HOUR VERSUS 4-HOUR BATTERY RESOURCES SELECTED IN PNM SCENARIO 1?

A. Batteries that are provided per an ESA contract, especially coupled with a solar resource like the Arroyo and Jicarilla solar projects, provide value primarily by moving energy from one part of the day to another – which is referred to as

energy arbitrage. Therefore, longer duration batteries in this type of configuration typically show more value.

Stand-alone batteries, especially that allow full utility control, also provide value in energy arbitrage but additionally allow fuller utilization for system ancillary services such as spinning reserves, frequency response and ramp control. These ancillary service functions are typically of short duration and occur numerous times throughout the day. Therefore, stand-alone batteries that can have their control systems more fully integrated into PNM's system needs and market conditions can establish added value with shorter duration designs as they can provide most of their value for ancillary services with a 2-hour design, without incurring the larger capital costs associated with a 4-hour design.

Q. PLEASE DISCUSS THE ISSUE OF OWNERSHIP VERSUS CONTROL OF BATTERY STORAGE GENERALLY.

A. As PNM Witness Kemp discussed in his Direct Testimony, ownership (versus purchased storage agreements) is important from an integration and resource management and control perspective. As discussed further by PNM Witness Maestas, the knowledge and experience gained from an ownership level of operational control will also better inform either a PPA or utility ownership model for the next phase of energy storage resources. A controlled transition is also necessary to ensure that PNM is maintaining system reliability as we progress. A key difference between ownership versus contractual agreements relates to the

control system and how the battery is operated. Under an ESA, the control system is focused on controlling and protecting the battery. To the extent the ESA relies on underlying tax credits, energy sources for charging the battery also must be tightly controlled. Under utility ownership, the focus is on optimizing the value of the battery to the overall system.

PNM notes that batteries are still an emerging technology and the industry is clearly still trying to understand how to best capture their full value stream, and to determine which battery type can work best under given conditions. Given that batteries can provide energy capacity, energy arbitrage, ancillary services, and transmission/distribution relief, it is important to stack the values of all of these benefits together and have the ability to control and operate a battery to optimize these activities. Right now, the utility is in the best position to identify and stack those values for customers. During bid evaluations and bidder discussions, it became clear that there would be a number of restrictions in battery control by the utility under an ESA structure, which would limit the full value of batteries to PNM's customers if battery selection was limited to contractually and operationally restricted options. The supplemental energy storage RFP allowed PNM to consider the wider type of multiple functionality.

Also, since the current state of full battery control integration with the grid control system is developing, PNM would anticipate a series of control system advancements over the next several years. The ability to have full control to

upgrade and refine these control systems is best made available with utility ownership, as an ESA would typically require a contract amendment for each upgrade which typically drives costs higher.

Q. DID PNM ULTIMATELY PROVIDE PREFERENCE TO UTILITY OWNERSHIP BECAUSE OF THE ABOVE STATED BENEFITS?

A. No. PNM evaluated ESA and utility owned batteries equally as identified in the competitive RFP process. The combination of batteries coupled with the solar resources provided the lowest cost batteries due to the associated tax credit benefits. The best solar/battery combination projects happen to be ESA contracts, two of which were selected. However, due to the transmission limits on the PNM system, no additional solar/battery resource combinations were available. Stand-alone batteries were then selected as the next low-cost resource for PNM customers. The best stand-alone batteries resulted in utility ownership of these projects. The result of the overall selection process was based on the low-cost resource within these categories. An additional benefit from the final selection is the approximate equal balance of ESA and utility owned resources which provides the additional benefits described above. A specific ownership structure was not forced in the evaluation process, and intervenors' criticisms of the RFP process lack a factual basis.

VI. COMMUNITY IMPACT

Q. HAS THE COMPANY CONSIDERED THE ECONOMIC IMPACT ON THE SAN JUAN COUNTY COMMUNITY IN ITS REPLACEMENT RESOURCE PROPOSALS?

