APS RPAC Meeting

03/24/2023

MEETING AGENDA

Welcome & Meeting Agenda
Matt Lind
1898 & Co.

RPAC IRP Survey Recap
Matt Lind
1898 & Co.

Perspective on IRP Practices
Aaron Schwartz
Rocky Mountain Institute

2023 IRP Update
Mike Eugenis
Manager, Resource Planning

Reliability Planning for APS
Nick Schlag
E3

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.

Following Up

- Action Items from previous meetings:

- Ongoing Commitments:
  - ❑ Distribute meeting materials in a timely fashion (3 bd prior)
  - ❑ Transparency and dialogue

February Meeting Recap

- APS provided updates on the 2023 Load Forecast. Datacenter and large manufacturing customers are expected to be the major source of load growth, energy sales and peak forecast are planned to increase with a slight decrease among residential and C&I.
- APS shared an update to the 2022 RFP. Negotiations are underway and a 2023 RFP is planned to be issued in 2023.
- Customer to Grid Solutions team informed RPAC members on APS Microgrid strategies and some of the economic and environmental benefits that microgrids have to offer.
- 1898 & Co. outlined the 2023 IRP planning principles and solicited feedback from RPAC members related to portfolio risk factors and characteristics.

Perspectives on IRP Practices

Resource Planning: Presentation to APS RPAC

AARON SCHWARTZ

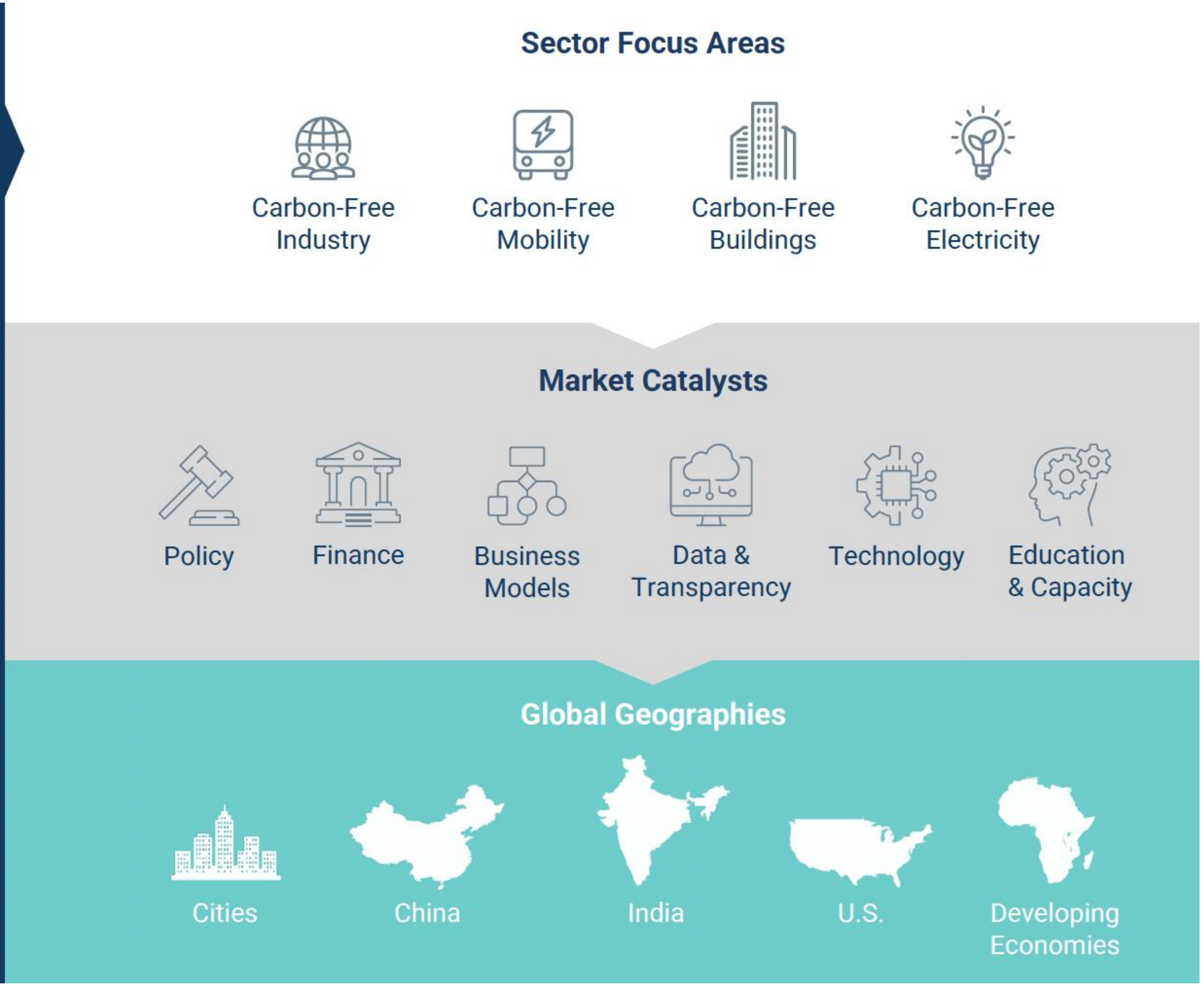
MARCH 24, 2023

RMI
ENERGY. TRANSFORMED.

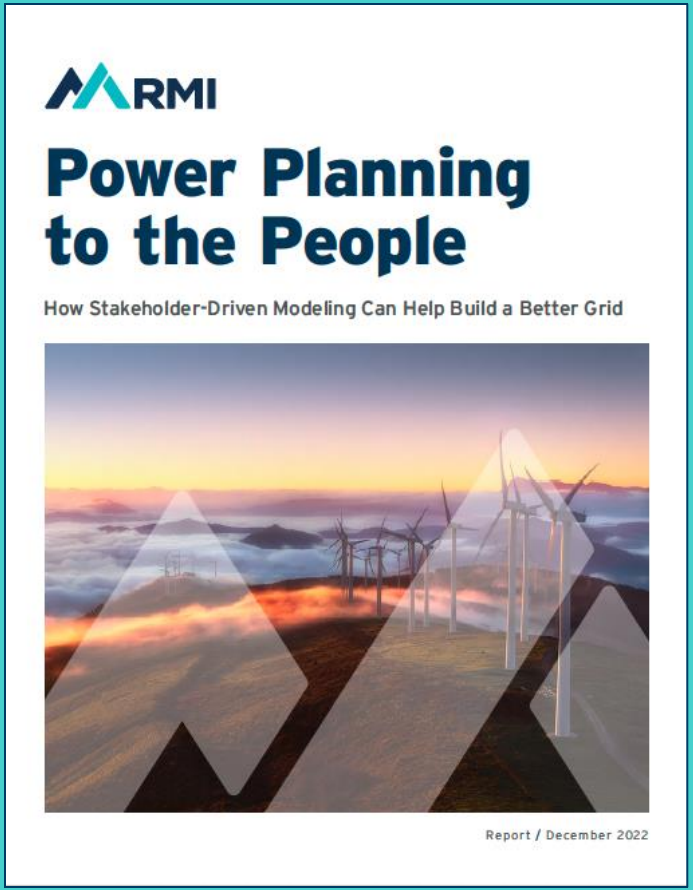
About RMI

RMI's mission is to transform the global energy system to secure a clean, prosperous, zero-carbon future for all

RMI – Energy. Transformed.



