PNM 2023-2042 IRP: Modeling Framework and Core Scenarios, RFI Selections, Existing System, and Economic Development

PUBLIC ADVISORY GROUP MEETING #14
STEERING MEETING #11

FEBRUARY 15, 2023

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MEETING GROUND RULES

THE FOCUS OF THE MEETING IS THE DEVELOPMENT OF THE 2023 IRP

01

- Questions and comments are welcome – one Person Speaks at a Time

02

- Reminder; today's presentation is not PNM's plan or a financial forecast, it is an illustration of the IRP process

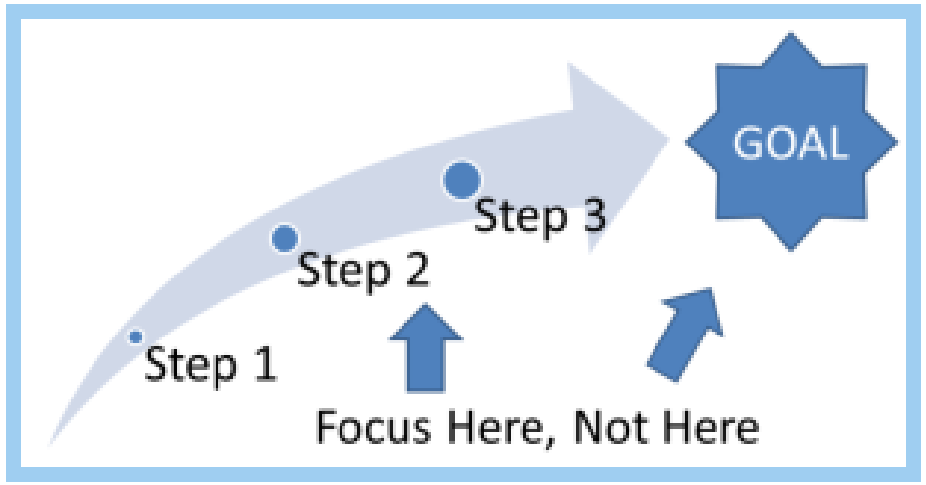
03

- When asking a question, please speak clearly and slowly as all questions will be logged and labeled with the person and organization responsible for asking the question

04

- These meetings are about the 2023 IRP, questions and comments should relate to this IRP. Any questions or comments related to other regulatory proceedings should be directed towards the specific filing.

THE FOCUS OF THE MEETING IS THE DEVELOPMENT OF THE 2023 IRP



The technical sessions are about discussing the advantages and disadvantages regarding the application of different technical methodologies within the IRP modeling framework.

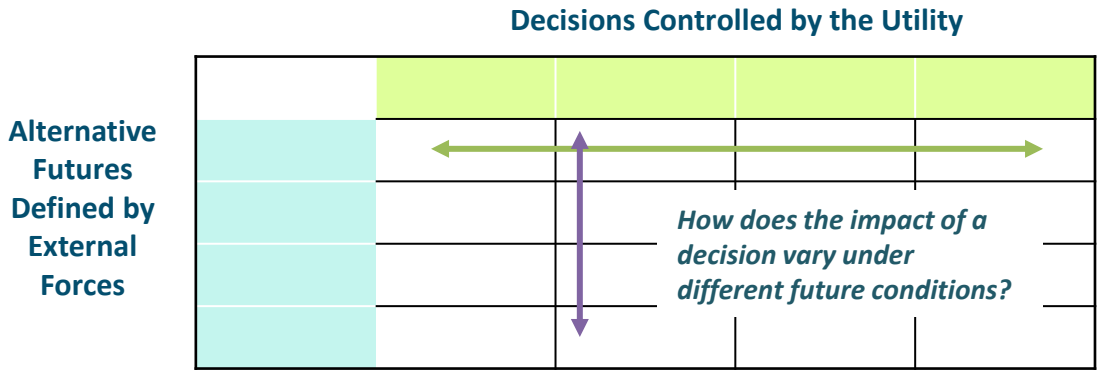
We are not here to focus on the results or drive towards a specific result. **We all know where we are going: 100% Carbon Free by 2040. The focus in the IRP development is how do we get there in the best way possible for PNM's customers and New Mexico.**

MEETING AGENDA

- Modeling terminology
- IRP modeling framework and key elements in analysis timeline
- Scenario screening overview and examples
- Modeled technologies vs. RFP resources
- RFI selections for Phase 1 modeling
- Treatment of existing resources
- Economic Development forecast for IRP modeling
- IRP scenarios
- Time for questions or follow-ups from previous meetings

TERMINOLOGY

- A **scenario** describes potential key decisions made by PNM
- A **future** consists of a set of forecasts or conditions that describe a future state of the world; PNM generally has no ability to influence factors that determine which future becomes reality
- A **sensitivity** describes a change in a single element of a given future; sensitivity analysis is used to understand how sensitive the results are to the changed variable