A. Yes. PNM recognizes that there will be a significant impact in San Juan County and is seeking to maximize the economic support provided under the Energy Transition Act in the abandonment/securitization phase of this proceeding, Case No. 19-00018-UT. PNM also developed Scenario 2 as a reliable portfolio that maximizes the locational benefits to the Central Consolidated School District. However, since PNM Scenario 2 results in a higher cost to PNM customers and does not provide as robust renewable integration as PNM Scenario 1, PNM is not recommending the selection of this plan as favored by Staff. PNM Scenario 1 nonetheless provides concrete tax and job benefits to the school district and the San Juan area communities in accordance with the Energy Transition Act's criteria to be considered by the Commission.

Q. WHAT IS PNM'S POSITION ON THE ENERGY TRANSITION ACT PROVISIONS WITH RESPECT TO NAMEPLATE CAPACITY IN SAN JUAN COUNTY?

A. While I'm not a lawyer, I've read Section 3 of the Energy Transition Act, and it says "up to" 450 MW. Given the myriad of factors to be considered, and that cost, system reliability and renewable preferences are still primary drivers for

resource selection, I don't understand the position of some that "up to" 450 MW should be read to mean that 450 MW or "at least" 450 MW of replacement resources must be located within the school district.

VII. NM AREA RATE STRUCTURE CONCERNS

Q. NM AREA WITNESS DAUPHINAIS RAISES CERTAIN RATE STRUCTURE CONCERNS. IS THIS THE RIGHT PROCEEDING TO ADDRESS THESE CONCERNS?

A. No. The more appropriate forum for these concerns is in a general rate case. The Rebuttal Testimonies of PNM Witnesses Settlage and Phillips address these issues in more detail.

VIII. PINON 20 MW SOLAR PROJECT

Q. REGARDING THE 20 MW SOLAR PROJECT DISCUSSED IN THIS CASE, NMAG WITNESS CRANE BELIEVES THAT THIS IS AN UNECONOMIC AND POOR CHOICE FOR MEETING THE REQUIREMENTS OF PARAGRAPH 40 OF THE MODIFIED STIPULATION IN CASE NO. 13-00390-UT. WHAT IS YOUR RESPONSE TO THIS POSITION?

A. In my Direct Testimony, I proposed that consideration be given to a PNM-owned 20 MW solar facility (referred to as the Pinon Solar Facility) which could be built to fulfill PNM's obligation to acquire renewable energy certificates pursuant to

the Modified Stipulation in Case No. 13-00390-UT. As I indicated in my Direct Testimony, PNM suggested the Commission could consider this proposal either in this or a separate proceeding, if there was sufficient consensus that the Pinon Solar Project should be pursued. Based on the record in this proceeding, we do not believe sufficient consensus exists to move forward with this proposal and that further discussions are necessary among the Signatories to the Modified Stipulation approved by the Commission in Case 13-00390-UT to determine the best way to meet the relevant requirement to acquire renewable energy certificates.

IX. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY AND RECOMMENDATIONS.

A. As PNM begins its journey to a 100 percent carbon-free energy system, PNM Scenario 1 responsibly introduces energy storage to PNM's system, adds significant amounts of low-cost renewable energy resources, and includes flexible natural gas for system reliability, all of which positions PNM well for the first step of this energy transition process and subsequent resource additions. This case provided for significant stakeholder involvement with stakeholder meetings, well over 2,100 discovery requests, and unrestricted access to modeling software at no cost for the intervenors. A review of the wide range of intervenor proposals

confirms that PNM's Scenario 1 is the most balanced approach that meets the various considerations under the Energy Transition Act.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

GCG#526582

PNM Scenario 1 Energy Storage Bids

PNM Exhibit TGF-1 (Rebuttal)

Is contained in the following 2 pages.

	A	B	C	D	E	F	G	H	I	J
1	**PNM Exhibit TGF-1 (Rebuttal)** **PNM Scenario 1 Energy Storage Bids**									
2	**Assigned Proposal Number**	**Bidder**	**Bidder**	**Project**	**Bid Type**	**Bid Type Subcategory**	**Chemistry***	**OEM**	**Installer**	**Owner / Operator**
3	CR02	Clenera Renewable Energy	13	Arroyo Solar + Storage	PPA	Solar & BESS	Li-ion - NMC or LFP	TBD - BYD, CATL, or Samsung	Swinerton	SPE Owned by Equity Sponsors / Clenera
4	PE02	Primary Energy	30	Jicarilla Apache- Solar + Storage	PPA	Solar & BESS	Li-ion - LFP	Powin Energy as integrator with CATL cells	TBD	Hecate
5	30a	Affordable Solar	9	Sandia BESS	EPC	BESS	Li-ion - NMC	Tesla	Affordable Solar, Inc.	PNM
6	Z2	Affordable Solar	9	Zamora BESS	EPC	BESS	Li-ion - NMC	Tesla	Affordable Solar, Inc.	PNM
7										
8	* PPA provider battery chemistry subject to change									