Key Resources: Reimagining Resource Planning & Power Planning to the People



The goal of Reimagining Resource Planning was to explore the fundamentals of planning today and how it needs to change

Landscape assessment of resource planning today

- Conducted 12 expert interviews
- Resource planning literature review

Finding: The basics of how planning needs to change are well covered

Deep dive on 4 IRPs

Analyzed how each tackled cutting edge of planning topics:

- Emissions and climate goals
- Economy-wide assumptions
- Reliability and resilience
- EJ and local economic development

Identify leading examples and need to reimagine

- Identified major challenges with resource planning
- Reviewed regulation and identified enhancements in practice today
- Tested frameworks with peers and practitioners

Resource planning is a crucial opportunity for utilities, regulators, and stakeholders to shape the future electricity system

Understand the energy needs of the households, communities, and businesses a utility serves, as well as how they will change over time, and translate them into system needs

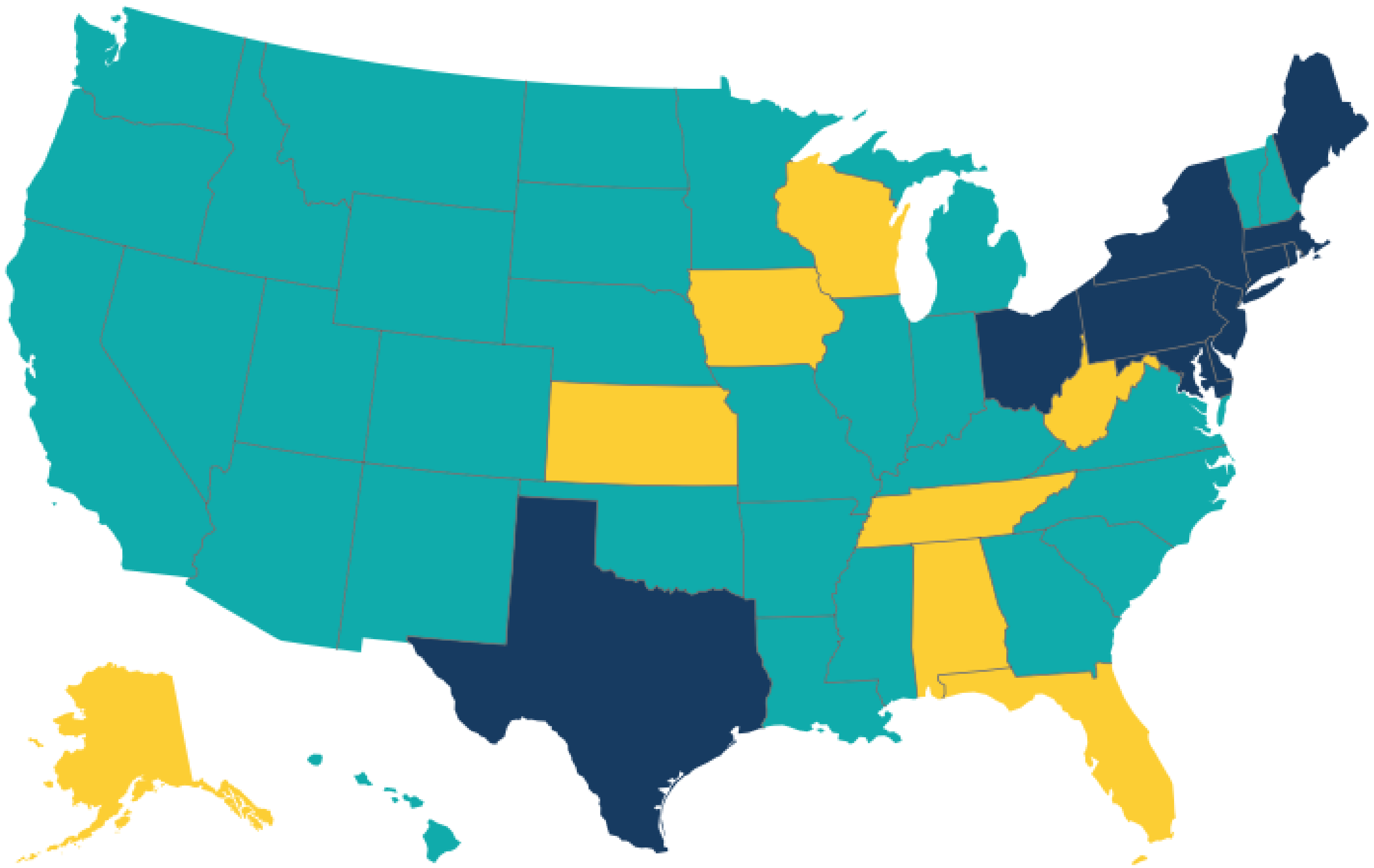
Establish a common set of assumptions and evidence that can be used to assess which near- and long-term options can meet system needs and achieve desired utility performance across multiple objectives

