APS RPAC Meeting

07/19/2023

MEETING AGENDA

Welcome & Meeting Agenda
Matt Lind
1898 & Co.

Regulatory Update
Todd Komaromy
APS

Transmission Interconnection Reform
Jason Spitzkoff
APS

Climate Change Scenario Analysis: Low-Carbon Transition
Steve Rose & Chris Roney
EPRI

2023 APS Resource Adequacy Study
Akhil Mandadi
APS

Next Steps & Open Discussion
Matt Lind
1898 & Co.

Meeting Guidelines

- RPAC Member engagement is critical. Clarifying questions are welcome at any time. There will be discussion time allotted to each presentation/agenda item, as well as at the end of each meeting.
- We will keep a parking lot for items to be addressed at later meetings.
- Meeting minutes will be posted to the public website along with pending questions and items needing follow up. We will monitor and address questions in a timely fashion.
- Consistent member attendance encouraged; identify proxy attendee for scheduling conflicts.
- Meetings and content are preliminary in nature and prepared for RPAC discussion purposes. Litigating attorneys are not expected to participate.

June Meeting Recap

- APS detailed specific technical aspects of the 2023 ASRFP leading up to the June 30th release date.
- APS explained that Energy Exemplar has confirmed that all modeling licenses have gone through the NDA process. A technical discussion and training course on the tool was held on June 29th.
- APS announced that the 2023 IRP filing date has been moved to November 1st 2023.
- APS informed RPAC Members that the dates for the August RPAC meeting may conflict with various meetings in August. APS is proposing an August 4th date for the RPAC meeting.

Following Up

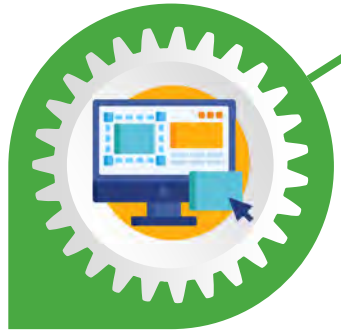
- Action Items from Previous Meetings:
  - No immediate action items
- Ongoing Commitments:
  - Distribute meeting materials in a timely fashion (3 business days prior)
  - Transparency and dialogue

APS Announcements

APS Milestones

- IRP due date moved to November 1st, 2023
- Public Stakeholder Meeting #2 in September

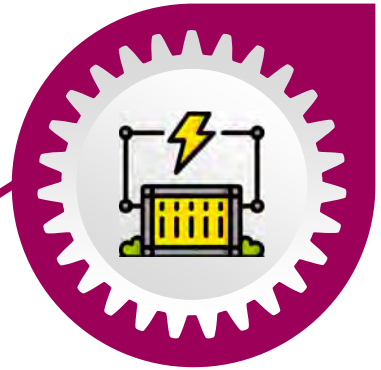
RPAC Modeling Group Meetings



Production Cost - June 29th, 2023

Capacity Expansion - July 11th, 2023

2023 ASRFP



- 2023 ASRFP Released on June 30th, 2023
- Bidders Conference Scheduled for July 26th, 2023

APS RFP Website

www.aps.com/rfp


aps
Regulatory Update

ACC Regulatory Update

On May 1, 2023 TEP, UNSE, and APS filed a request with the ACC for a 90-day extension of the filing date for IRPs.

Request would extend filing deadline in order to give the Companies and RPAC additional time to complete aspects of Decision No. 78499.

The request from APS, TEP, UNSE was granted on June 28, 2023.

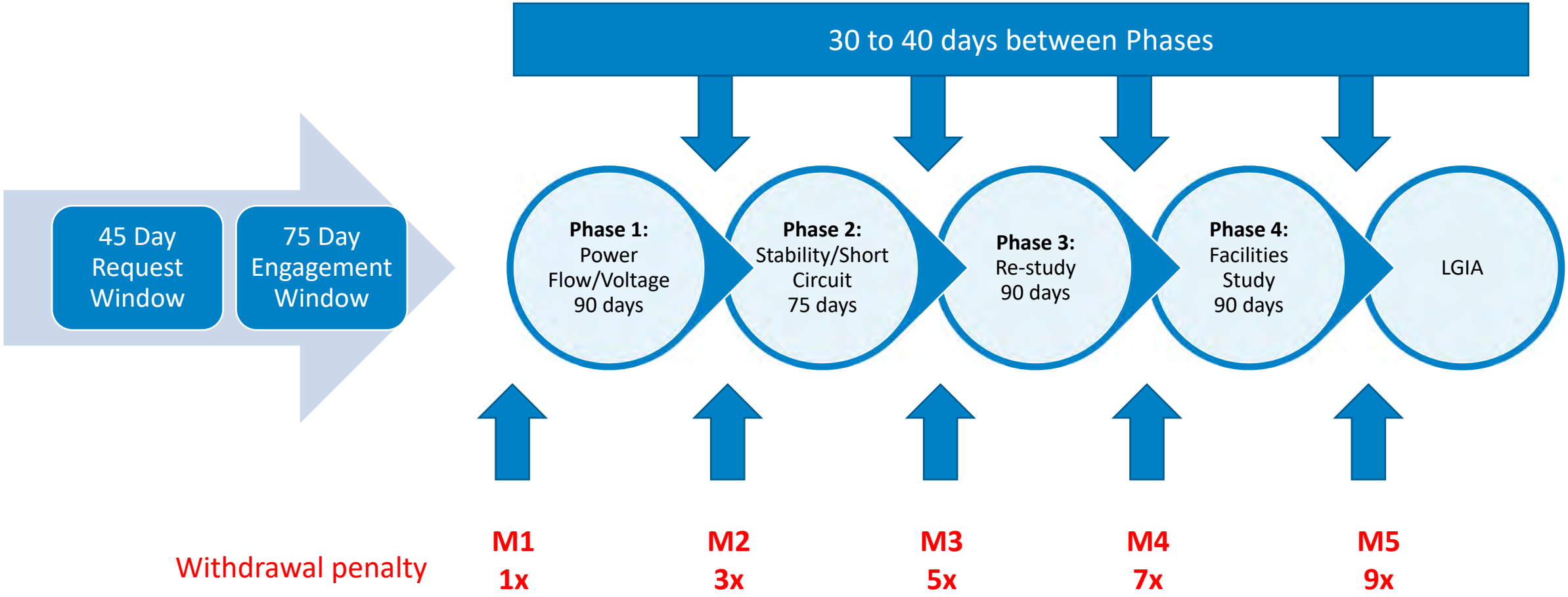
Deadline: November 1, 2023

APS Large/Small Generation Interconnection Reforms

Agenda

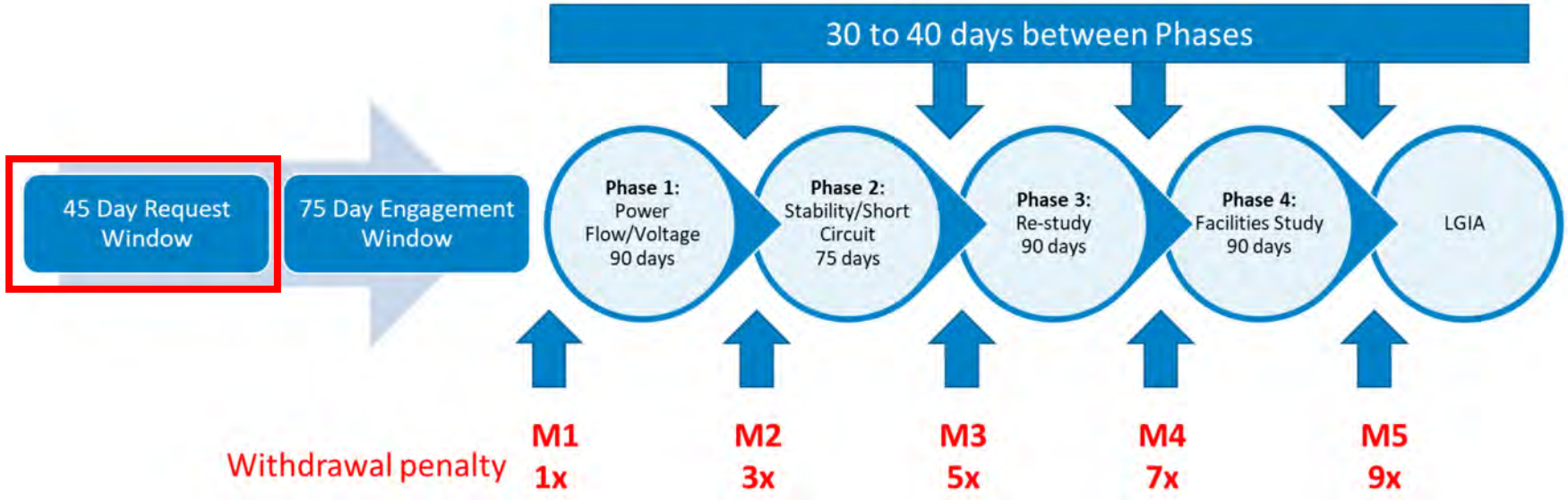
- Application Process
- Customer Engagement Window
- Study Process
- Withdrawal Penalties
- Additional Modification
- Transitional Process