	A	B	K	L	M	N	O	P	Q	R
1	**PNM Exhibit TGF-1 (Rebuttal)** **PNM Scenario 1 Energy Storage Bids**									
2	**Assigned Proposal Number**	**Bidder**	**Total Project Capacity (MW)**	**Generation Capacity (MW)**	**Energy Storage Capacity (MW)**	**Energy Storage Duration (hrs)**	**Energy Storage (MWh)**	**Site**	**County**	**Point of Delivery**
3	CR02	Clenera Renewable Energy	340	300	40	4	160	Arroyo	McKinley	Path 48 onsite
4	PE02	Primary Energy	70	50	20	4	80	JAN Advanced Energy Center	Rio Arriba	PNM San Juan-Ojo 345 kV line
5	30a	Affordable Solar	40	0	40	2	80	Sandia Tech Park	Bernalillo	Sandia 115 kV Switchyard
6	Z2	Affordable Solar	30	0	30	2	60	Zamora	Bernalillo	Zamora 115 kV Switchyard
7										
8	* PPA provider battery chemistry subject to change									

Updated August 2019 Brattle Group Study

PNM Exhibit TGF-2 (Rebuttal)

Is contained in the following 8 pages.

The Value of Energy Storage to the PNM System

PREPARED BY

Ryan Hledik

Johannes Pfeifenberger

Judy Chang

Pablo Ruiz

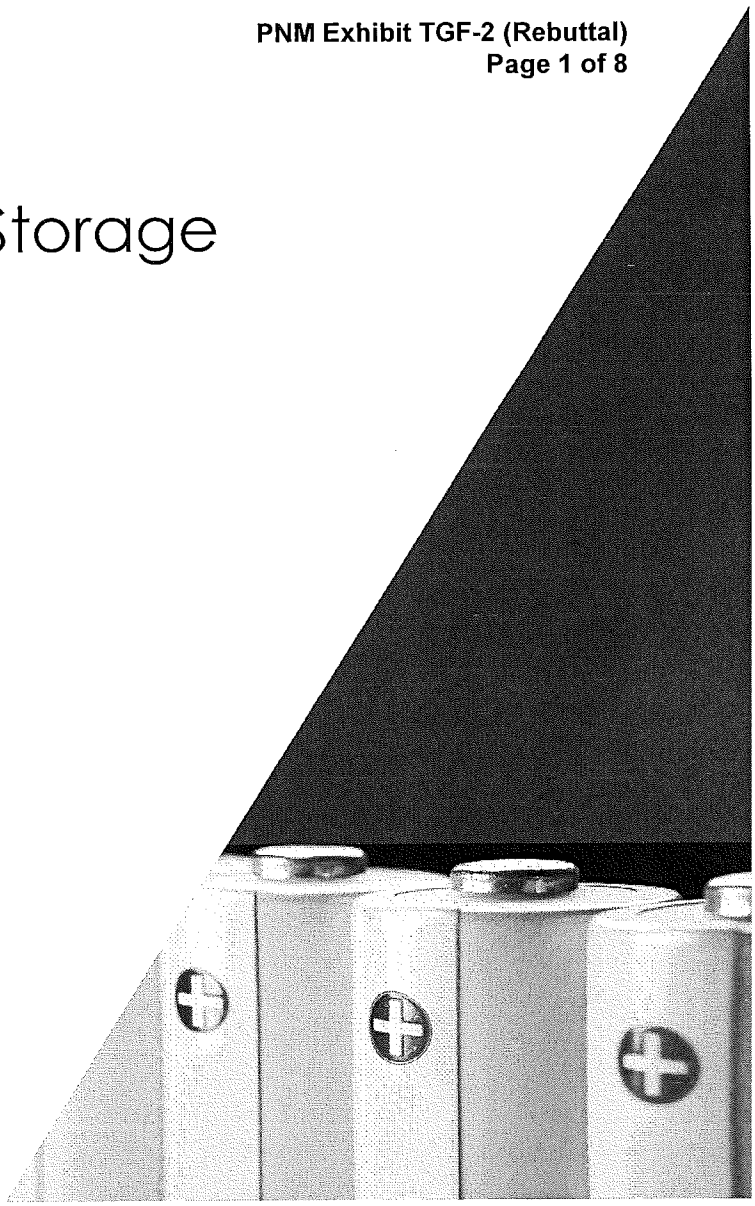
Jesse Cohen

PREPARED FOR

PNM

Final: June 6, 2019

Revised: August 4, 2019



THE Brattle GROUP

I. Introduction

The purpose of this study is to summarize the potential benefits of energy storage additions to the Public Service Company of New Mexico (PNM) system. In particular, PNM is interested in understanding the advantages of a standalone utility-owned energy storage project compared to a PPA (Power Purchase Agreement) contract structure for storage that is co-located with a solar photovoltaic (PV) facility and owned by a third party.

Our assessment identifies two areas in which utility-owned storage provides incremental benefits relative to a contract for storage that is co-located with solar PV. First, PNM's knowledge of its own transmission and distribution (T&D) system would allow the company to site utility-owned storage in the most beneficial locations on the power grid, irrespective of whether that location is suitable for co-location with solar generation. We estimate this locational transmission-related value of storage to be up to $22/kW-year for a 4-hour (e.g., 1 MW / 4 MWh) battery. Second, storage ownership would give PNM greater operational capabilities, including the flexibility to mitigate off-peak wind curtailments. Specifically, a standalone energy storage system could charge during any hour of the day, rather than being constrained to charging from the output of the solar PV facility. This ability to charge and discharge any time would increase the energy value of the storage system by approximately $10 to $25/kW-yr according to our simulations (and more through the provision of ancillary services and possibly other grid services). Direct ownership would also provide PNM with options to modify the use of the storage device as operational experience is gained and market conditions change over time.