Identify longer-term risks and opportunities and strategies to navigate them

Utilities in most states do resource planning

Planning requirements by state

Has IRP requirement | No IRP requirement | No IRP requirement — primarily restructured



Source: US Environmental Protection Agency, *State Energy and Environment Guide to Action: Resource Planning and Procurement*, Figure 2; RMI analysis of EIA-860M to add distinction for primarily restructured states

IRPs must maintain three core qualities to be effective tools for utilities and regulators to evaluate resource decisions

IRP quality	*Definition*
Trusted	The IRP is **transparent and well vetted**, with stakeholder input.
Comprehensive	The IRP can **accurately represent the costs, capabilities, system impacts, and values of resources** that might be available within the planning time horizon; the IRP can **consider actions across the transmission and distribution systems** as portfolio options.
Aligned	It is clear how the plan evaluates options to meet traditional planning requirements such as **reliability, affordability, and safety,** as well as **state and federal policies and customer or company priorities**, such as reducing emissions and advancing environmental justice.

It is important for utilities to consider each of these qualities in their resources planning

IRP quality	*Why quality is important to utilities*
Trusted	When utilities seek input from their customers and engender trust in their assumptions, they can **develop an accurate plan that meets customer energy needs and leads to regulatory approval.**
Comprehensive	When plans are comprehensive, utilities can **adequately assess the value and risk of their potential future investments.**
Aligned	When utilities demonstrate that plans are aligned with policy and customer objectives, they can **avoid future disallowance of investments and under-or over-procurement of resources.**

Several key trends are challenging utilities and regulators to maintain these qualities in planning processes

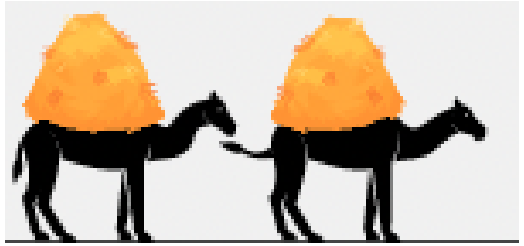
- **Rapid technology change and shifting resource costs**
- **New policies that expand planning objectives beyond affordability, reliability, and safety to include:**
    - Emissions reductions
    - Advancement of environmental justice
    - Economic development
    - Support of electrification of transportation, buildings, and industry
- **Recognition that distribution and transmission impact resource planning (and vice versa)**
- **Links between planning and local air quality, health, jobs, energy bills, and climate change**

Its time to reimagine resource planning to ensure these new expectations don't "break the camel's back"…

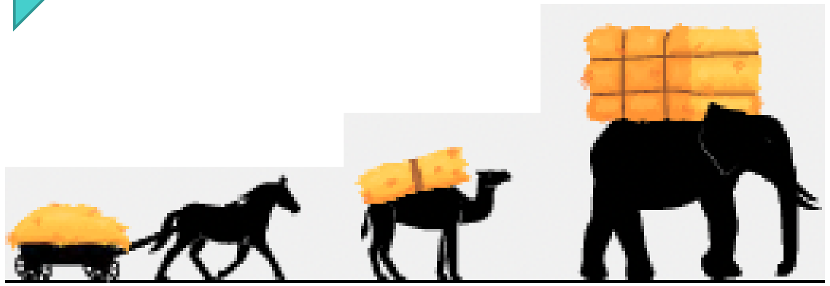
New IRP expectations risk being like the straw that breaks the camel's back