New Process Diagram



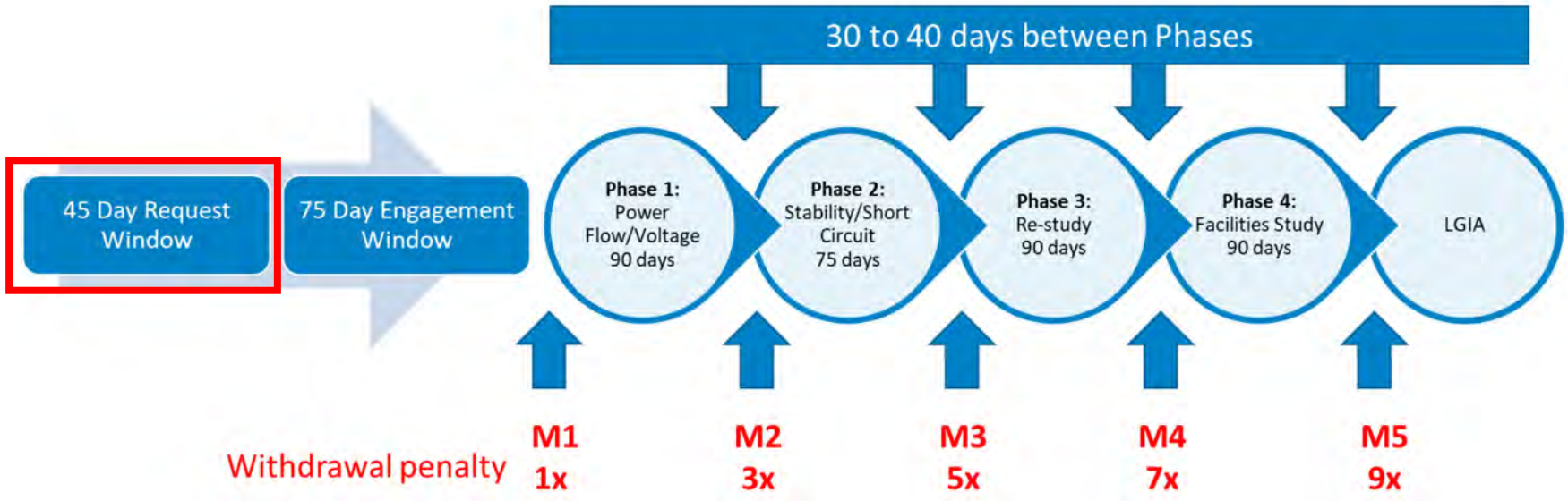
Withdrawal penalty

Application Process



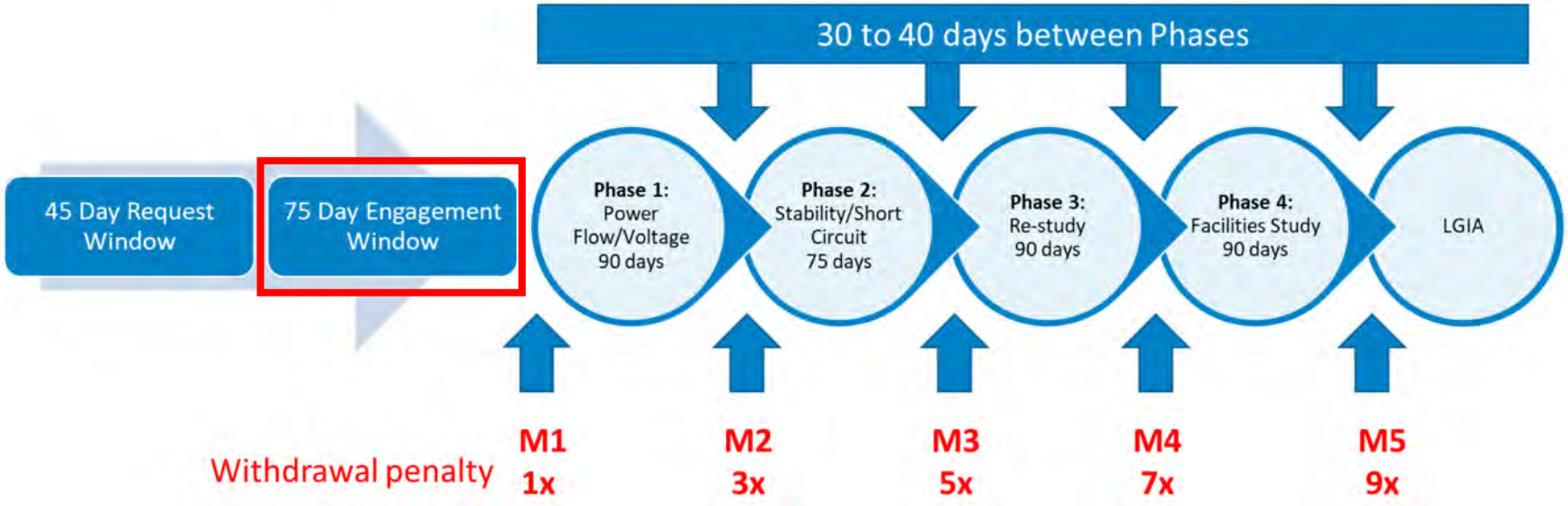
- **Annual Cluster Window**
  - Window to open annually on April 1st
  - 45 day window
  - Application and associated requirements complete prior to window close

Application Process



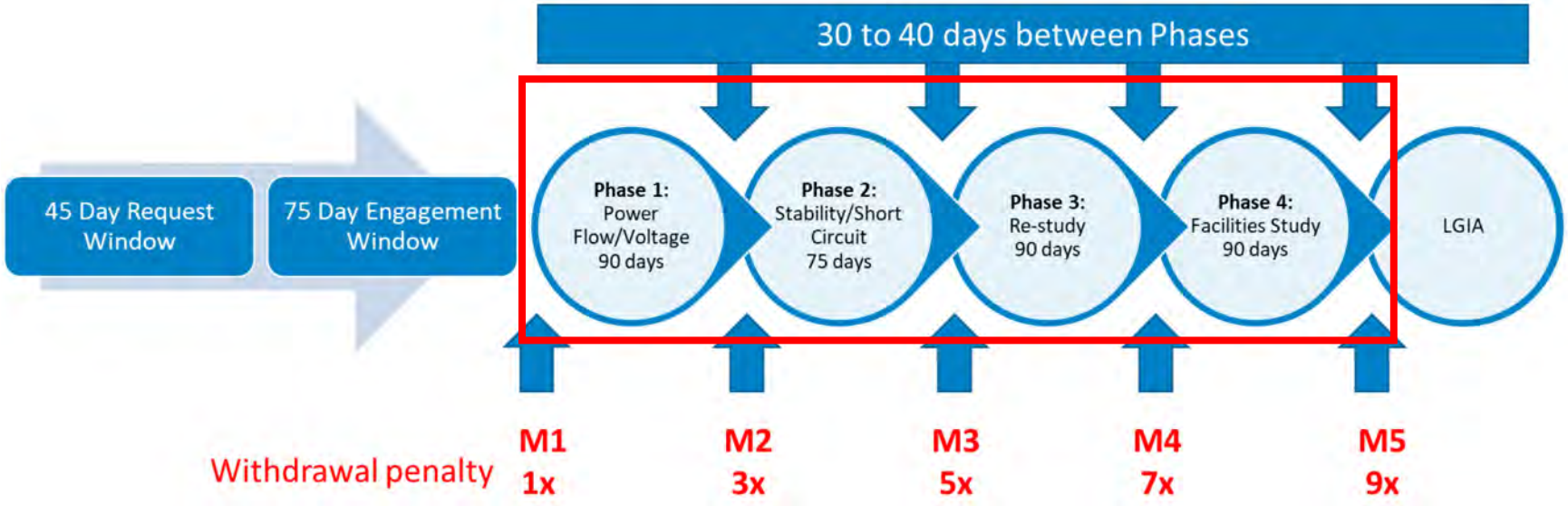
- **Valid Interconnection Request**
  - $105,000 initial deposit
  - Application and models
  - Site Control
  - Commercial Readiness Demonstration