This analysis is based on a review of (1) PNM transmission and outage data and (2) energy storage market simulations using Brattle's bSTORE model.[1] The scope of our study focused specifically on the incremental value that the standalone utility-owned storage system could provide relative to the storage portion of a hybrid "solar+storage" contract. Further analysis could estimate the total value of the combined storage+solar facility and produce a holistic assessment of the costs and benefits of each storage application.

II. System Benefits of Energy Storage

Due to rapidly falling costs and its operational flexibility, energy storage can be a valuable addition to the PNM system. Possible benefits of energy storage include the following:

Reducing the production costs of generating electricity. Energy storage can be charged in off-peak periods, when the cost of providing energy is low. It can then be discharged during peak load hours, reducing the need to operate expensive peaking units. The fast ramping capabilities of storage can help system operators manage rapid changes in load or variable generation,

---

[1] For more information about the bSTORE model, see https://www.brattle.com/bstore.

thereby reducing the production costs associated with the (up and down) ramping of conventional generators.

Reducing the production cost associated with providing ancillary services. The operational flexibility of storage would allow it to provide regulation and operating reserve services more cost-effectively than conventional resources.

Reducing capacity needed from traditional power generation resources. By discharging during peak load hours, storage can reduce the need for peaking capacity that would otherwise be built to maintain resource adequacy.

Avoiding customer outages. If located on the transmission or distribution system, the deployment of storage can be targeted to reduce the frequency and severity of customer outages.

Reducing transmission congestion costs. Energy storage can effectively increase transmission capacity when deployed to congested locations of the system. This reduces the cost of otherwise dispatching more expensive generators to address the transmission congestion constraints.

Reducing emissions and decreasing the curtailment of renewable generation. Storage can potentially reduce emissions either by reducing generation from high-emitting generators or by being charged with the output of wind and solar generators that would otherwise be curtailed due to system constraints. Reducing the curtailment of renewable generation will reduce system-wide production costs. The extent to which storage reduces emissions depends on the marginal emissions profile of the resource mix during the charging and discharging of the storage systems.