MODELING FRAMEWORK

Utility decisions;

future portfolio choices made by the utility to meet objectives

e.g., carbon target, resources considered, plant retirements

Scenarios

Futures

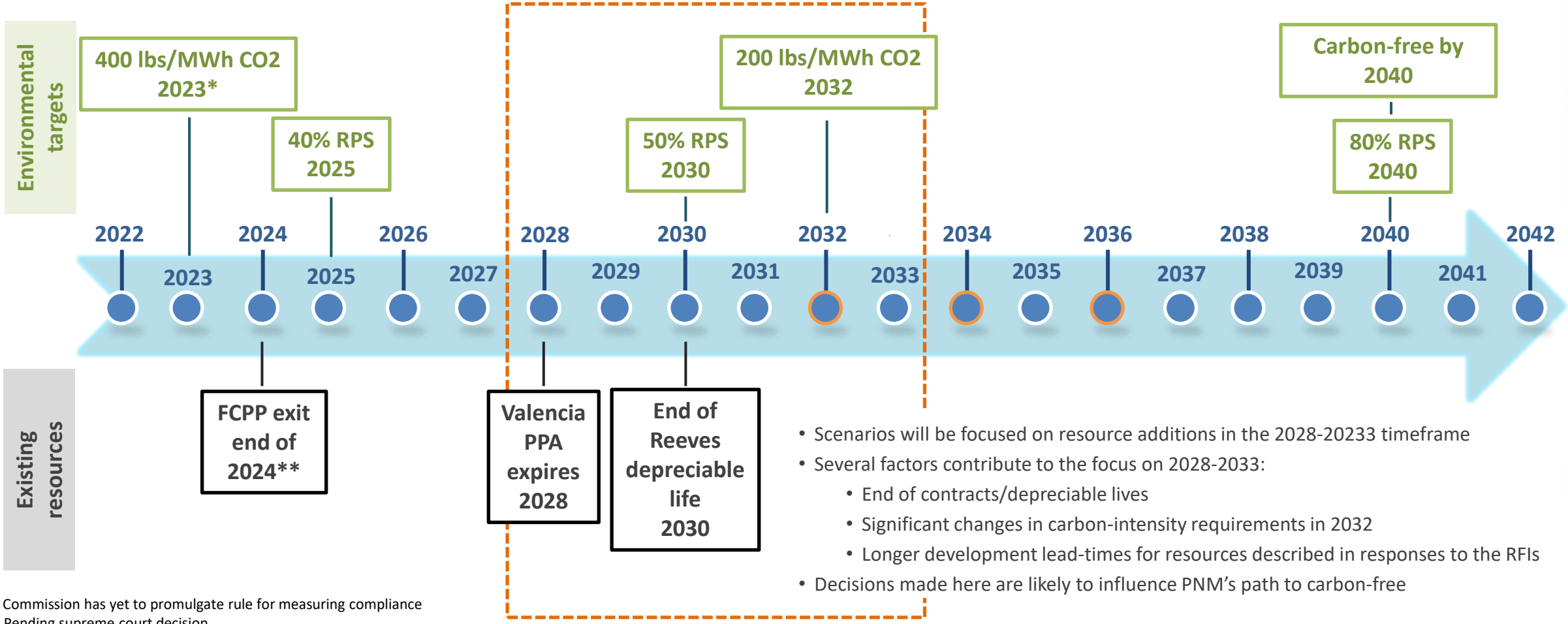
External forces; certain or uncertain variables outside of utility's control that present risks

e.g., gas price, load forecast, technology prices

Variation of selected parameter or variable within a scenario in order to understand its impact on key metrics

Sensitivities

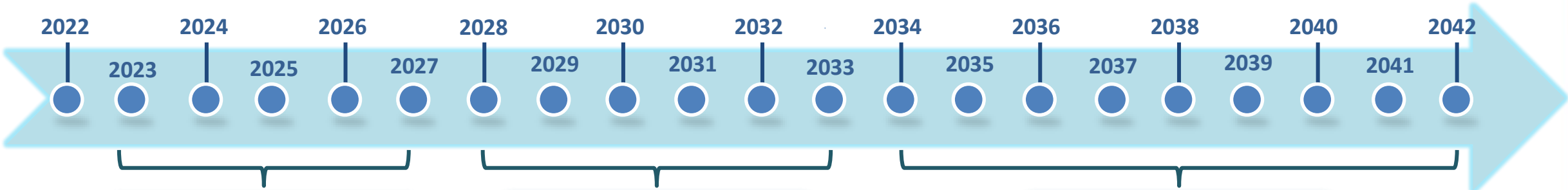
KEY ELEMENTS WITHIN TIMELINE FOR 2023 IRP ANALYSIS



