Integrated Resource Plan: Statement of Need
June 26, 2023 Draft

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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 for our customers over the next 20 years as we can envision. 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.

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 Resiliency: Utility's Obligation to Serve
         1. Minimum Reserve Requirements
         2. Reliability Standards
         3. Swift recovery from climate or cyber disruption
      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. Climate Change Impacts
            c. Life Cycle Impacts (Recycling/disposal)
               i. Greenhouse Gas emissions
               ii. Materials
               iii. Utility Disposal
         3. Consumer Education
         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. Making “no regrets” decisions
         i. Minimizing investment risk
            1. Stranded assets
               a. Loss of public trust
            ii. Maximizing investment opportunity
               1. First to market w/ long term solutions
               2. Public trust and sentiment
            iii. Value of money vs future human life opportunities
      c. Regional Planning and Coordination
         i. Organized Market Opportunities
         ii. Future Regional Transmission Operator
   4. Resources
a. Candidate Resources
   i. Renewable generation
      1. Solar (including community solar)
      2. Wind
      3. Geothermal
   b. No new gas of any type
   c. 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 charts below)
      iii. Seasonal Shifting
         1. Pumped-hydro storage, thermal energy storage, etc
   d. 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. Preferred Portfolio
   a. [results of PNM modeling]
   b. Potential pilot projects
   c. [PNM conclusions]
ADDITIONAL MATERIAL

Resource Description:
A brief description of the resource; its technical characteristics.

Commercial Maturity:
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.

Staged Cost:
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.

There are numerous technologies within Long Duration Storage

<table>
<thead>
<tr>
<th>Duration</th>
<th>Technology</th>
<th>Nominal duration, hrs</th>
<th>LCOE, $/MWh</th>
<th>Min. deployment size, MW</th>
<th>Average RTE, %</th>
<th>TRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-day</td>
<td>Mechanical</td>
<td>0–15</td>
<td>70–170</td>
<td>200–400</td>
<td>70–80</td>
<td>9</td>
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<tr>
<td></td>
<td>Traditional pumped hydro (PSH)</td>
<td>0–15</td>
<td>70–170</td>
<td>200–400</td>
<td>70–80</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Novel pumped hydro (PSH)</td>
<td>0–15</td>
<td>70–170</td>
<td>200–400</td>
<td>70–80</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Gravity-based</td>
<td>0–15</td>
<td>50–120</td>
<td>200–1000</td>
<td>70–80</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Compressed air (CAES)</td>
<td>6–24</td>
<td>80–150</td>
<td>200–300</td>
<td>40–70</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Liquid air (LAEK)</td>
<td>10–25</td>
<td>175–300</td>
<td>50–100</td>
<td>40–70</td>
<td>9</td>
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<tr>
<td></td>
<td>Liquid CO2</td>
<td>4–24</td>
<td>50–80</td>
<td>10–500</td>
<td>70–80</td>
<td>4–6</td>
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<tr>
<td>Multi-day / week</td>
<td>Thermal</td>
<td>10–200</td>
<td>300</td>
<td>10–500</td>
<td>55–90</td>
<td>6–9</td>
</tr>
<tr>
<td></td>
<td>Sodium heat (e.g., molten salts, rock material, concrete)</td>
<td>10–200</td>
<td>300</td>
<td>10–500</td>
<td>55–90</td>
<td>6–9</td>
</tr>
<tr>
<td></td>
<td>Latticed heat (e.g., aluminum alloys)</td>
<td>25–100</td>
<td>300</td>
<td>10–100</td>
<td>20–50</td>
<td>3–5</td>
</tr>
<tr>
<td></td>
<td>Thermochemical heat (e.g., zeolites, silica gel)</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
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<tr>
<td>Electro-chemical</td>
<td>Aqueous electrolyte flow batteries</td>
<td>25–100</td>
<td>100–149</td>
<td>10–100</td>
<td>50–80</td>
<td>9</td>
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<tr>
<td></td>
<td>Metal anode batteries</td>
<td>50–200</td>
<td>100</td>
<td>10–100</td>
<td>40–70</td>
<td>4–9</td>
</tr>
<tr>
<td></td>
<td>Hybrid flow battery, with liquid electrolyte and metal anode (some are Inter-day)</td>
<td>5–100</td>
<td>XX</td>
<td>&gt;100</td>
<td>55–75</td>
<td>4–9</td>
</tr>
</tbody>
</table>

1 Demand potential / market size is limited by the requirements for specific applications
2 Costed based on energy technology type
3 Can function as multi-day, but is operational based or limited duration potential
4 Some flow batteries under development will not work full-time, but it is categorized here so as such given the technology’s maximum duration


Grid Applications and Benefits:
Why is this resource important to the grid? What are its applications and benefits?

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.