Deferring transmission and distribution investment costs. To the extent that storage can be used to meet local peak loads, the loading on the transmission and distribution system during those hours would be reduced. In such cases, storage can help defer certain transmission and distribution upgrades. Currently, PNM staff have not identified any opportunities for T&D investment deferral on the PNM system.

Providing additional grid services. Storage can be deployed where additional grid services (such as voltage support) may be needed, thereby deferring other investments needed to provide the same service.

III. Advantages of Utility-Owned Storage

There are two ways in which standalone utility-owned storage can capture greater potential benefits than storage that is part of a contract for a hybrid solar+storage project: (1) locational value and (2) greater operational flexibility.

Locational Value

PNM is in the best position to determine the locations in which storage would provide the greatest value to its system. Owning the storage facility would provide PNM with the control necessary to capture this value. For example, PNM can deploy energy storage to targeted, high-value locations on the grid. PNM can take advantage of unrestricted site access (e.g., by integrating the storage system into an existing substation), thereby potentially reducing maintenance costs of the storage. With a storage contract, particularly one in which storage must be co-located with solar PV, this ability to site the storage device in specific locations on the grid is diminished.

To develop an estimate of the potential locational value of energy storage, we assessed the transmission value of battery investments in two locations that appear to be the most valuable based on discussions with PNM and our review of the PNM system: The Sandia substation and the Tijeras substation, both of which are located in the Albuquerque area.

A battery storage deployment at the Sandia substation would reduce the local system's congestion management costs. The storage deployment would lessen the need to run higher-cost generation units that would otherwise be required to address transmission constraints in that location of the grid. In 2017 and 2018, congestion management costs in the Sandia area averaged $3.8 million per year.[2] Based on analysis of the timing and size of those transmission congestion events, we identified the portion of the events that could be avoided for various battery sizes and configurations.

Smaller battery deployments mitigate a lower share of the total congestion management costs than larger battery deployments would. For instance, a 100 MW battery with a 2-hour duration (i.e., 200 MWh of energy storage capacity) could mitigate approximately 14 percent of the historical congestion, whereas a 200 MW, 4-hour duration battery could mitigate approximately 34 percent of the congestion. However, the value decreases incrementally with each additional megawatt of storage capacity addition. On a dollars-per-kilowatt basis, batteries with low MW capacity but high energy storage capability provide the most congestion management value. Table 1 summarizes the congestion management value of a range of battery storage deployments.

---

[2] Congestion management costs were significantly higher in 2018 than in 2017. PNM transmission planning staff have indicated that the higher value in 2018 may be an anomaly.

Table 1: Congestion Management Benefit of Sandia Storage Deployment, by Battery Size ($/kW-yr)

	2hr	4hr	6hr	8hr	10hr
50 MW	$6	$11	$15	$18	$20
100 MW	$6	$9	$12	$14	$15
150 MW	$5	$8	$10	$11	$12
200 MW	$5	$7	$8	$9	$10
250 MW	$4	$6	$7	$8	$8

Additionally, battery storage deployed at the Tijeras substation could be designed and operated to avoid downstream service interruptions. The battery's stored energy could be discharged during local reliability events to provide backup generation to customers who would otherwise experience an outage.[3] Between 2011 and 2018, customers in the Tijeras Canyon area experienced an average of 1.5 hours of outages per year. Studies of the value of lost load ("VOLL") have suggested that customers would be willing to pay about $12,000/MWh to avoid these interruptions, on average.[4]

Load at the Tijeras substation historically has ranged up to approximately 27 MW, suggesting that a maximum battery size of 30 MW would address local reliability conditions. Our assessment of the duration and frequency of the historical outages indicates that a 4-hour battery could fully mitigate these outages, with the customer value of those avoided outages being $11/kW-yr. Because Tijeras is connected into Sandia, the benefits of storage installed at Tijeras include (and thus are additive to) the congestion management benefits of a battery deployed at the Sandia substation.

