



# Meeting #7: July 27, 2023

## IRP Modeling Q&A

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## Michael Barrio, Advanced Energy United: Reliability evaluation

What was the reasoning for scuttling reliability?

### **PNM response:**

All portfolios are designed to meet a baseline Planning Reserve Margin (PRM) (calibrated to a 0.1 LOLE target); however, as we have discussed previously, PRM alone is insufficient to guarantee a reliable system. As a part of Phase 1-2 modeling, we performed a reliability check on all portfolios – see slides 10-12 of PNM modeling results update [presentation](#). When these portfolios were evaluated under a deterministic extreme weather load case, we did not find that any portfolio had unserved energy outside the range of outcomes considered reasonable for a reliable portfolio. Further, there was not enough differentiation in this deterministic approach to justify the weighting we originally contemplated.

As a part of Phase 3, we will conduct detailed reliability modeling via SERVIM. Additionally, we plan to conduct resiliency studies with the Most Cost Effective Portfolios (MCEPs) and we will give these results significant weighting when evaluating Phase 3 portfolio scores.

## Athena Christodoulou, CSOL Power: Carbon emissions

Are carbon emissions only restricted to operations and not upstream?

### **PNM response:**

Carbon emissions reflect those that result from the combustion of fossil fuels for electricity generation to serve PNM retail load.

Our modeling is consistent with the emissions requirements laid out in the New Mexico Energy Transition Act. This prescribes carbon intensity levels for emissions that result from electric power generation, i.e., stack emissions.



### Cynthia Mitchell, NM PRC: Fuel supply and price volatility sensitivities

IRP App A specifies fuel supply and price volatility as one of the criteria for evaluation. If PNM is to continue with the "donut" this should be added.

**PNM response:**

PNM will model a variety of sensitivities in Phase 3 scenarios, including those that incorporate high and low natural gas and market prices. Sensitivities can be found on slides 21 and 30 of PNM's modeling results update [presentation](#).





## Alondra Regalado, Strategen: Technology Readiness Level scale

Do you have a TRL scale that you can share with us?

### PNM response:

<b>TRL 0 – Idea phase</b>	<ul style="list-style-type: none"><li>• Unproven Concept with no testing having been done</li></ul>
<b>TRL 1 – Basic Research</b>	<ul style="list-style-type: none"><li>• Needs of the technology can be described, but have no evidence</li></ul>
<b>TRL 2 – Technology Formulation</b>	<ul style="list-style-type: none"><li>• Concept and application have been formulated</li></ul>
<b>TRL 3 – Needs Validation</b>	<ul style="list-style-type: none"><li>• You have an initial “offering”, stakeholders are interested</li></ul>
<b>TRL 4 – Small Scale Prototype</b>	<ul style="list-style-type: none"><li>• Built in laboratory environment.</li></ul>
<b>TRL 5 – Large Scale Prototype</b>	<ul style="list-style-type: none"><li>• Tested in intended environment</li></ul>
<b>TRL 6 – Prototype System</b>	<ul style="list-style-type: none"><li>• Tested in intended environment with close to expected performance</li></ul>
<b>TRL 7 – Demonstration System</b>	<ul style="list-style-type: none"><li>• Operating in operational environment at pre-commercial scale</li></ul>
<b>TRL 8 – First of Kind Commercial System</b>	<ul style="list-style-type: none"><li>• All technical processes and systems to support commercial activity at ready state</li></ul>
<b>TRL 9 – Full Commercial Application</b>	<ul style="list-style-type: none"><li>• Technology on “general availability” for all consumers</li></ul>

### Cynthia Mitchell, NM PRC: IRA incentives

I understood that the IRA provides incentives, funding, etc. for variety of technologies, hydrogen, RE, storage, DERs. Have you been able to include IRA effects on all resource types?

**PNM response:**

PNM has incorporated Investment Tax Credits for all storage and Carbon Capture technologies, and Production Tax Credits for renewable, nuclear, and hydrogen production.

### Brian Johnson, NM RETA: Base Technologies only scenario cost

Why are base tech costs high? Compared to tech that is not considered ready?

**PNM response:**

The Present Value of Revenue Requirement for each portfolio (presented on [slide 14](#)) reflects the portfolio cost over the study period. The cost for the “base technologies only” portfolio is highest because it requires the greatest amount of installed capacity (due to ELCC effects and the lack of long-duration storage or new dispatchable resources in that scenario).

### Cynthia Mitchell, NM PRC: Thermal-CT scenario

Clarify the "thermal -CT" scenario. I believe that is hydrogen-ready CT, right?

**PNM response:**

The “Thermal – CT” scenario includes base technologies, and allows for the addition of Combustion Turbines capable of burning hydrogen in 2040 and beyond (these incur a hydrogen conversion cost in 2040). The hydrogen burned in these CTs in 2040 and beyond is assumed to be delivered to the PNM system (as opposed to being created via electrolysis using designated renewables and stored on site, as in the Green Hydrogen scenario).