Customer Engagement Window



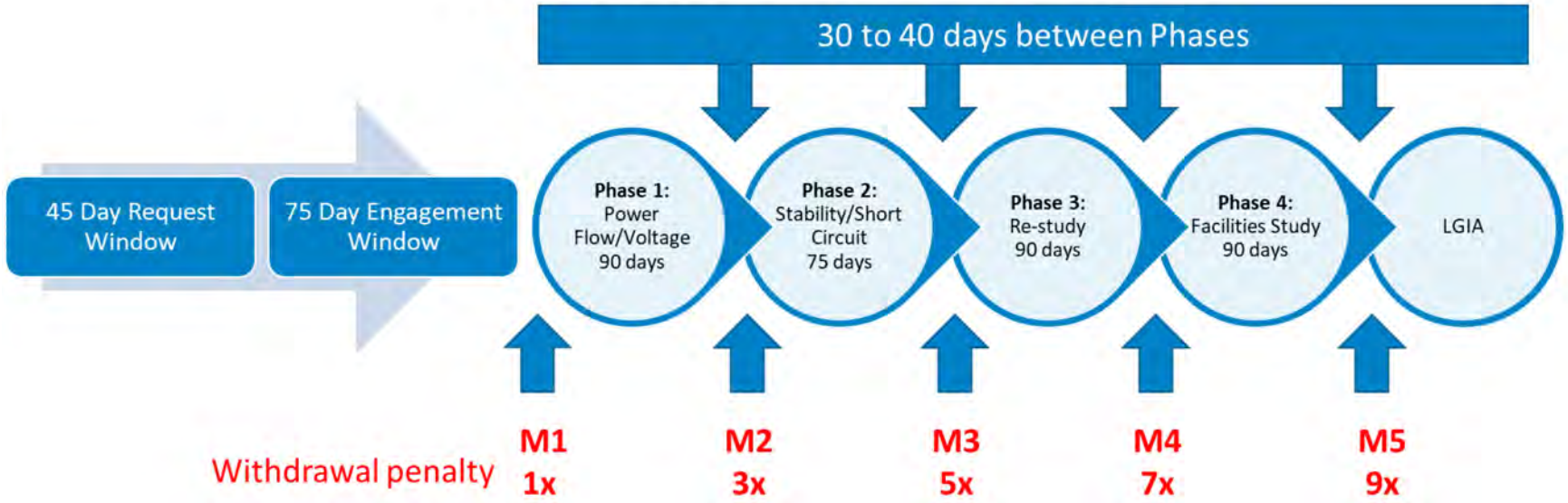
- Holding Scoping meeting(s)
- Modeling reviews and validation
- Letter of Credit
- All demonstrations, models, and deposit deficiencies must be cured prior to close of window
- Close of Customer Engagement Window starts Phase 1 study: M1 milestone

Study Process



- SIS is broken into two phases
- Phase 3 (re-study) will be as needed
- Phase 4 – No changes to existing process

Withdrawal Penalties



- **Tiered Level of Penalties**
  - Penalty is multiple of $100,000 deposit (1x up to 9x)
  - Alternate structure using payment in lieu of commercial readiness demonstration
  - Letter of Credit has to be in place prior to close of Engagement Window
- **Use of Withdrawal Penalties**
  - Fund re-study costs
  - Applied to Network Upgrades
  - Applied to APS formula rate

Additional Modifications

- **Suspension Provision**
  - Suspension no longer a right
    - Demonstration of delays
  - Maintain site control and commercial readiness demonstrations

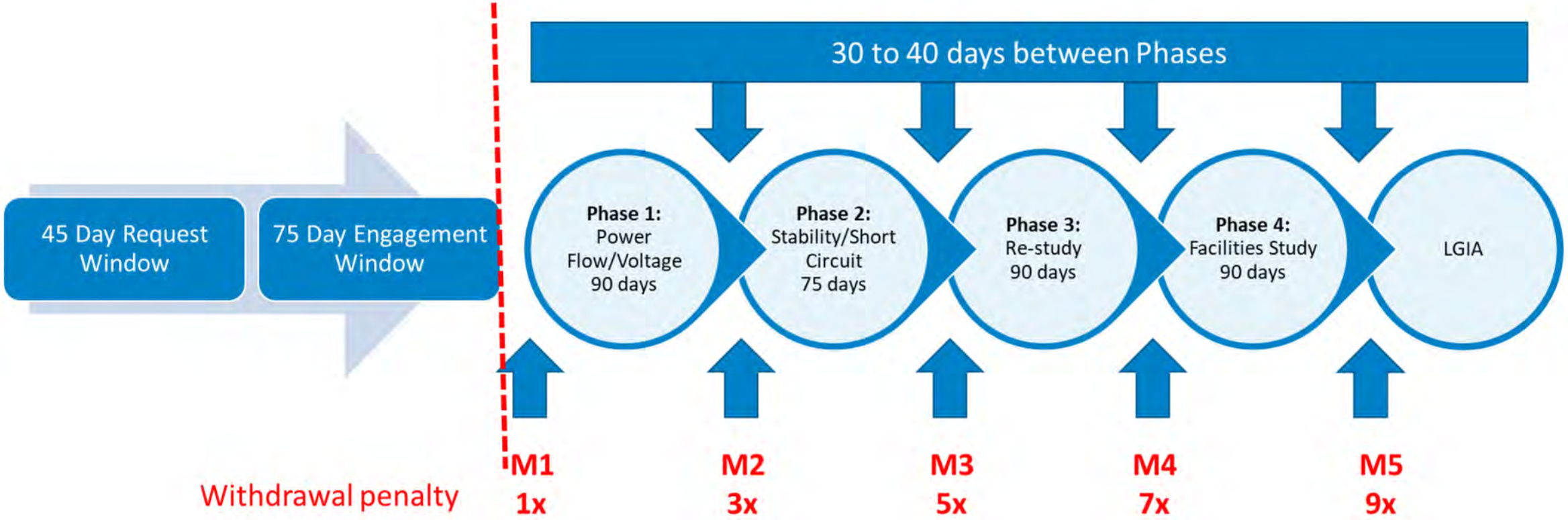
- **Small Generators in same clusters as Larger Generators**
  - Requests that do not qualify for fast-track or invertor process
  - Do not require Commercial Readiness demonstration
  - Are required to provide Site Control
  - Are subject to Withdrawal Penalties
  - Require posting a LOC

Transitional Process

- **Projects with executed FaS**
  - Provided 60 days to request cancellation of their LGIA without withdrawal penalties
  - Must provide LOC of $900,000 to maintain their LGIA
  - If project does not achieve commercial operation subject to withdrawal penalties

- **Projects in SIS or FaS**
  - Subject to new requirements
  - 60 days to provide site control, commercial readiness, and appropriate LOC
  - Failure to provide will be deemed withdrawn by APS
  - Remaining projects included in a single new Transitional Cluster Study
  - Withdrawals after start are subject to withdrawal penalties

Process Timeline



- **Complete w/in 2 years**
- **Designed not to overlap Phase 1-3 studies**


aps
Discussion & Questions

Climate Change Scenario Analysis – Low Carbon Transition

Climate Change Scenario Analysis

Arizona Low-Carbon Transition Risk Assessment Update and Draft Scenario Design

Steven Rose and Chris Roney
Energy Systems and Climate Analysis

APS RPAC
July 19, 2023

Project overview

- APS initiated this project with EPRI to explore climate and energy system transitions to inform their climate risk management thinking

- Three analyses
  1. **Initial Physical Climate Risk Assessment Analytical Foundation (discussed previously, final report forthcoming)**
  2. **Arizona Low-carbon Transition Risk Analysis (draft scenario design and analysis started)**
  3. **Low-Carbon Transition Strategy & GHG Goals Contextualization (analysis started)**

- Motivation
  - The climate is changing and will continue to change
  - There is significant interest in decarbonization to limit climate change
  - Companies need to evaluate potential climate and transition risks and develop risk management strategies

Critical issues for companies in climate risk assessment

- Uncertainty
- Uniqueness
- Multiple objectives
- Flexibility
- Robust strategies (resilient to possible futures)
- Assessing climate risk requires knowing more than whether there are emissions and climate change

Rose and Scott (2020, 2018), EPRI (2022), Rose et al (2022)

Arizona Low-carbon Transition Risk Analysis

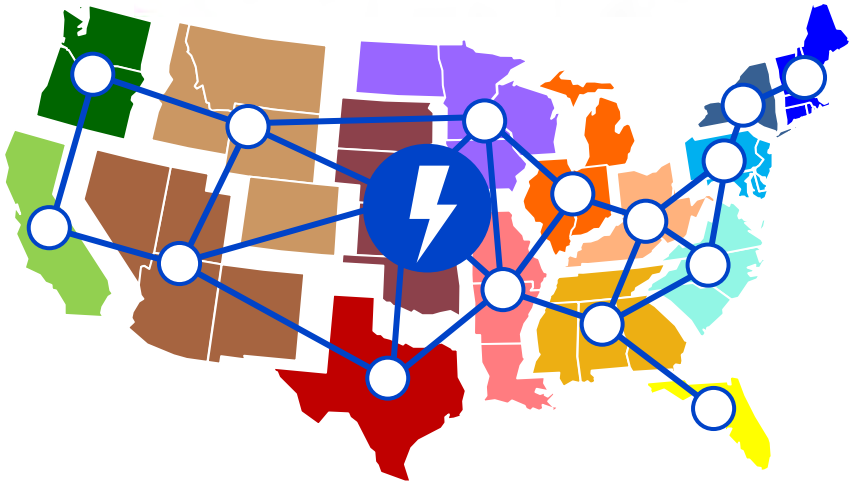
AZ low-carbon transition risk analysis

- **Objectives**
  - Inform APS strategy & risk management by assessing potential low-carbon energy-system transitions and risks
  - Supplement APS' analyses and processes with broader and longer-term strategic perspectives of potential energy transitions, markets, and policies
  - Provide a scientific basis and grounded insights regarding transition risk in a manner aligned with TCFD
- **Approach**
  - Use tailored, well-designed scenarios and Arizona energy-system modeling analysis to evaluate the opportunities and uncertainties, risks and risk management options, signposts, trade-offs, enabling conditions, and potential no-regrets strategies – not modeling the APS system, but providing relevant strategic insights
- **Analysis steps**
  1. Scenario design: custom, alternative plausible extreme transition scenarios
  2. Modeling: evaluating Arizona energy-system transition implications of the alternative scenarios
  3. Results: key insights regarding risks, risk management options, etc.
  4. Communications: a written report & executive summary to communicate insights
- **Today, discuss draft scenario design. In the future, discuss draft modeling results.**