- Scenarios will be focused on resource additions in the 2028-20233 timeframe
- Several factors contribute to the focus on 2028-2033:
  - End of contracts/depreciable lives
  - Significant changes in carbon-intensity requirements in 2032
  - Longer development lead-times for resources described in responses to the RFIs
- Decisions made here are likely to influence PNM's path to carbon-free

* Commission has yet to promulgate rule for measuring compliance
** Pending supreme court decision

POTENTIAL RESOURCE DECISIONS IN THE 2028-2033 TIMEFRAME IMPACT LONGER-TERM SYSTEM DYNAMICS



Near-term (Action Plan Period)
2023-2027:

Full transparency, low uncertainty

- The resource portfolio for this period has largely been determined through 2025; additional resources selected from near-term 2026-28 RFPs
- PNM may be required to act here to prepare for changes in the 2028-2033 period

Mid-term
2028-2033:

Focus of 2023 IRP analysis

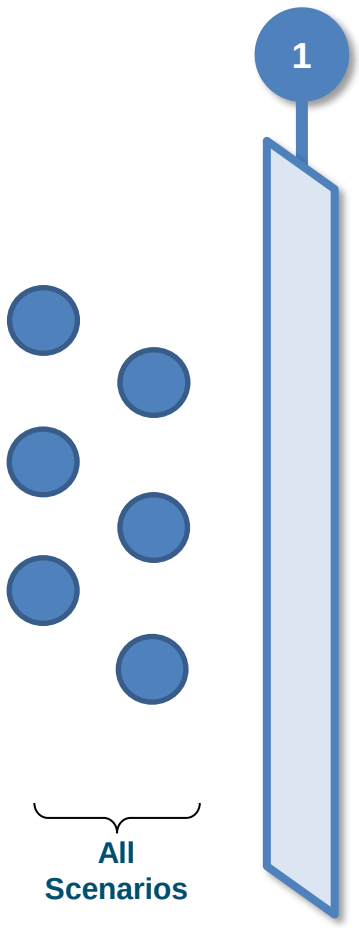
- IRP will evaluate best mix of known resource alternatives pivotal for enabling a carbon-free system by 2040
- Carbon intensity requirement of 200 lbs/MWh in 2032 is expected to be highly impactful
- Use of the scenario screening approach

Long-term
2034-2042:

Less transparency, high uncertainty

- Core scenarios outline additions in the 2028-2033 timeframe, which will impact PNM's portfolio in the later years of the study period

SCENARIO SCREENING ILLUSTRATIVE EXAMPLE: HIGH LEVEL

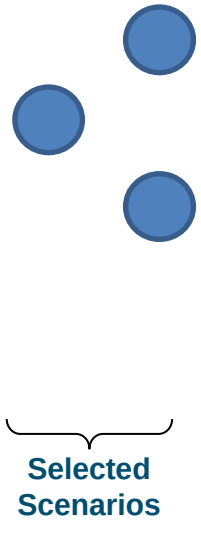


1

Phase 1: Scenario Screening

A scenario focuses on key decisions PNM will make through the planning process

- *No defined number of scenarios that make it through screen*
- *Analyze 2040 outcomes*



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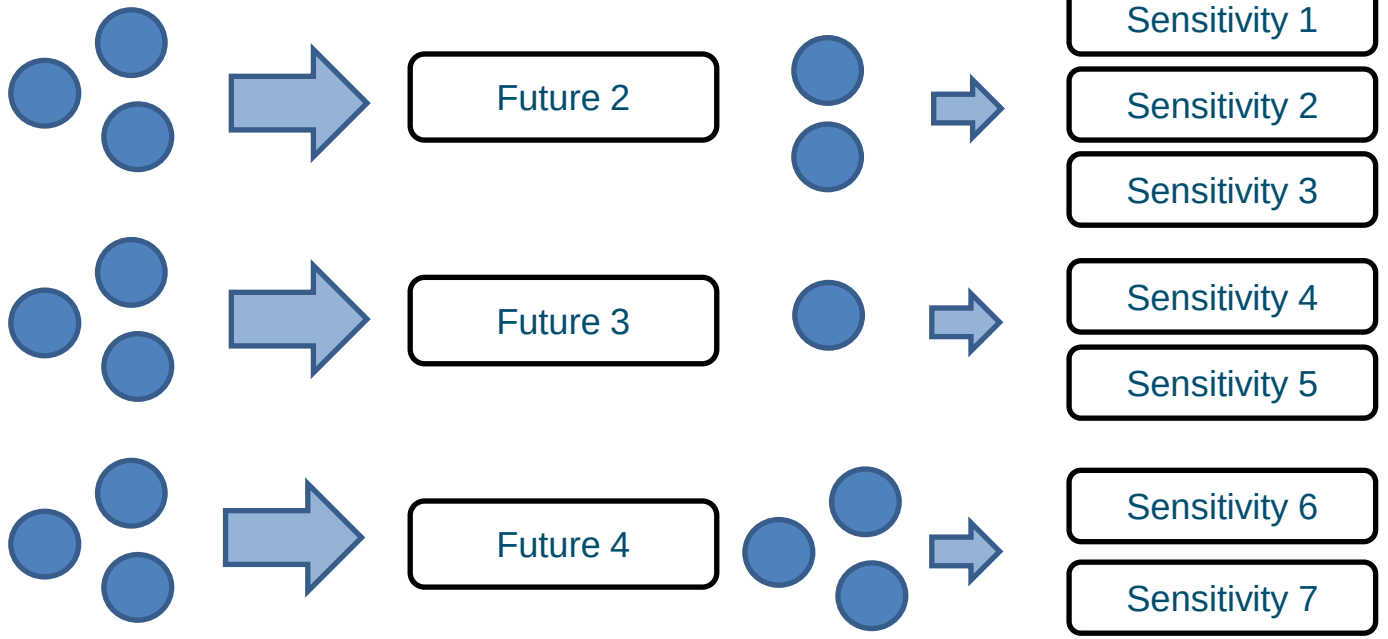
Phase 2: Futures & Sensitivities