### Cynthia Mitchell, NM PRC: Hydrogen costs in Thermal-CT scenario

What hydrogen-related costs are included in the CT scenario, conversion cost, CCS, fuel cost, hydrogen transport cost.

**PNM response:**

In the Thermal-CT scenario, all CTs remaining online in 2040 and beyond incur a conversion cost that reflects the necessary upgrades to enable 100% hydrogen combustion. The cost of delivered hydrogen ranges \$20-21/MMBtu (\$2025, base assumption) in 2040-2042.

In the Green Hydrogen scenario, costs associated with hydrogen production and combustion include hydrogen-ready CTs, electrolyzers (and associated PTCs for hydrogen production), solar resources to supply the electrolyzers (and associated PTCs), and hydrogen storage (above-ground).

### Maria Scheller, ICF International: Hydrogen economics

Is the Hydrogen scenario economic in the long term after the IRA credits expire?

**PNM response:**

All of our modeling is based on our current understanding of the IRA and assumes the hydrogen PTC expires in 2032. Based on these assumptions, we don't see much hydrogen production and combustion once the hydrogen PTC expires. While the Green Hydrogen case is the lowest cost over the study horizon (2023-2042), cost advantages are directly attributable to PTC value (including PTCs for wind and solar).

However, the extent of the IRA impact on the Green hydrogen industry remains to be seen. The PTC is incredibly valuable and is likely to spur investments in green hydrogen production that provide for technology improvements and efficiency gains and could eventually result in a hydrogen economy. These types of developments may decrease the cost of initial investments in green hydrogen on a broader scale and help future project economics, particularly in places where there is a strong renewable resource. Extension of the hydrogen PTC can be expected to incentivize hydrogen investments further into the future.



### Gwen Farnsworth, Western Resource Advocates: Hydrogen costs

To Cynthia's point on the hydrogen question, we'd like the filed IRP testimony to explain the hydrogen cost, and the assumptions for how hydrogen will be proven to be green that is underlying the cost estimate (including examples of real projects for hydrogen production).

#### **PNM response:**

The IRP is not filed with testimony, it is a report that is either accepted or sent back for revision based upon whether the IRP Statement of Need and Action Plan comply with the policies and procedures of the IRP rule (NMAC 17.7.3.9).

### Cynthia Mitchell, NM PRC: Scenarios in Phase 2 vs. Phase 3

Slide 20: what is the difference/distinction between the Phase 2 last and next to last runs w/ all LDS and LDS+CT (slide 8), and what you show here # 3 and 4? PRC Staff would like to see a BaseTech with Valencia and Reeves extension and LDS.

#### **PNM response:**

- a) Phase 3 will incorporate the Base technologies + LDES and Base technologies + LDES + CT scenarios also modeled in Phase 2 – there is no difference in the technologies available for the model to optimize in these scenarios between Phase 2 and Phase 3. However, when modeled under different sensitivities in Phase 3, these scenarios might produce different portfolios/resource mixes than in the Current Trends and Policy (CT&P) case modeled in Phase 2.
- b) Per Gridworks, the deadline for submitting modeling run requests was May 26.



### Cynthia Mitchell, NM PRC: Valencia/Reeves extension scenarios

Slide 24: should FC be adjusted now to reflect 2031? How does the early retirement FC effect the analysis? Q: There is no change in installed capacity between BT and V&R cases. You assumed 5-year extension on V&R? So, there might be value to a 5 year extension that is not being reflected here.

#### **PNM response:**

These scenarios were specifically requested by a stakeholder. The first assumes PNM exits its share of Four Corners in 2027, and the Valencia PPA is extended through 2039. The second assumes PNM exits its share of Four Corners in 2027, the Valencia PPA is extended through 2039, and Reeves continues to operate through 2039. In both of these requested scenarios, Valencia and Reeves extensions do not incur any costs – they are free (as agreed to by stakeholders in the modeling request meetings).

In the Base Technologies only scenario, Valencia PPA expires in 2028 and Reeves retires in 2031.

In 2040, the stakeholder requested scenarios produce the same portfolio as in the Base Technologies only scenario because Valencia and Reeves do not operate past 2039.

### Cynthia Mitchell, NM PRC: Hydrogen costs in Thermal-CT case

PRC would like the underlying cost assumptions and 20-year cost stream (capital, fixed and variable O&M, and fuel costs), and any hydrogen related costs, for the CT case. Q: does PNM have similar cost data for Valencia and Reeves?

#### **PNM response:**

All available information can be found in the data sets posted to the Venue site. Because this is not an RFP evaluation, we will not be posting project-specific information, such as for a Valencia extension.





### Thomas Solomon, Member of the Public: PVRR translation to bill impacts

Can we translate the highest cost to the lowest cost portfolios into the real world? What would be the difference in an average consumer's monthly electric bill?