US-REGEN

Regional Economy, GHG, and Energy

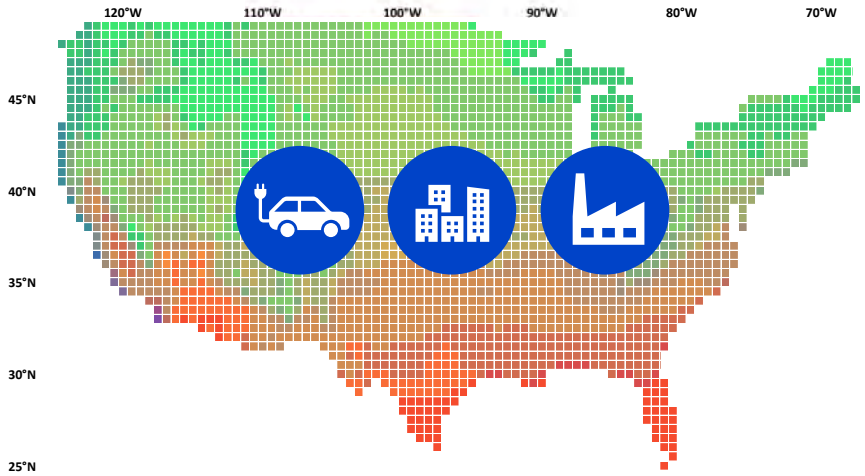
Electric Generation



Synchronized

Hourly Load, Renewables, and Prices

Energy Use



Detailed representation of:

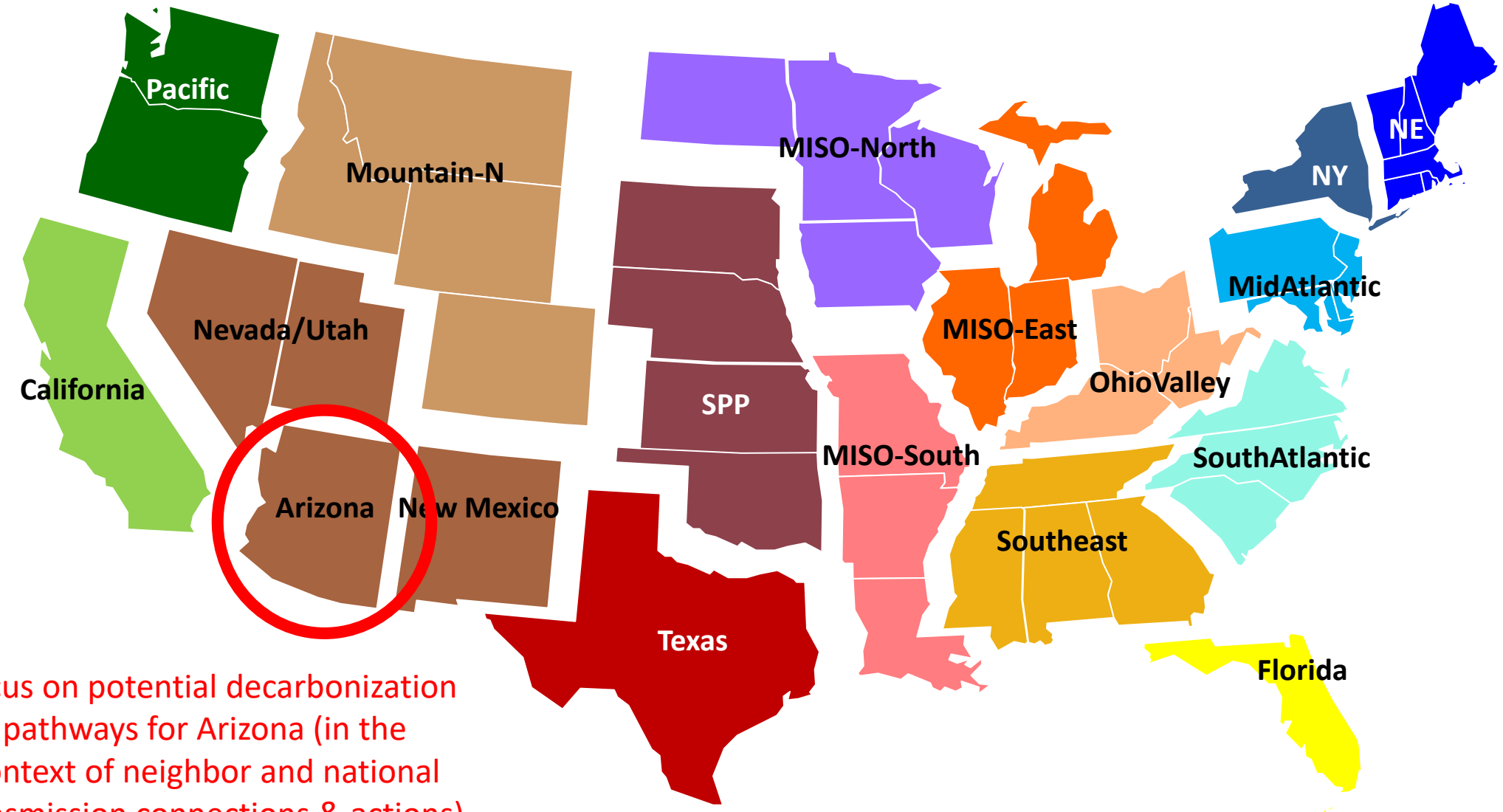
- Energy and capacity requirements
- Renewable integration, transmission, storage
- State-level policies and constraints

Detailed representation of:

- Customer heterogeneity across end-use sectors
- End-use technology trade-offs
- Electrification and efficiency opportunities

Documentation, articles, and reports available at https://esca.epri.com

Customized regional resolution for APS



Focus on potential decarbonization pathways for Arizona (in the context of neighbor and national transmission connections & actions)

Modeling outputs

Modeling to 2050 and state level results

1 Capacity and Generation

State-level capacity and generation

2 Hourly Load

Aggregated and disaggregated by end-use

3 CO_2 Emissions

Electric sector and energy system carbon emissions

4 Electricity Prices and Costs

Generation component of retail pricing and sector costs

5 Transmission

Size of additional regional transmission capacity

6 End-use Service, Electricity & Fuel Demands

Evolution of end-use service, electrification, other fuel demands

7 End-use Vehicle and Equipment Stocks

Electric vehicle adoption, building heating and cooling systems, and other equipment decisions

8 Others

Additional reporting potentially available (e.g., water use) as areas of uncertainty and interest decided

Providing statewide, long-run insights to inform APS strategic thinking, analyses, and risk management

Scenario design 2x2 concept – plausible extremes

Simple 2x2 scenario design for defining company-specific alternative plausible extremes to bound the decarbonization risk space, and explore sensitivities within

		Uncertain non-climate-policy conditions *(technology, markets, etc.)*	
		Facilitate	***Challenge***
Uncertain climate policy conditions *(incentives & options)*	***Broader***	Broader & Facilitate	Broader & Challenge
	Narrower	Narrower & Facilitate	Narrower & Challenge

Draft scenario specification – broader/narrower policy extremes

SPECIFICATION FOUNDATION (all scenarios)

- AZ power net zero by 2050 (linear glide path from 2025), and 2030 45% renewables & 65% CES requirements
- Inflation Reduction Act (IRA) active nationally, and current state electric sector GHG policies outside AZ

Uncertainty	Broader	Narrower
AZ decarbonization incentive/scope	AZ economy-wide 80% CO_2 reduction in 2050	AZ power sector net zero in 2050
AZ decarbonization option set	• Renewables (wind, solar, bio, hydro) • Nuclear (extensions) • Advanced nuclear (additions) • Gas • Gas w/CCS • CDR (biopower w/ CCS only) Storage • Hydrogen • Low-carbon power imports • Fossil reserves permitted (within emissions constraint) • Biomass carbon neutrality	• Renewables (wind, solar, bio, hydro) • Nuclear (extensions only) • Storage • Electrolytic Hydrogen only • Fossil reserve eligibility declines to zero in 2050
Outside AZ	Economy-wide decarbonization incentives similar to AZ	Only current state-specific policies