…by ensuring utilities and regulators are proactively and repeatedly refining IRP purpose, scope, roles, and tools

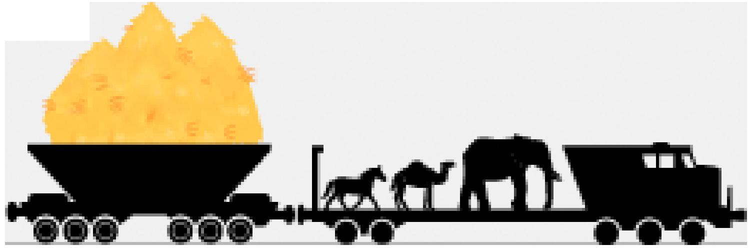
Purpose



Scope



Roles



Tools

RMI has identified several options to enhance resource planning practices to make them more comprehensive, trusted, and aligned. We will focus on three of these today

IRP quality	*Description of planning enhancement*
Trusted	1. Prioritizing transparency **2. Meaningful engaging stakeholders**
Comprehensive	3. Integrating resource, transmission, and distribution planning **4. Using all-source solicitations in planning** 5. Updating assumptions for DER adoption and demand-side value 6. Accurately representing emerging resources and their value
Aligned	**7. Updating approaches to planning for reliability** 8. Accounting for carbon emission and decarbonization targets 9. Analyzing air quality and health impacts 10. Including affordability, jobs, and environmental justice

Each of these options affect one or more "building blocks" of integrated resource planning

- Establish assumptions
- Develop forecasts
- Set objectives and scenarios
- Determine system needs
- Identify solutions
- Evaluate solutions
- Finalize plan
- Implement

Source: "Standard Building Blocks" from the National Association of Regulatory Utility Commissioners-National Association of State Energy Officials (NARUC-NASEO) Task Force on Comprehensive Electricity Planning, 2019

Options for meaningfully engaging stakeholders

Define how to engage stakeholders before and during plan development*

1 **Create a dedicated IRP advisory group***

2 **Document how stakeholders influenced the plan***

Reduce barriers to participation*

- Establish assumptions
- Develop forecasts
- Set objectives and scenarios
- Determine system needs
- Identify solutions
- Evaluate solutions
- Finalize plan
- Implement

1. Oregon utilities are developing equity and environmental justice focused advisory groups whose feedback will be incorporated into their IRPs

2. In Washington, utilities demonstrate how stakeholder input was used in the development of the IRP

*Applied before and throughout the process

Options for using all-source solicitation in planning

1 Use all-source solicitation results to inform planning

1. In Michigan, utilities uses data collected from a supply-side RFP to inform resource costs and capabilities in planning

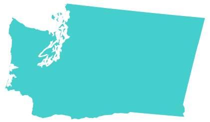
- Establish assumptions
- Develop forecasts
- Set objectives and scenarios
- Determine system needs
- Identify solutions
- Evaluate solutions
- Finalize plan
- Implement