- *A future consists of a set of forecasts that describe the state of the world.*
- *A sensitivity describes the variation of a single input assumption within a defined future*



ILLUSTRATIVE MODELING PROCESS EXAMPLE #1

PHASE 1

Select core scenarios | ***Screen core scenarios*** | ***Select scenarios for further analysis***

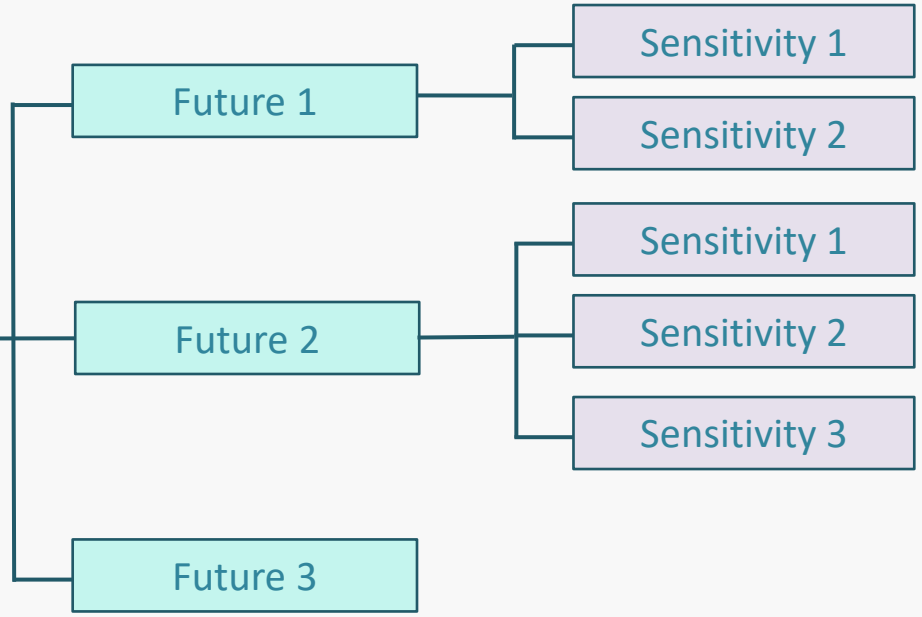
Scenario 1 → Screen → Scenario 1

Scenario moves to Phase 2

- *Identify potential resource options for key planning decisions in 2028-2033*
- *Core scenarios reflect the option to add from a set of resources with similar operating characteristics*

- *Screen core scenario against two capacity expansion cases:*
  1. *Current Trends & Policy future*
  2. *Current Trends & Policy w/ Strong Economic Development growth*
- *For each resulting portfolio, run 8760 production cost with both 50/50 and extreme weather load cases for both resulting portfolios*
- *If scenario needs no adjustments, it is ready for Phase 2*