Operational Flexibility

By owning a standalone energy storage system, PNM would have complete control over when and how to operate the storage system. This is particularly valuable for managing wind curtailment during overnight hours when load is low. In contrast, a battery that is co-located with solar PV would need to charge from the output of the solar PV facility in order to qualify for the federal Investment Tax Credit. This daytime charging constraint would reduce the ability to otherwise charge during low-cost hours when solar output is low. Additionally, the PPA contract structure could establish contractual requirements that would constrain the utility to a

---

[3] The battery would need the ability to function in islanded mode ("grid forming" capability), typically not a standard feature of such deployments.

[4] Based on a review of several Value of Lost Load (VOLL) studies. Assumes a VOLL of $3,000/MWh for residential and $20,000/MWh for commercial and industrial (C&I) customers, and a weighted average based on approximate PNM customer load shares of 45% residential and 55% C&I.

specific storage use case. These contractual limitations would reduce PNM's ability to modify the operations of the storage device as experience is gained and market conditions change over time.

To assess the incremental value of charging at any time of day, we simulated the potential energy revenues of a battery storage system for both daytime-only and 24-hour charging cases.[5] The simulations used recently-observed prices in the California ISO's Energy Imbalance Market (EIM) at three locations near PNM's service territory: Arizona Public Service (APS), Nevada Energy, and PacifiCorp East (Utah). Since the EIM is not an ancillary services market, we separately assessed spinning reserves and frequency regulation revenues based on experience from the nearby CAISO, ERCOT, and SPP markets.

The ability to charge the battery during any hour increases energy revenues by between 14 and 40 percent, relative to the case where the battery can only charge during daytime hours. This amounts to between $10 and $25/kW-year in incremental value, depending on the locational prices used in the analysis. Ancillary services revenues are increased even further (between 70 and 148 percent) when the restriction on daytime charging is lifted.

It is worth noting that the pricing locations (i.e., EIM prices) that were used in the analysis have significant market penetration of solar PV. Therefore, these locations tend to have lower prices during daytime hours, making storage less valuable than at locations where off-peak prices (in the nighttime) are much lower than prices during the day. It is likely that the incremental value of unrestricted battery charging would be greater for PNM's system than our simulations indicate, because PNM is expected to experience development of significant additional wind generation on its system, which will yield more nighttime charging opportunities than offered in the more solar-dominated EIM pricing points in Arizona and Nevada. Growth in wind adoption may lead to curtailments due to the high wind generation output during off-peak hours, which could be avoided by charging a standalone battery. The need for ancillary services may also be higher during those off-peak times.

Results of the revenue analysis are summarized in Figure 1. As shown in the figure, the proxy energy and ancillary services revenues are estimated to be greater if PNM owns and operates the storage as a standalone facility. Even though PNM is a vertically integrated utility and would not "earn revenues" directly from the market, these proxy market revenue estimates represent the type of value that PNM could realize on behalf of its customers if PNM were to own the energy storage resources. At the lower end, the additional value of standalone storage could be approximately $10/kW-year greater if the storage had been contracted for from a third party that restricted the charging pattern of storage co-located with the solar PV.[6] At the high end, based