Draft scenario specification – facilitate/challenge non-policy extremes

Uncertainty	Facilitate	Challenge
Load growth *(factors: relocation of industry, population, market structure, consumer electro technology preferences, DERs)*	Lower *30% industry growth by 2040*	Higher *150% industry growth by 2040*
Renewable & battery storage cost improvements	Faster *Lower costs*	Slower *Higher costs*
Electricity capacity additions *(factors: supply chain issues, siting and permitting environment, etc.)*	Enabling *Build as economical*	Constrained *Annual additions constrained*
Interregional transmission additions *(factors: infrastructure investment support, realized costs, siting and permitting environment, etc.)*	Enabling *Build as economical*	Constrained *Annual additions constrained*
Water stress	Lower *Default residential builds; generation water costs lower*	Higher *Restricted residential builds; generation water costs higher*
Fuel supply *(factors: resource availability, pipeline capacity/augmentation)*	Lower prices (abundant) *AEO 2022 reference path*	Higher prices (scarce) *AEO 2022 low oil & gas recovery path*
End-use technology cost improvements	Faster *Lower EV component costs, range anxiety lower, EV availability higher*	Slower *Higher EV component costs, range anxiety higher, EV availability lower*

RPAC Feedback Request

Eric Massey (APS)

RPAC feedback request

- Your thoughts on the four plausible extreme future conditions proposed for evaluating Arizona decarbonization?
  - Extreme enough/too extreme?
  - Add/remove characteristics?
  - Other thoughts?
- Your thoughts on potential intermediate sensitivity scenarios for exploring the space between the plausible extremes?

		Uncertain Non-climate-policy Conditions	
		Facilitate	***Challenge***
Uncertain Climate Policy Conditions	***Broader***	AZ **80% economy-wide** policy & **Many** decarbonization options **Lower** load growth, **Faster** generation cost improvements, **Enabling** capacity additions, **Enabling** transmission additions, **Lower** water stress, **Lower** fuel prices, **Faster** end-use tech improvements	AZ **80% economy-wide** policy & **Many** decarbonization options **Higher** load growth, **Slower** generation cost improvements, **Constrained** capacity additions, **Constrained** transmission additions, **Higher** water stress, **Higher** fuel prices, **Slower** end-use tech improvements
	Narrower	AZ **power sector net zero** policy & **Fewer** decarbonization options **Lower** load growth, **Faster** generation cost improvements, **Enabling** capacity additions, **Enabling** transmission additions, **Lower** water stress, **Lower** fuel prices, **Faster** end-use tech improvements	AZ **power sector net zero** policy & **Fewer** decarbonization options **Higher** load growth, **Slower** generation cost improvements, **Constrained** capacity additions, **Constrained** transmission additions, **Higher** water stress, **Higher** fuel prices, **Slower** end-use tech improvements

Together...Shaping the Future of Energy®

Steven Rose
srose@epri.com

Chris Roney
croney@epri.com

About EPRI

- A non-advocacy, nonprofit, scientific research organization with a public benefit mandate
- EPRI strives to advance knowledge and facilitate informed discussion and decision-making
- Recognized expertise in, among other things, climate scenarios, climate-related risk assessment, energy and societal transitions, climate impacts, policy evaluation, sustainability
  - Including research community leadership and participation in related activities, e.g., Intergovernmental Panel on Climate Change (IPCC), research community studies, the Task Force on Climate-Related Financial Disclosures (TCFD) Advisory Group for Scenario Guidance
- EPRI climate-related risk research informing companies and stakeholders

Securities and Exchange Commission

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Moody's

NGFS Central Banks and Supervisors Network for Greening the Financial System

BlackRock.

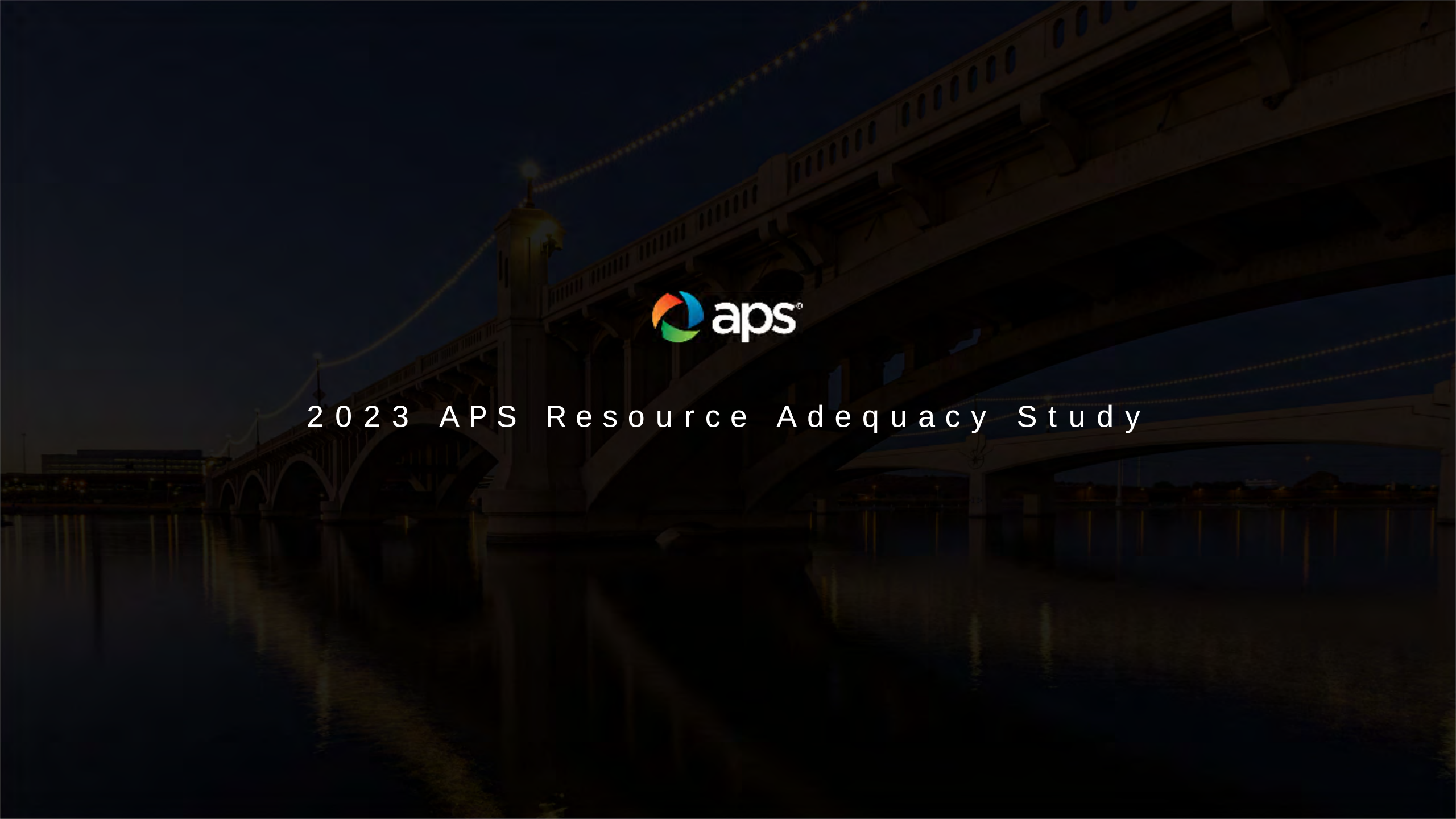
SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Resources

- EPRI, 2022. *Technical Considerations for Climate-Related Risk Disclosure Rules*. EPRI, Palo Alto, CA. #3002024244.
- Rose, S, L Fischer, D Diaz, FR Fonseca, J Lala, R Siddique, A Staid, 2022. Grounding Climate Risk Decisions: Physical Climate Risk Assessment Scientific Foundation and Guidance for Companies - Initial Key Company-level Insights, Technical Principles, and Technical Issues. EPRI: Palo Alto. 3002024246.
- Rose, S and M Scott, 2020. *Review of 1.5˚C and Other Newer Global Emissions Scenarios: Insights for Company and Financial Climate Low-Carbon Transition Risk Assessment and Greenhouse Gas Goal Setting*. EPRI, Palo Alto, CA. #3002018053.
- Rose, S and M Scott, 2018. *Grounding Decisions: A Scientific Foundation for Companies Considering Global Climate Scenarios and Greenhouse Gas Goals*. EPRI, Palo Alto, CA. #3002014510.
- US-REGEN (U.S. Regional Economy, Greenhouse Gas, and Energy) model website, https://esca.epri.com/models.html.

