Integrated Resource Plan:
Statement of Need Table of Contents
Working group suggestions for Public Service New Mexico - May 31, 2023

Statement of Need 17.7.3.10

- The statement of need is a description and explanation of the amount and the types of new resources, including the technical characteristics of any proposed new resources, to be procured, expressed in terms of energy or capacity, necessary to reliably meet an identified level of electricity demand in the planning horizon and to effect state policies.
- The statement of need shall not solely be based on projections of peak load. The need may be attributed to, but not limited by, incremental load growth, renewable energy customer programs, or replacement of existing resources, and may be defined in terms of meeting net capacity, providing reliability reserves, securing flexible resources, securing demand-side resources, securing renewable energy, expanding or modifying transmission or distribution grids, or securing energy storage as required to comply with resource requirements established by statute or commission decisions.

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1. Introduction
   a. The PNM Integrated Resource Plan 2023 provides a comprehensive long range path for building out the strongest, most reliable electrical power delivery system we can envision for our customers over the next 20 years. The IRP report begins with the current status of PNM's system, and shows how available resources and technologies can bring improvements. Simultaneously we recognize that changes are occurring in nearly every sector of the environment in which we operate. These will require ongoing re-evaluation and modifications to the 2023 IRP plan that will be incorporated in future triennial PNM IRPs.

      Meeting our clean energy goals and preserving system reliability, while providing for the growing needs of our customers in an affordable manner, will require the addition of significant amounts of new generation capacity over the next twenty years. We anticipate that between today and 2040, the likely amount of new installed generation capacity will total between 4,000 to 5,000 MW or more. This amount of *new* capacity is significantly greater than the amount that exists today, implying that the achievement of our goals will require continuous and significant evolution of our portfolio. [For context, please include here: Current PNM capacity so we see what growing to 4-5K means and # of customers on the PNM system now and if changing in the future] Barbara

      This IRP does not represent a future system design or even a pathway to a full system design for the PNM planned 2040 zero carbon grid. The action plan, dictated in the IRP rules, only provides a 3-year detailed plan and thus any identified resources past 2027 are currently speculative. The limited timeframe of an action plan may well serve a semi-static resource portfolio with a highly predictive load profile, but the addition of a State clean energy policy requirements, which requires a massive rebuild of the entire 100-year-old system, may require a more defined and longer-term action plan to initiate actual projects toward building out the final solution. Given the buildout of long duration energy storage and other zero carbon dispatchable power generation could take decades and cost tens of billions of dollars, an IRP that can only speculate on this future is insufficient for determining the most reliable and affordable system, that can be initiated today, to meet the operational needs of the grid a mere 16-years from now.

2. Vision and Goals
    a. The identification of a set of resources and a sequencing of those resource deployments that conforms to the regulations and policies of the State of New Mexico, reliably serves all customers at a reasonable cost with electrical energy that is that is resilient in the face of national security, technology, infrastructure, resource, cyber and environmental constraints.
    b. Goals
        i. Reliability and Resilience: Utility's Obligation to Serve
            1. Minimum Reserve Requirements
            2. Reliability Standards
            3. Swift recovery from climate or security threats
        ii. Public Interest and Equity
            1. Responsibilities to Ratepayers and Shareholders
                a. Affordability
                b. Availability to Underserved Communities
                c. Climate Justice for individuals and communities impacted by plant retirements or local pollution
            2. Costs associated with the development and deployment of all candidate resources
                a. Costs of Energy to Consumers
                b. Life Cycle Impacts
                    i. Pollution
                    ii. Greenhouse Gas emission
                    iii. Materials
                    iv. Utility disposal
            3. Community Communication
            4. NIMBY
3. Identified Decision Points and Pathways
    a. "Getting to Zero" Carbon
        i. Motivations
            1. Regulations & Policy
                a. ETA (2019)
                    i. EPA - evolving
                b.
            2. Public Service in response to Mar 2023 IPCC report analysis - https://www.ipcc.ch/report/ar6/syr/ summary for policymakers - pg 23
    b. Making "no regrets" decisions
        i. Evaluation of land use and community impact
        ii. Minimizing investment risk
            1. Stranded assets
                a. Loss of public trust
        iii. Maximizing investment opportunity

1. First to market w/ long term solutions
2. Public trust and sentiment

iv. Value of money vs future human life opportunities

c. Regional Planning and Coordination
   i. Organized Market Opportunities
   ii. Future Regional Transmission Operator
d. Grid Modernization (data, demand response, etc.)