2. In Colorado, utilities fille an all-source, competitive solicitation as part of their resource plan

Use the planning process to structure an all-source solicitation 2

Options for updating reliability modeling throughout the IRP process

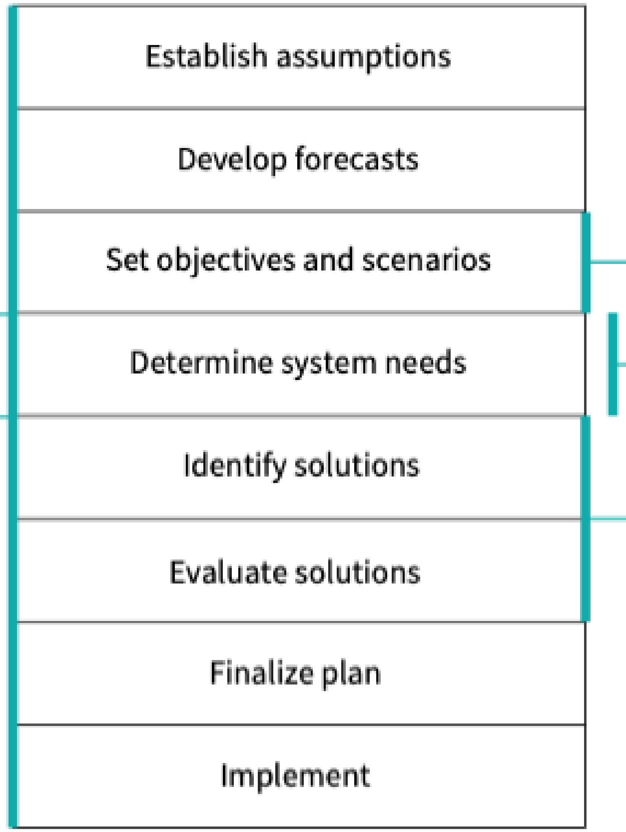
2. PacifiCorp in Washington assesses climate impacts on load and resource availability



1 Redefine the goals and metrics for assessing reliability in an IRP*

Integrate resilience into planning*

1. Oregon planning guidelines require utilities to assess expected and worst-case unserved energy in addition to loss of load probability and planning reserve margins



Analyze the impacts of reliability-threatening scenarios, including those exacerbated by climate change 2

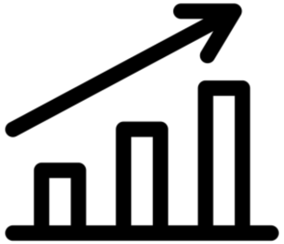
Understand regional reliability needs

Improve alignment between portfolio optimization models and reliability analysis

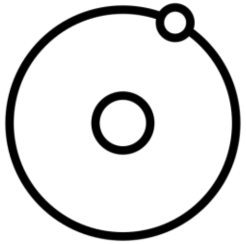
*Applied before and throughout the process

The IRA can impact resource planning by lowering clean energy costs, driving electrification and EE, lowering costs associated with fossil retirements, and more

Updated resource costs include new ITC and PTC assumptions



Load projections reflect accelerated customer electrification and additional energy efficiency



Emerging resources are included as options

Plans consider the opportunity to leverage Energy Infrastructure Reinvestment (EIR) program funding at fossil sites

By incorporating assumptions related to IRA tax credits, DTE executives projected that they will be able to save customers ~$500 million over the course of the 20-year IRP.

Thank You

Reimagining Resource Planning: https://rmi.org/insight/reimagining-resource-planning/

Power Planning to the People: *https://rmi.org/insight/power-planning-to-the-people/*

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- *Aaron Schwartz* – aschwartz@rmi.org

Discussion & Questions

aps

Break

Reliability Planning for APS

Reliability Planning in the Modern Era

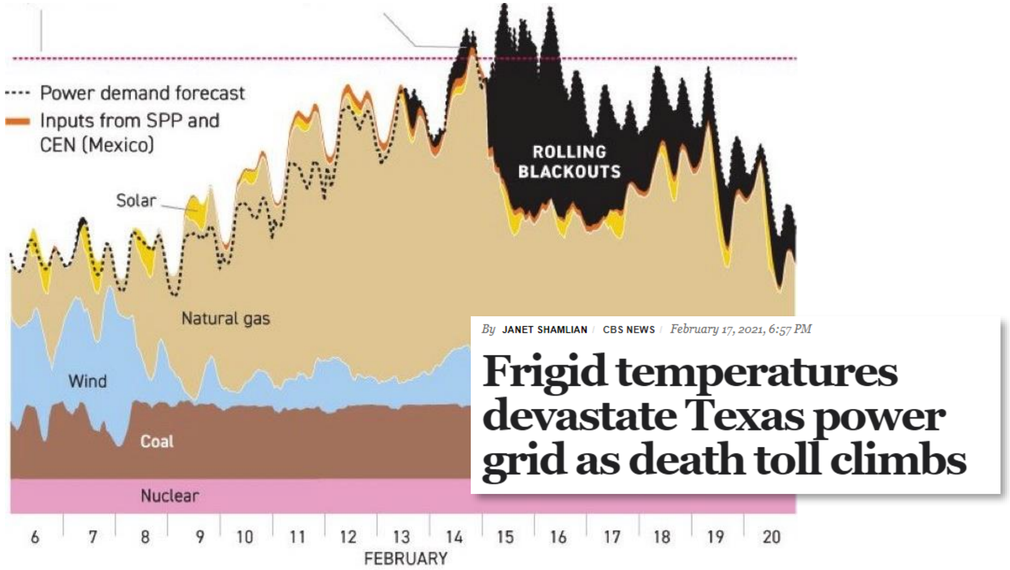
- Resource adequacy – essential for maintaining a reliable and safe electricity system – is becoming increasingly complex