Discussion & Questions


aps
Break



2023 APS Resource Adequacy Study

2023 APS RESOURCE ADEQUACY STUDY OVERVIEW

RPAC Meeting, July 19

Agenda

Overview of the 2023 Resource Adequacy Study

- Key Objectives
- Key Findings
- Study in relation to the overall 2023 APS IRP Modeling Process

Deeper Dive

- Key Assumptions
- Planning Reserve Margin
    - Different Flavors – ICAP and PCAP
    - PCAP Accounting Methodology
- ELCC Assessment

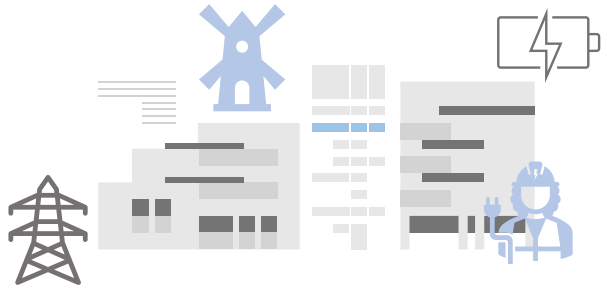
Concluding Remarks

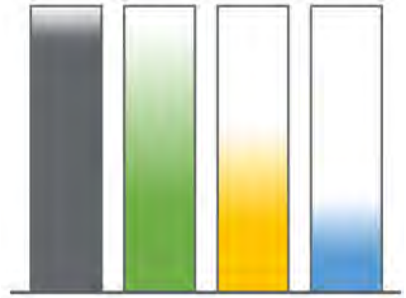
- Discussion

Key Objectives

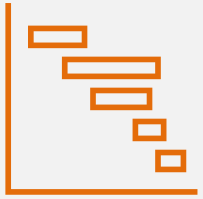
Determination of APS's Planning Reserve Margin (PRM) based on current planning and operating conditions

Determination of the Effective Load Carrying Capability (ELCC) of various resources and their reliable capacity contribution to APS's system demand

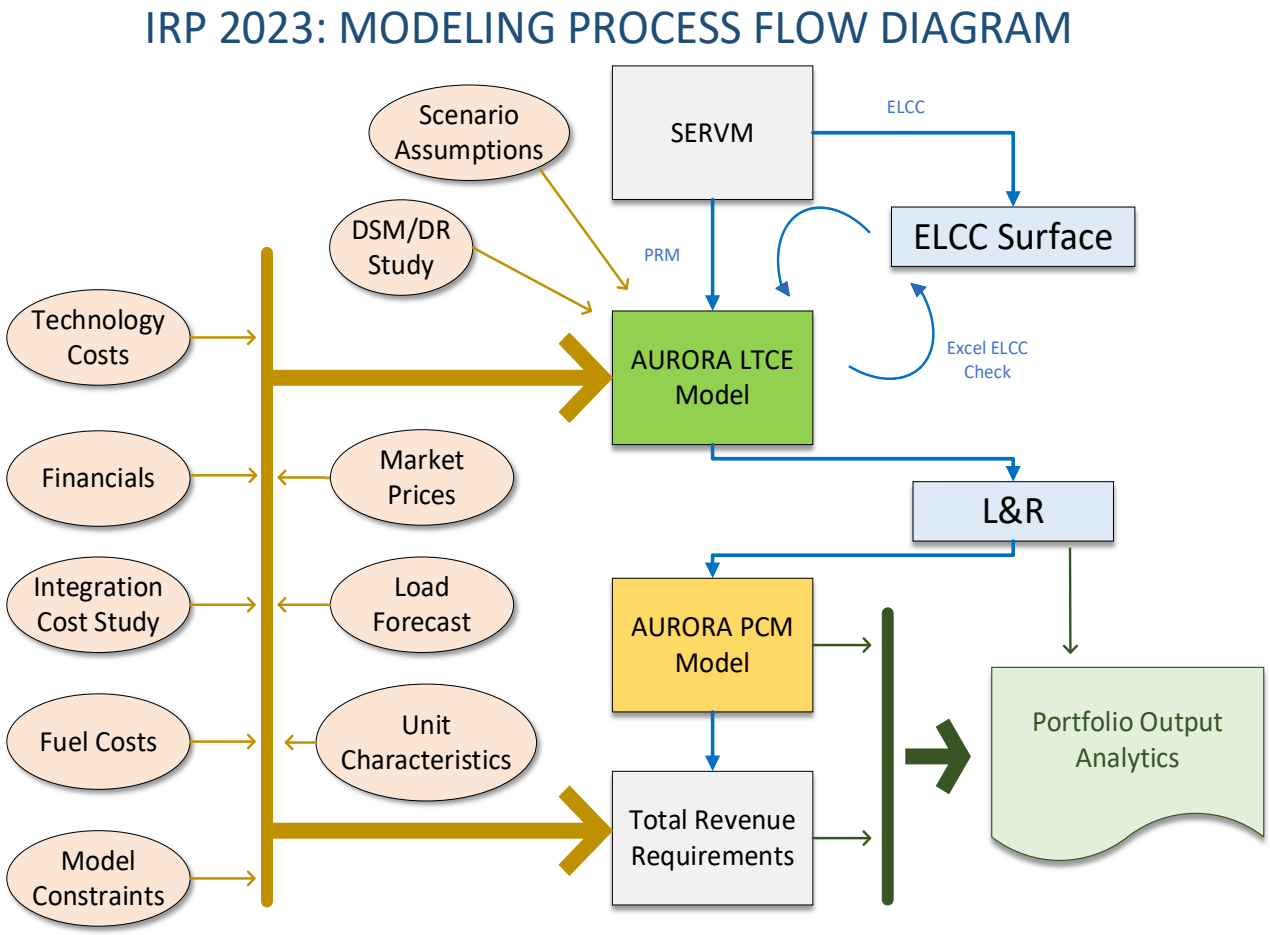




Key Findings

PRM Determination:		20.2 % (ICAP Accounting Methodology)
PRM Accounting Mechanism Recommendation:		Transition to PCAP Methodology Starting in 2026
ELCC Assessment:		ELCC values for various resources, accounting for a) Increasing resource Levels b) Interactive effects among key resource types c) Changing demand and impacts of demand modifiers

Study in relation to overall 2023 APS IRP Modeling Process



Foundation to the entire Modeling Process

Capacity Expansion Tool Utilizes

a) Established PRM
b) ELCC as the qualifying capacity to meet Demand + PRM = Total Demand Needs = Total Capacity Needs

Key Assumptions

Operating Reserve Used	6%
Transmission Connectivity	Transport Zonal Model with ties to all immediate neighbors modeled
Market Resource Adequacy	Neighboring market has a shortfall in meeting 0.1 LOLE by 3%
Load and Weather Modeling	Utilized 23 weather years data adjusted to the trend of the last 10 years of weather data
Battery Energy Storage Held for Reliability	Yes

Determination of PRM

- Study Year: 2026
- Study Framework: Utilized SERVM software – combines hourly production costing with Monte Carlo outage simulation.

Uncertainty Addressed	
Supply	**Demand**
Weather Based • Intermittent Resource Output • Temperature Derates	Weather Based • Fundamental Demand characteristics • Extreme temp Impacts
Availability Based	Forecast Based

Flavors of PRM Accounting

❑ Installed Capacity Accounting

- Conventional/Firm Resources accredited with summer-rated installed capacity
- ELCC Resources such as solar, wind, storage, energy efficiency, etc. accredited with ELCC values
- APS currently has a PRM of 15%, which was established using the ICAP accounting methodology

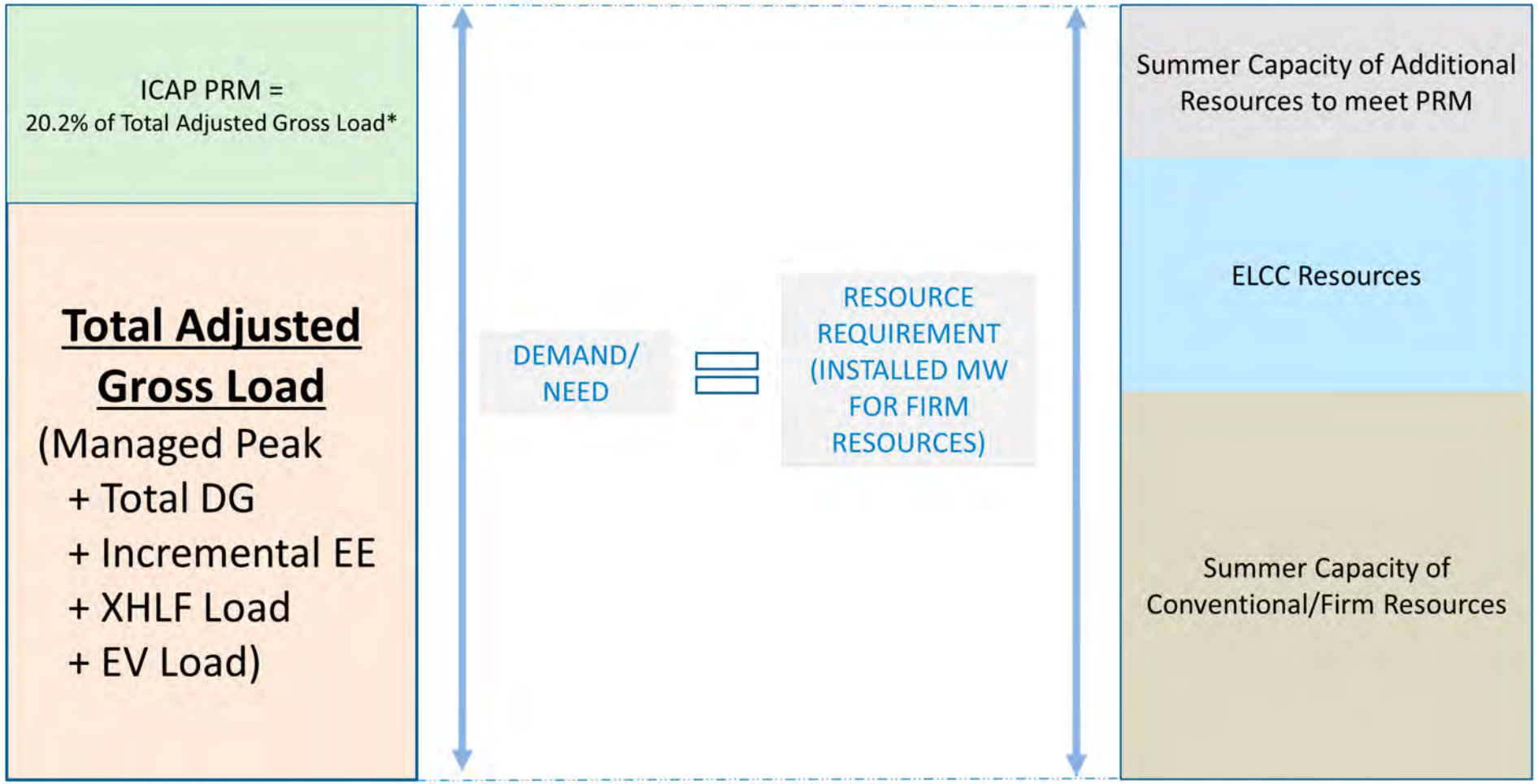
Current Market Conditions Scenario, ICAP PRM Accounting, 2026			
Resource Type	Capacity	ELCC	Equivalent Capacity
Conventional Resources	7518		7518
ELCC Resources	6992	55.23%	3861.8
MW Adjustment	973		973
Total Capacity	15483		12352.8
Load (including Adjustments)			10333
Reserves			2019.8
PRM			20.2%