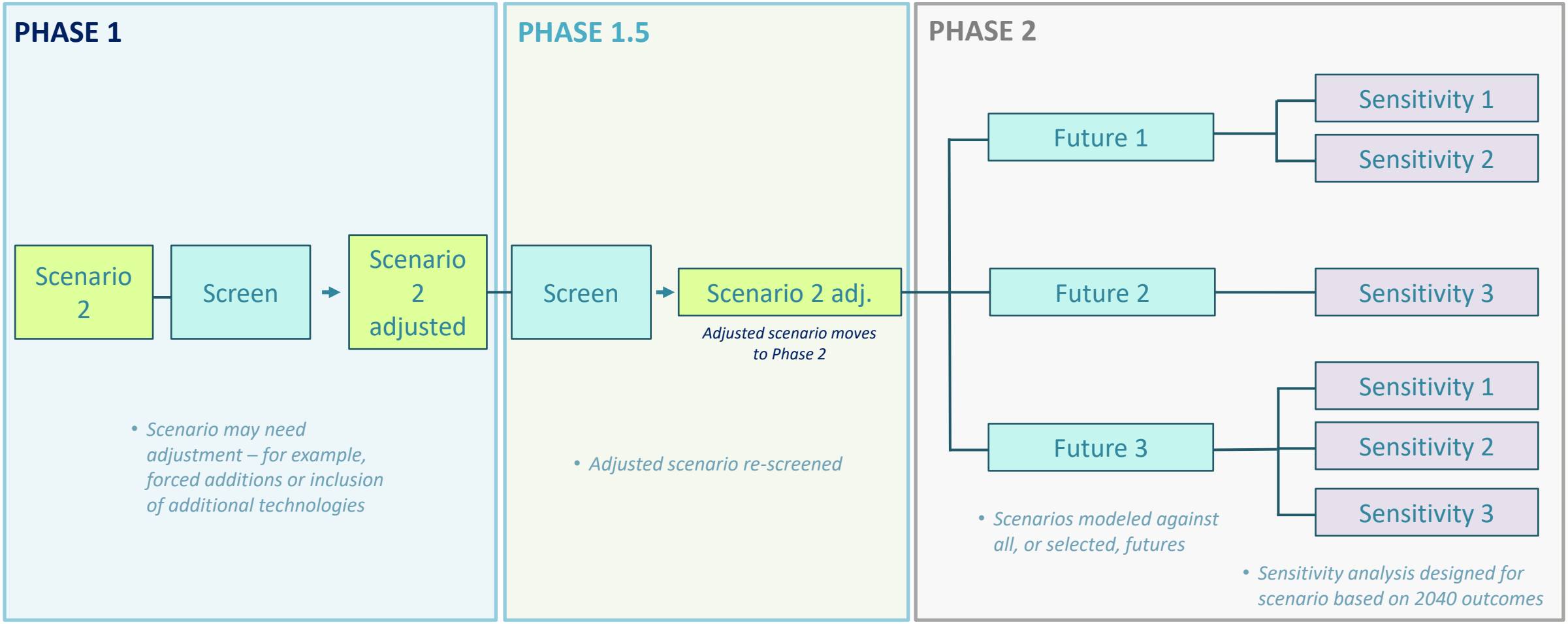
PHASE 2



- *Scenarios modeled against all, or a selection of, futures*
- *Sensitivity analysis designed for scenario based on 2040 outcomes*

- *Not all sensitivities will need to be evaluated under all futures – some combinations of scenario/ future/sensitivity may not make sense*

ILLUSTRATIVE MODELING PROCESS EXAMPLE #2



MODELED TECHNOLOGIES VS. RFP RESOURCES

The IRP is different from an RFP evaluation

- We do not intend to model every specific project, RFI response, model of equipment, etc.
- We are examining the type of operating characteristics and attributes of resources that will lead to the most-cost effective path to decarbonizing the system in a safe, reliable, and resilient way
- We will issue RFPs in the future to identify specific projects that can provide the types of operating characteristics and attributes that we identify in the IRP as leading to the most-cost effective portfolio
- For example – we do not need to model every turbine type or battery/storage chemistry, as many different types have similar characteristics

RFI SELECTIONS FOR PHASE 1 MODELING

- IRP analysis will focus on identifying the resource mix necessary to enable a carbon-free system by 2040
- When reviewing RFI responses and selecting technologies to model, we chose to focus on operating characteristics, not specific projects
- RFI technologies selected for Phase 1 modeling (in addition to other non-RFI technologies modeled):
    1. Long-duration storage:
        - Pumped Hydro Storage (70+ hours in duration, 85% efficiency)
            - Shorter duration variant may or may not need to be modeled depending on outcomes of other modeling
        - Iron-air storage (100 hours in duration, 38% efficiency)
    2. Natural gas:
        - Linear generator units
    3. Dispatchable generation with carbon capture:
        - NET power plant utilizing supercritical CO2 Allam Cycle
    4. Hydrogen:
        - Single site production, storage, and combustion
    5. Concentrated Solar Power with Thermal Energy Storage and/or other Thermal storage?
- Phase 2 modeling scenarios still in development, and depend heavily on Phase 1 results
- Phase 2 will also incorporate scenarios that study treatment of existing resources set for retirement within the planning period