#### **PNM response:**

The IRP rule requires evaluation of portfolio costs over a planning horizon of at least 20 years, – we have done this with the PVRR metric. Bill impacts would only look at a single year and may not adequately capture long-term tradeoffs in resource choices. Furthermore, transforming PVRR into bill impacts would require assumptions around cost of service, cost allocation, ownership structures, etc. – this is beyond the scope of the IRP.



## Ed Rilkoﬀ, NM PRC: Thermal-CT scenario vs. Valencia/Reeves extension scenarios

I am having diﬃculty understanding the thermal-CT case versus extending Valencia and Reeves. They're all just CT's burning gas except the thermal-CTs have the potential for hydrogen conversion at the end. Is this correct?

### **PNM response:**

In the Valencia and Valencia & Reeves extension scenarios (stakeholder requests) there are no additions of thermal resources (and no hydrogen combustion) – the only new resource types available to the model are wind, solar, and 4-hr lithium-ion storage (the same as in the Base Technologies only scenario). However, one can glean from the Thermal - CT analysis whether gas fired generation is cost eﬀective when Reeves or Valencia would come out of the portfolio. If similar amount of new gas is added at those times, one can conclude that whether new gas, or an extension of those units, is cost eﬀective and the speciﬁc choice would come down to RFP bids in an RFP evaluation.

These two stakeholder-requested scenarios diﬀer from the Base Technologies scenario in only two ways:

1. PNM exits its share of Four Corners in 2027 (as opposed to in 2031)
2. Either Valencia (in the Valencia extension scenario), or Valencia and Reeves (in the Valencia and Reeves extension scenario) extend through 2039 at no additional cost (as opposed to the Valencia PPA ending in 2028 and Reeves retiring in 2031)

The stakeholder requested scenarios diﬀer from the Thermal-CT scenario in three ways:

1. PNM exits its share of Four Corners in 2027 (as opposed to in 2031)
2. Either Valencia (in the Valencia extension scenario), or Valencia and Reeves (in the Valencia and Reeves extension scenario) extend through 2039 at no additional cost (as opposed to the Valencia PPA ending in 2028 and Reeves retiring in 2031)
3. Options for new resource additions include only wind, solar, and 4-hr lithium-ion storage (as opposed to wind, solar, 4-hr lithium-ion storage, and generic Combustion Turbines that will be converted to burn hydrogen in 2040)

### Ed Rilkoﬀ, NM PRC: Carbon emissions scoring criteria

Is it necessary to score scenarios on carbon emissions when the NPVs are all very close and they all meet the ETA?

**PNM response:**

We think it’s important to consider the extent to which some portfolios can provide for earlier reduction in carbon emissions. Given that all portfolios meet ETA requirements, the NPV CO2 metric receives an overall weight of 15% in the scoring methodology – far below the 70% weight given to portfolio cost (as measured by PVRR).

### Gwen Farnsworth, Western Resource Advocates: Survey factors use in IRP

How would the 12 factors then be used in the IRP?

**PNM response:**

Stakeholders were asked to submit their top five factors (IRP evaluation criteria priorities) and rank by importance. PNM has proposed using the results of the factor survey to create a stakeholder-derived scoring matrix. Ultimately, we’d like to compare Phase 1-2 results scored using PNM’s scoring matrix with those scored using the stakeholder matrix. The overall goal would be to understand where PNM and stakeholders align in terms of evaluation criteria and level of importance.

### Glen Wilke, NM State University: RFP resources in IRP modeling

Re: the new 2026 storage and solar contracts covered at the start of this meeting, was their pricing already factored into the pricing assumptions used as input for the IRP modeling?

**PNM response:**

Final modeling results will incorporate 2026 RFP resources and associated costs. The results presented on July 27<sup>th</sup> do not reflect incorporation of these resources into IRP modeling.

Ultimately, the RFP resources will be the same in all portfolios so addition of these resources is not expected to materially change the comparison across portfolios.

### Cynthia Mitchell, NM PRC: Hydrogen costs

Additional question for follow-up modeling discussion: for green hydrogen, could we please have all cost assumptions (capital, fixed and variable O&M, fuel, water, transportation) and the 20-year cost stream?

**PNM response:**

All available information can be found in the data sets posted to the Venue site. Because this is not an RFP evaluation, we will not be posting project-specific information.

### Gwen Farnsworth, Western Resource Advocates: CT conversion for hydrogen combustion capability

If new CTs are assumed to use up to 30% hydrogen, depending on fuel availability assumptions, would they be restricted to a 20-year lifetime and depreciation period in the modeling? (Because a 30% H<sub>2</sub> capable CT cannot be converted to 100% HC capability)

**PNM response:**

New CTs in the Thermal-CT case are assumed to burn natural gas through 2039. In 2040 they incur a conversion cost and are assumed to burn 100% hydrogen thereafter. Generic LM6000s have a 40-year operating life and depreciation period. This is appropriate because it is reasonable to assume that these resources will be able to utilize a non-carbon-emitting fuel (hydrogen or other) and operate for the entire 40-year life.