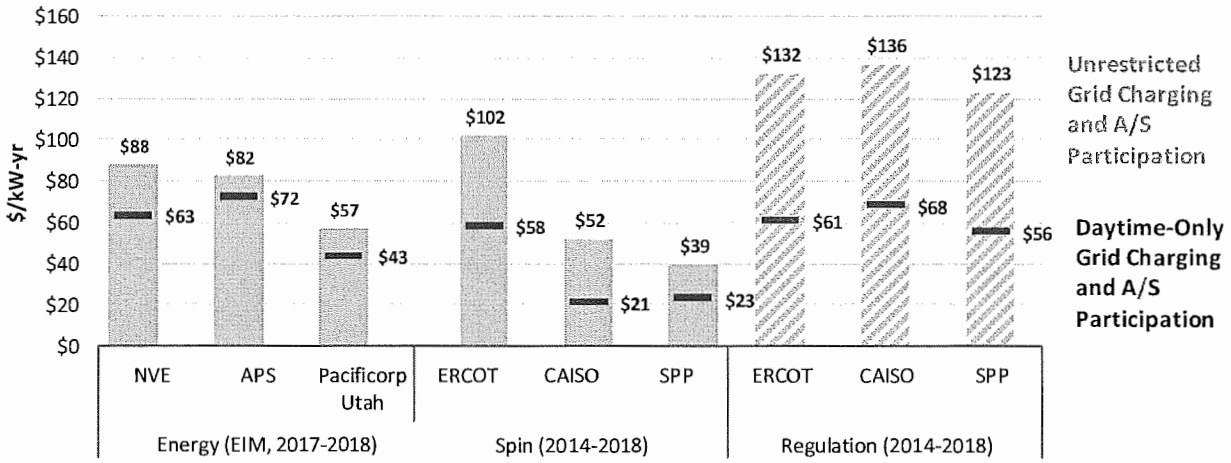
---

[5] Energy and ancillary services revenues for standalone battery facilities were simulated for a case where they battery can charge at any time of day, and separately for a case where the battery can only charge between the hours of 8 am and 7 pm (thus approximating a scenario where the battery can only charge from solar PV output).

[6] This is the incremental energy value at the nearby APS location in the EIM.

on the value of providing frequency regulation services under ERCOT-like market conditions, the additional value of standalone storage could be $71/kW-year. These incremental values of standalone storage systems are in addition to the transmission-related values presented earlier in this paper.

Figure 1: Simulated Energy and Ancillary Services Revenue, with and without Limits on Timing of Charging



Note: Results shown for 100 MW, 4-hour battery. Frequency regulation value is limited to a relatively low overall need for capacity (estimated at 20 to 40 MW for PNM system).

Addendum – Benefits of Projects Proposed by PNM

Following the development of this study, PNM proposed to develop two storage projects. The first project ("Sandia") is a 40 MW, 80 MWh battery located near the Sandia substation. The second project ("Zamora") is a 30 MW, 60 MWh battery located on the Tijeras radial line. For clarity, this addendum describes the annual transmission value that we identified for projects of those sizes and locations.

Sandia: As described earlier in this report, a battery located at the Sandia substation would reduce congestion-related dispatch costs. Brattle estimated the congestion cost savings associated with a range of 2-hour battery deployment capacities, ranging from 50 MW up to 250 MW. On a dollars-per-kilowatt-year basis, the 40 MW deployment proposed by PNM would provide benefits at least as high as the 50 MW deployment level simulated in our study. Based on an estimated benefit of $6/kW-year, the proposed Sandia project would produce benefits of $240,000 per year.

Zamora: Because the Tijeras substation is connected radially to the Sandia substation, a 30 MW battery with 2-hour duration located at the Tijeras radial line would reduce congestion-related

dispatch costs at the same rate as the Sandia location, i.e., $6/kW-year. In addition, such a battery would also provide $6/kW-year in reliability benefits by reducing local outages.[7] The $6/kW-year reliability benefit estimate is additive to the $6/kW-year congestion relief benefit, as it accounts for the possibility that the battery would not be sufficiently charged when needed to provide reliability services due to its use for congestion management.[8] Based on estimated total benefits of $12/kW-year, the proposed Zamora project would produce benefits of $360,000 per year.