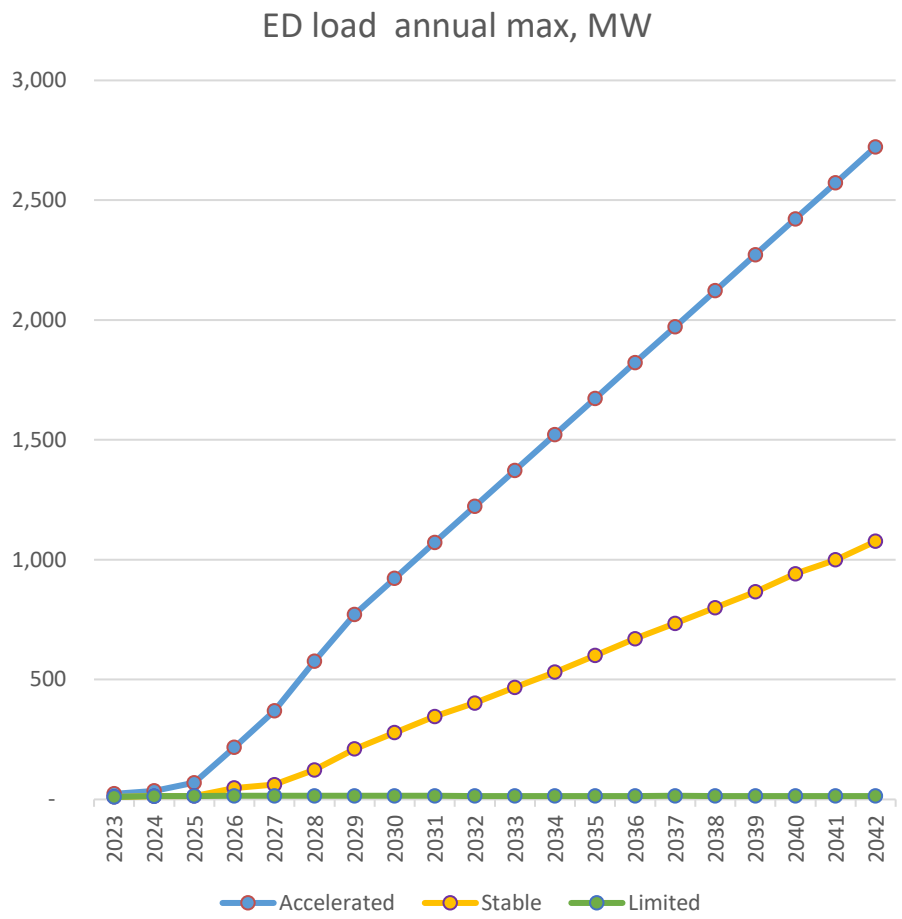
TREATMENT OF EXISTING SYSTEM RESOURCES

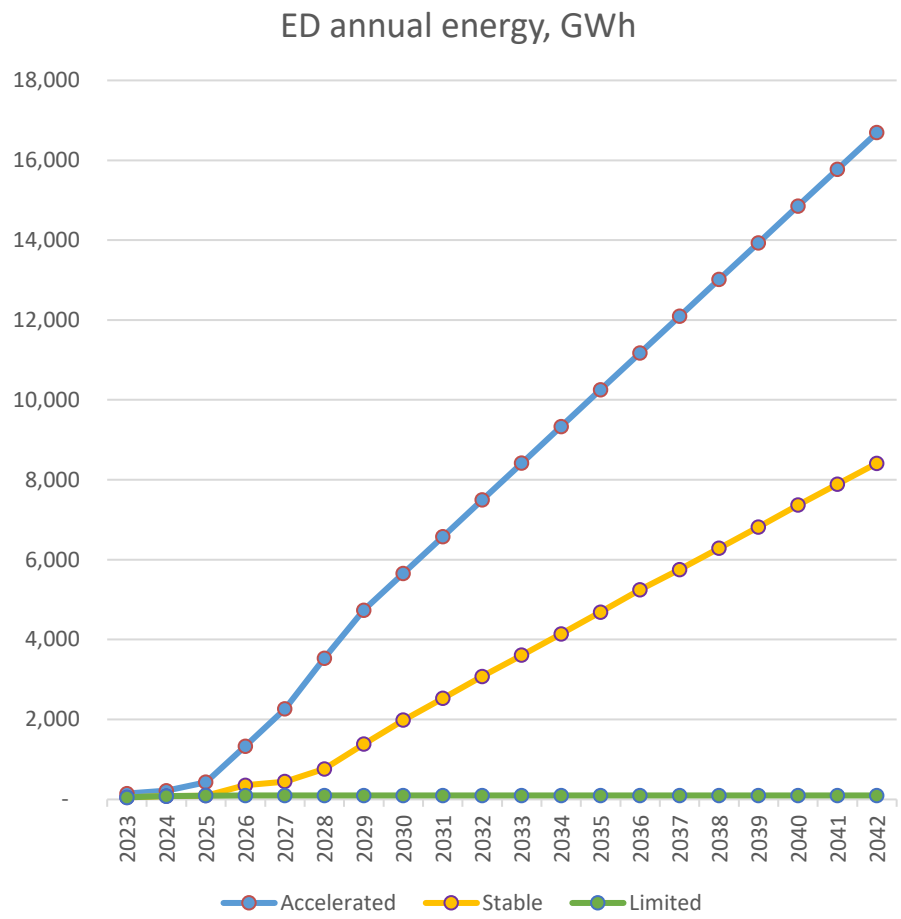
- The focus on existing system resources revolves around those that will retire during the planning period (2028-2033)
    - Reeves retires in 2030
    - Valencia PPA expires 2028
    - Four Corners exit in 2024*
- In Phase 1 modeling, these resources will be replaced with generic additions of wind/solar/storage, or additions of capacity specific to a given Core scenario
- In Phase 2 modeling, we will test scenarios against different futures and sensitivities to examine robustness of selected strategies