❑ Perfect Capacity Accounting

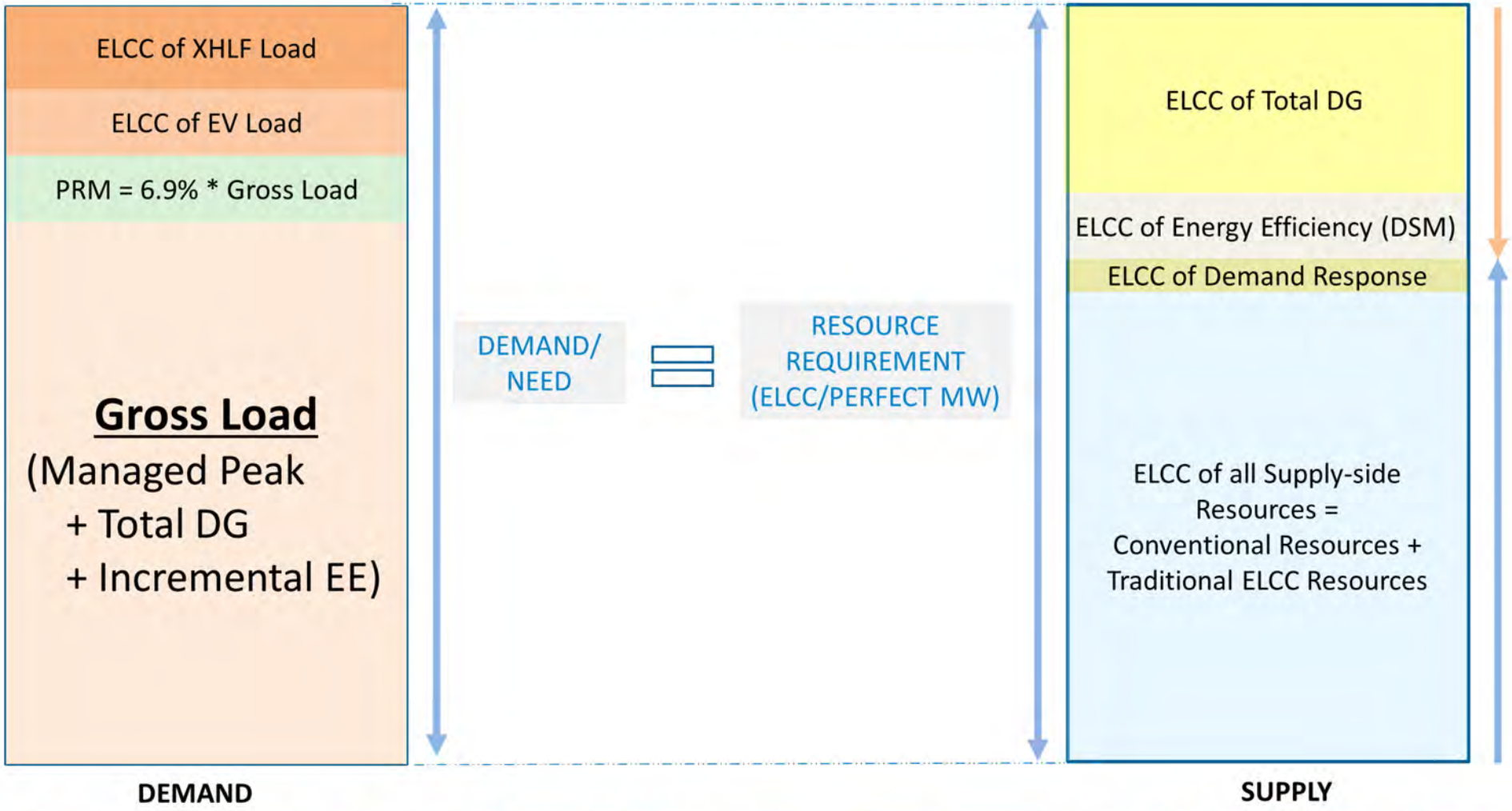
- All resources are accredited ELCC values (i.e., removes from the reserve margin an allowance for forced outages of conventional resources)
- PCAP PRM is more durable to portfolio changes
- APS will transition to using the PCAP accounting method starting in 2026

Current Market Conditions Scenario, PCAP	
Resource Type	Equivalent Capacity
PCAP Capacity	10369
Load	9696
Reserves	673
PRM	6.9%

ICAP Accounting Mechanism



PCAP Accounting Mechanism



ELCC ASSESSMENT

No Resource is Perfect

- ELCC measures a resource's contribution to the system's needs relative to "perfect" capacity, accounting for their capabilities and constraints across all hours.

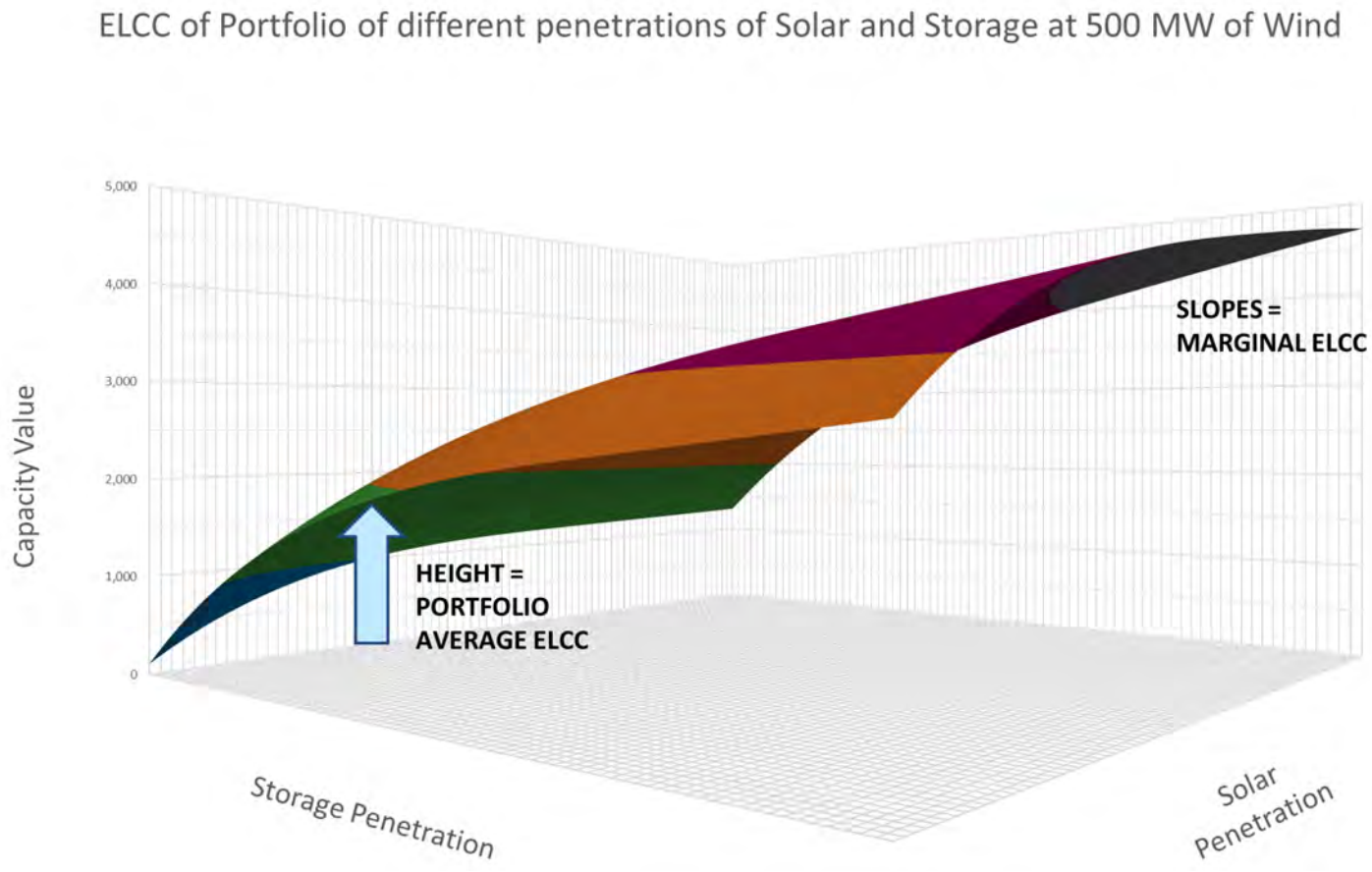
Indefinite loop between Resource Adequacy and Capacity Expansion Modeling?