---

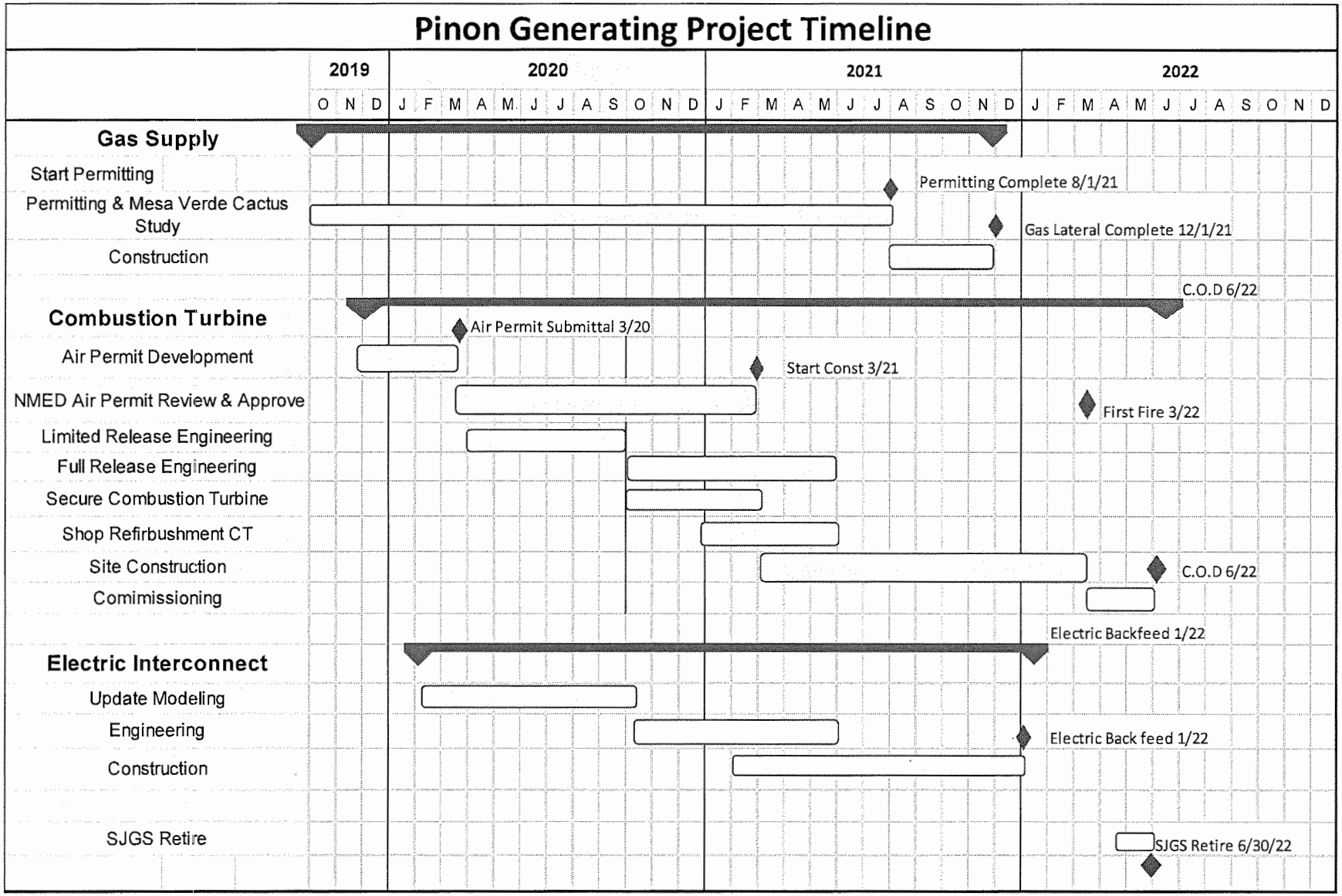
[7] As noted, the battery would need the ability to function in islanded mode ("grid forming capability") in order to produce these reliability benefits.

[8] Not accounting for such possibility leads to $7/kW-year reliability benefits.

Outline of the Required Timeline for the Pinon Gas Plant

PNM Exhibit TGF-3 (Rebuttal)

Is contained in the following 1 page.



PNM Exhibit TGF-3 (Rebuttal)
Page 1 of 1

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

IN THE MATTER OF PUBLIC SERVICE COMPANY OF NEW MEXICO'S CONSOLIDATED APPLICATION FOR APPROVALS FOR THE ABANDONMENT, FINANCING, AND RESOURCE REPLACEMENT FOR SAN JUAN GENERATING STATION PURSUANT TO THE ENERGY TRANSITION ACT	)	**Case No. 19-00195-UT**

AFFIDAVIT

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

THOMAS G. FALLGREN, Vice President of Generation for Public Service Company of New Mexico, upon being duly sworn according to law, under oath, deposes and states: I have read the foregoing **Rebuttal Testimony of Thomas G. Fallgren** and it is true and correct based on my personal knowledge and belief.

SIGNED this 19th day of December, 2019.

THOMAS G. FALLGREN

SUBSCRIBED AND SWORN to before me this 19th day of December, 2019.

OFFICIAL SEAL
TANYA D. ARAGON
NOTARY PUBLIC - STATE OF NEW MEXICO
My commission expires January 31, 2023

NOTARY PUBLIC IN AND FOR
THE STATE OF NEW MEXICO

My Commission Expires:

January 31, 2023