* Pending supreme court decision

ECONOMIC DEVELOPMENT FORECAST FOR IRP MODELING

- In Phase 1 modeling, core scenarios will be screened based on:
    a) Current trends & Policy Future
    b) Current Trends & Policy Future + Stable Economic Development forecast





SCENARIOS FOR PHASE 1 MODELING

Base technologies only

PNM relies on solar, wind, and storage (lithium-ion) to meet future need and carbon emission reduction goals

Base + long-duration Storage

PNM makes a commitment to add long-duration storage in the 2028-2033 timeframe to meet future capacity need and facilitate clean energy transition

Base + natural gas

PNM allows new build of natural gas resources that will be converted to utilize hydrogen in 2040

Base + wind expansion

PNM seeks strategic transmission expansion in the late 2020's/early 2030s to integrate a large quantity of wind resources

Base + carbon capture

PNM relies on carbon capture and sequestration technologies to meet future capacity need and facilitate clean energy transition

Base + H2/early gas conversion

PNM pilots use of hydrogen before 2040 by creating green hydrogen via electrolysis for use in new or existing CTs

BASE TECHNOLOGIES SCENARIO

Base technologies only

PNM relies on solar, wind, and storage (lithium-ion) to meet future need and carbon emission reduction goals

- Modeling allows for additions of generic resources in the base case and across all scenarios:
  - Solar (beginning in 2026)
  - Wind (beginning in 2033 – to compare against the Base + Wind Exp.)
  - Battery storage – 4-hr, with the option to convert to 8-hour (beginning in 2026)
- Once the RFP resources for 2026 are determined, those resources will become part of the base portfolio analyzed across all scenarios
- In other scenarios, additions of these resources are optimized around the addition of scenario resources

BASE + LONG-DURATION STORAGE SCENARIO

Base + long-duration Storage

PNM makes a commitment to add long-duration storage in the 2028-2033 timeframe to meet future capacity need and facilitate clean energy transition

- Modeling allows for addition of base case resources (generic solar, wind, and storage) plus optimal long-duration storage project(s) from selection of technologies
- Allow addition of long duration storage projects beginning in 2028 (earliest COD tied to RFI)
- Allow model to optimize among additions of:
    - 85% efficiency storage resource with long-duration/mid-ramp (70-hr) (i.e., PHS)
        - Shorter duration variant
    - ~40% efficiency storage resource with mid-duration/long-ramp (100-hr) (Form)

BASE + NATURAL GAS SCENARIO

Base + natural gas

PNM allows new build of natural gas resources that will be converted to utilize hydrogen in 2040

- Modeling allows for addition of base case resources (generic solar, wind, and storage) plus optimal natural gas project(s) from selection of technologies
- Allow addition of natural gas-fired projects beginning in 2026-2033 timeframe
- Allow model to optimize among additions of:
  - Generic gas project in any location
    - La Luz project (LM6000) – option to force addition if indicated by RFP analysis
    - Pinion project (LM6000) – option to force addition if indicated by RFP analysis
  - Linear generator units
- All gas resources will be converted to burn Hydrogen at the end of 2039 (assumes hydrogen economy)

BASE + WIND EXPANSION SCENARIO

Base + wind expansion

PNM seeks strategic transmission expansion in the late 2020's/early 2030s to integrate a large quantity of wind resources

- Modeling allows for addition of base case resources (generic solar, wind, and storage) plus optimal level of new transmission with access to generic wind resource in eastern New Mexico
- Transmission project added in 2030-2032 timeframe
- Transmission project reflects a new "pipe", with access to new "bubble" containing wind resources
- Allow for optimization regarding:
    - When to add the transmission line
    - The amount of new wind to add