4. Resources
   a. **Resource Description:**
      i. A *brief* description of the resource; its technical characteristics.
   b. **Commercial Maturity:**
      i. The TRL level or similar metric to describe the commercial maturity of the resource. How long has it been used in electric utility applications? This criteria needs to be done carefully. Some technologies have been the brunt of sabotage, business ineptness, and smear campaigns by the opponents.
   c. **Staged Cost:**
      i. This is a breakdown of cost by scale (if applicable). For example, solar may have a cost for 1 MW to 5 MW; and a different cost for 10 MW to 100 MW. And for storage it should also include RTE and similar variables as are in the below table.
   d. **Grid Applications and Benefits:**
      i. Why is this resource important to the grid? What are its applications and benefits?
   e. **End of Life:** **From an Environmental engineering perspective, the proper heading should be "Life-Cycle Impacts"**
   f. **And the Sub headings should be: 1) Greenhouse Gas emissions 2)Materials 3)Utility Disposal**
   g. Candidate Resources
      i. Renewable generation
         1. Solar (including community solar)
         2. Wind
         3. Geothermal
   h. No new gas of any type
   i. Energy Storage
      i. Short duration (up to 10 hr)
         1. Lithium-ion battery etc. see below charts
      ii. Inter-day & Multi-day/week Long Duration Energy Storage (LDES) - see chart 1 below
      iii. Seasonal Shifting
         1. Pumped-hydro storage, thermal energy storage, etc
   j. Not for electric
5. Potential New Resources
   a. Adoption of new technologies
   b. High Penetration of Distributed/Customer-owned Generation
   c. Firming Plans
   d. Energy efficiency and demand-response
   e. Cost-effective repowering or upgrading of existing fossil resources to minimize risk of stranded investment or delayed decarbonization
6. [System Needs]
7. Preferred Portfolio

a. [results of PNM modeling]
b. Potential pilot projects
c. [PNM conclusions]

DETERMINATION OF THE RESOURCE PORTFOLIO:

A. To identify the most cost-effective resource portfolio, utilities shall evaluate all supply- side resources, energy storage, and demand-side resource options on a consistent and comparable basis, taking into consideration risk and uncertainty, including but not limited to financial, competitive, operational, fuel supply, price volatility, downstream impacts on transmission and distribution investments, extreme-weather events, and anticipated environmental regulation costs.

B. The utility shall evaluate the cost of each resource through its projected life with a life-cycle or similar analysis.

C. The utility shall consider and describe ways to mitigate ratepayer risk.

D. Each electric utility shall provide a summary of how the following factors were considered in, or affected,
the development of resource portfolios:

(1) load management or modification and energy efficiency requirements;
(2) renewable energy portfolio requirements;
(3) existing and anticipated environmental laws and regulations, and, if determined by the commission, the
standardized cost of carbon emissions;
(4) fuel diversity;
(5) susceptibility to fuel interdependencies;
(6) transmission or distribution constraints; and
(7) system reliability and planning reserve margin requirements.

E. Alternative portfolios. In addition to the detailed description of what the utility determines to be the most cost-effective resource portfolio, the utility shall develop alternative portfolios by altering risk assumptions and other parameters developed by the utility.

1 There are numerous technologies within Long Duration Storage

NON-EXHAUSTIVE – HYDROGEN AND HYBRID LONG DURATION STORAGE EXCLUDED

Less Desirable → More Desirable

△ Faces geologic constraints[1] | Not enough public datapoints to obtain a reliable value (XX) | Inter-day | Can function as both | Multi-day / week

Duration	Energy storage form	Technology	Nominal duration, hrs	LCOS[5], $/MWh	Min. deployment size, MW	Average RTE[1], %	TRL
Inter-day	Mechanical	Traditional pumped hydro (PSH) △	0–15	70–170	200 – 400	70–80	9
		Novel pumped hydro (PSH)	0–15	70–170	10–100	50–80	5-8
		Gravity-based △	0–15	90–120	20–1,000	70–90	6-8
		Compressed air (CAES) △	6–24	80–150	200–500	40–70	7-9
		Liquid air (LAES)[1]	10–25	175–300	50–100	40–70	6-9
		Liquid CO2[1]	4–24	50–60	10–500	70–80	4-6
Multi-day / week	Thermal	Sensible heat (e.g., molten salts, rock material, concrete)[2]	10-200[2]	300	10–500	55–90	6-9
		Latent heat (e.g., aluminum alloy)	25–100	300	10–100	20–50	3-5
		Thermochemical heat (e.g., zeolites, silica gel)	XX	XX	XX	XX	XX
	Electrochemical	Aqueous electrolyte flow batteries	25–100	100-140	10–100	50–80	4-9
		Metal anode batteries	50–200	100	10–100	40–70	4-9
		Hybrid flow battery, with liquid electrolyte and metal anode (some are Inter-day)[2,3]	8–50[2]	XX	>100	55–75	4-9

1 Demand potential / market size is limited by the requirement for specific geological formations
2 Codified based on primary technology type
3 Can function as inter-day, but organized based on longest duration potential
4 Some flow batteries under development will not work for multi-day, but it is categorized here as such given the technology's maximum duration

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Source: Adapted from LDES Council Net-Zero Power Report 2021, Wood Mackenzie Long Duration Energy Storage Report 2022, Company websites, Academic research