- Changing capacity values and interactive effects between resources imply a Chicken or Egg problem.
- No current commercially-available tools to perform overall optimization in a single step

Functional Exit:

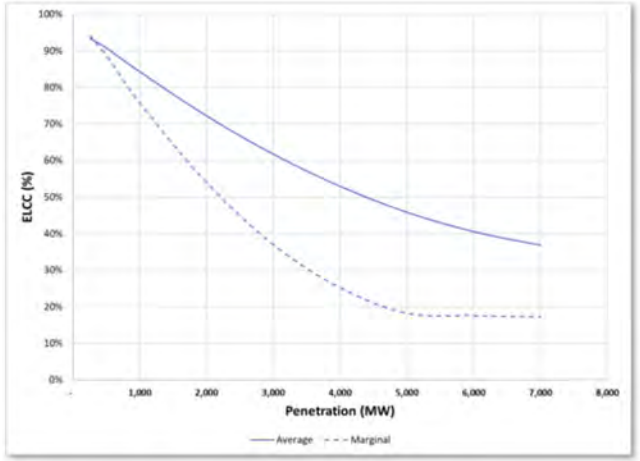
- ELCC Surfaces to meaningfully capture the interactive effects between key resource types
- ELCC curves to address other resource types and effects of changing demand
- Out-of-model ELCC checks and potential re-runs

ELCC Surface for a Portfolio of Solar, Wind, and Battery Energy Storage

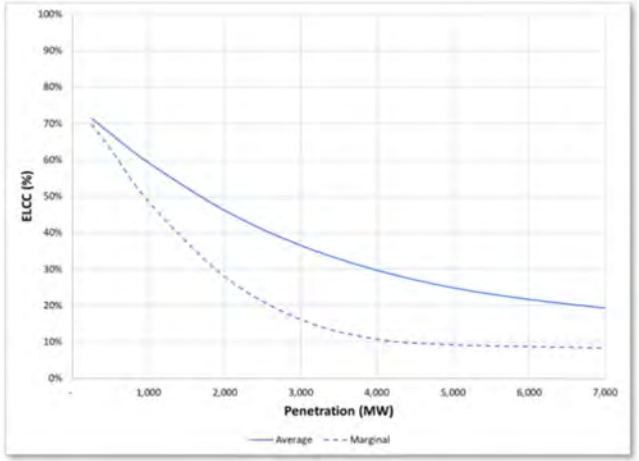


Captures changes to ELCC due to penetration levels as well as interactive effects between Resource Types

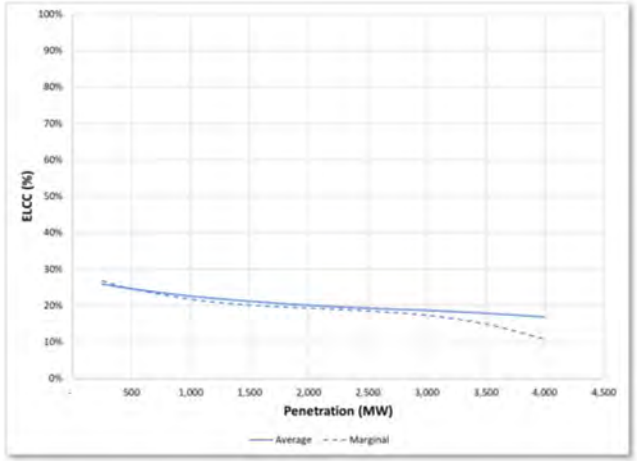
ELCC Trends with Isolated Resource Penetration



ELCC for Increasing Battery Resource Penetration at 2500 MW of Solar and Wind



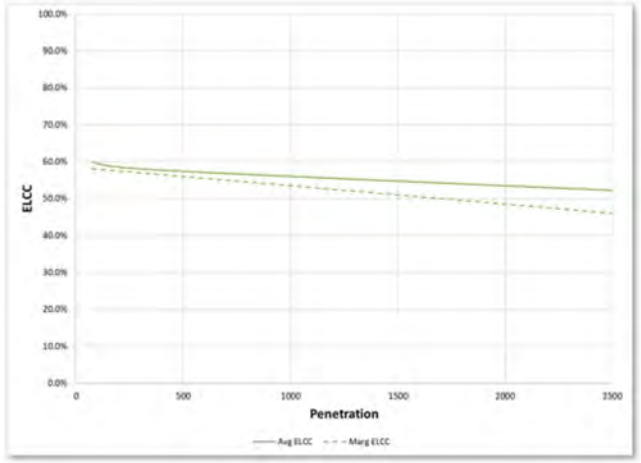
ELCC for Increasing Solar Resource Penetration at 2500 MW of Wind and Battery



ELCC for Increasing Wind Resource Penetration at 2500 MW of Solar and Battery

ELCC was also established for

- Conventional/Firm Resources
- Load-Modifiers



ELCC for Increasing Energy Efficiency Resource Penetration

Concluding Remarks and Discussion

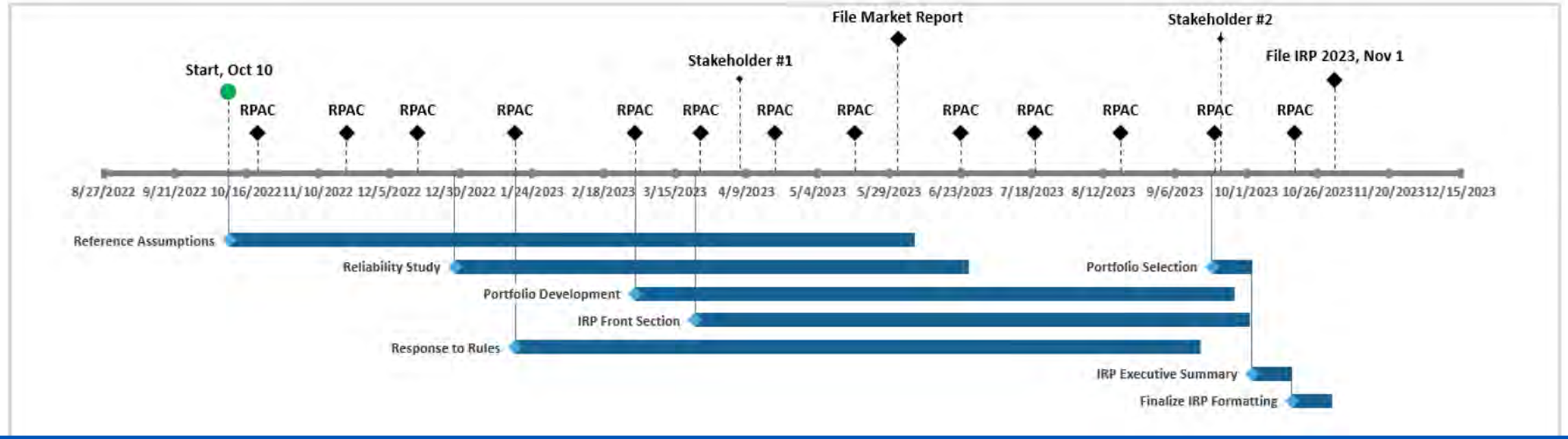
- ✓ 2023 Resource Adequacy Study provided a deeper understanding of the impact various resource types have on achieving resource adequacy of the APS system.
- ✓ Recommended findings will be incorporated into the 2023 Integrated Resource Plan.

Thank you !

Discussion & Questions


aps
Next Steps

IRP Timeline



Key Milestones

August RPAC Meeting: 8/04/2023

Public Stakeholder Meeting #2: September

IRP Filing: 11/01/2023