BASE + CARBON CAPTURE SCENARIO

Base + carbon capture

PNM relies on carbon capture and sequestration technologies to meet future capacity need and facilitate clean energy transition

- Modeling allows for addition of base case resources (generic solar, wind, and storage) plus optimal carbon-free dispatchable project(s) from selection of technologies
- Allow for addition of carbon capture and storage technologies beginning in 2028
- Allow model to optimize among additions of:
    - Existing CCGT fitted with Carbon Capture and Storage (CCS) technology
    - New or existing CT with CCS
    - Net Power Plant with CO2 transport and storage

BASE + HYDROGEN SCENARIO

Base + H2/early gas conversion

PNM pilots use of hydrogen before 2040 by creating green hydrogen via electrolysis for use in new or existing CTs

- Modeling allows for addition of base case resources (generic solar, wind, and storage) plus optimal hydrogen-fueled project(s) from selection of technologies
- A hydrogen facility will include electrolysis, on-site storage, and CT for combustion
- Hydrogen tax credits applied
- Allow for addition of hydrogen facilities starting in 2028
- Allow model to optimize among additions of:
    - Small project (250 MW)
        - Greenfield and brownfield options
    - Large project (500 MW)
        - Greenfield and brownfield options

2023 IRP FUTURES

Key assumption	Current Trends & Policy	High Economic Growth	Low Economic Growth	National Carbon Policy
Load forecast	Mid	**High**	**Low**	**High**
BTM PV forecast	Mid	**High**	**Low**	**High**
EV adoption forecast	Mid	**High**	**Low**	**High**
Building Electrification Forecast	Mid	Mid	Mid	**High**
Economic development	Limited	**Accelerated**	Limited	**Stable**
Gas price forecast	Mid	Mid	**Low**	**High**
Carbon price forecast	Mid	Mid	Mid	**High**
Technology cost forecast	Mid	Mid	Mid	**Low**

2023 IRP SENSITIVITIES

Sensitivity	Load forecast	Economic Development	BTM PV forecast	EV adoption forecast	Building electrification	Gas price forecast	CO2 price forecast	Technology costs	IRA tax credits & incentives
High load	High	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Extended
Strong ED growth	Mid	Stable	Mid	Mid	Mid	Mid	Mid	Mid	Extended
Very strong ED growth	Mid	Accelerated	Mid	Mid	Mid	Mid	Mid	Mid	Extended
Extreme weather	P90 hot/cold	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Extended
Low load	Low	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Extended
TOU pricing	TOU load shaping	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Extended
High BTM PV	Mid	Limited ED	High	Mid	Mid	Mid	Mid	Mid	Extended
Low BTM PV	Mid	Limited ED	Low	Mid	Mid	Mid	Mid	Mid	Extended
No BTM PV	Mid	Limited ED	Zero	Mid	Mid	Mid	Mid	Mid	Extended
High EV adoption	Mid	Limited ED	Mid	High	Mid	Mid	Mid	Mid	Extended
Low EV adoption	Mid	Limited ED	Mid	Low	Mid	Mid	Mid	Mid	Extended
High building electrification	Mid	Limited ED	Mid	Mid	High	Mid	Mid	Mid	Extended
High gas price	Mid	Limited ED	Mid	Mid	Mid	High	Mid	Mid	Extended
Low gas price	Mid	Limited ED	Mid	Mid	Mid	Low	Mid	Mid	Extended
IRP rule $40 CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	$40/ton	Mid	Extended
IRP rule $20 CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	$20/ton	Mid	Extended
IRP rule $8 CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	$8/ton	Mid	Extended
PNM high CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	High	Mid	Extended
PNM mid CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Extended
PNM low CO2 price	Mid	Limited ED	Mid	Mid	Mid	Mid	Low	Mid	Extended
Fast technology advancement	Mid	Limited ED	Mid	Mid	Mid	Mid	Mid	Low	Extended
Slow technology advancement	Mid	Limited ED	Mid	Mid	Mid	Mid	Mid	High	Extended
IRA tax credits expire	Mid	Limited ED	Mid	Mid	Mid	Mid	Mid	Mid	Expire 2032-2034
DERMS?	Mid	Limited ED	High	High	Mid	Mid	Mid	Mid	Extended

Questions or Follow-ups from Previous Meetings

NEXT MEETING

We encourage you to send in your thoughts ahead of time to IRP@pnm.com so that we can summarize them and distribute them for the next meeting. Please have your submissions in by March 10, 2022.

NEAR TERM SCHEDULE

FUTURE MEETING TIME & LOCATION

When: March 15, 2023

Topics: Scenario form, others TBD

Start Time: 9:00 AM

Location: Virtual

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