- Each resource’s ability to contribute to reliability needs is unique; resource diversity can mitigate risks associated with individual resources

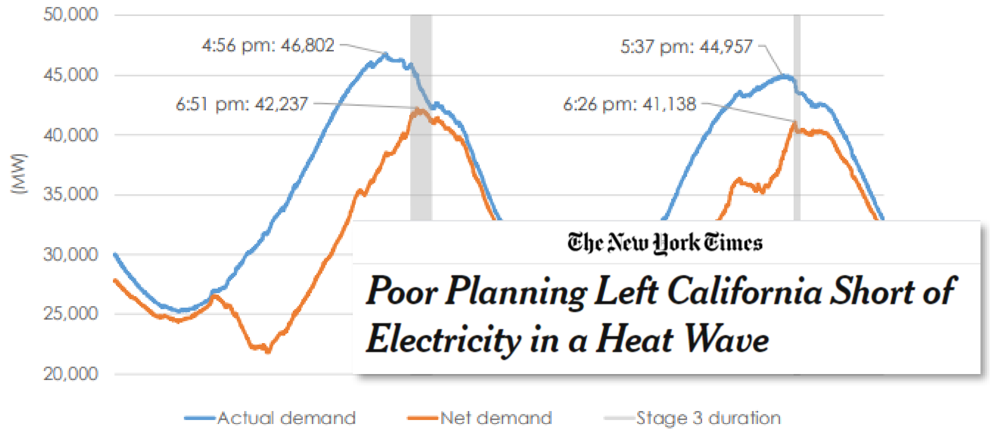
- Best practices for reliability planning continue to evolve, but remain rooted in loss of load probability modeling to captures resources’ capabilities and imperfections and variability in energy demand

Evolving Challenges for Reliability Planning

- **Reliable electricity supply is essential to society and becoming even more important:**
  - Meeting cooling and heating electric demands as extreme weather events become more frequent and severe is increasingly a matter of life or death
  - Economy-wide decarbonization requires electrification of transportation and buildings, making the electric industry the keystone of tomorrow's energy economy
- **Transitioning to a system with more renewable and storage resources introduces new sources of complexity in resource adequacy planning:**
  - Planning exclusively for "peak" demand is obsolete
    - This was reasonable when all resources were firm
  - Resource adequacy must consider conditions across all hours of the year – as underscored by California's rotating outages during August 2020 "net peak" period



Graph source: https://twitter.com/bcshaffer/status/1364635609214586882



Graph source: http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf

Many Uncertainties Pose Risks to Reliability

Electricity Demand

High electricity demands during extreme weather (hot or cold) place a strain on generation resources to produce at maximum capability

Battery Performance

Battery storage has not yet been widely deployed at grid scale, and if it does not perform as often idealized, could be less effective as a capacity resource

Renewable Variability

Variable resources (wind and solar) cannot produce consistently at all times; at higher penetration, reliability risks align with periods of lower variable renewable production (the "net peak")

Fuel Supply

Reliance on just-in-time delivery of natural gas creates fuel security risks and possibility of multiple simultaneous plant outages

Correlated Outages

Extreme weather conditions result in higher probabilities of generator and/or equipment failure

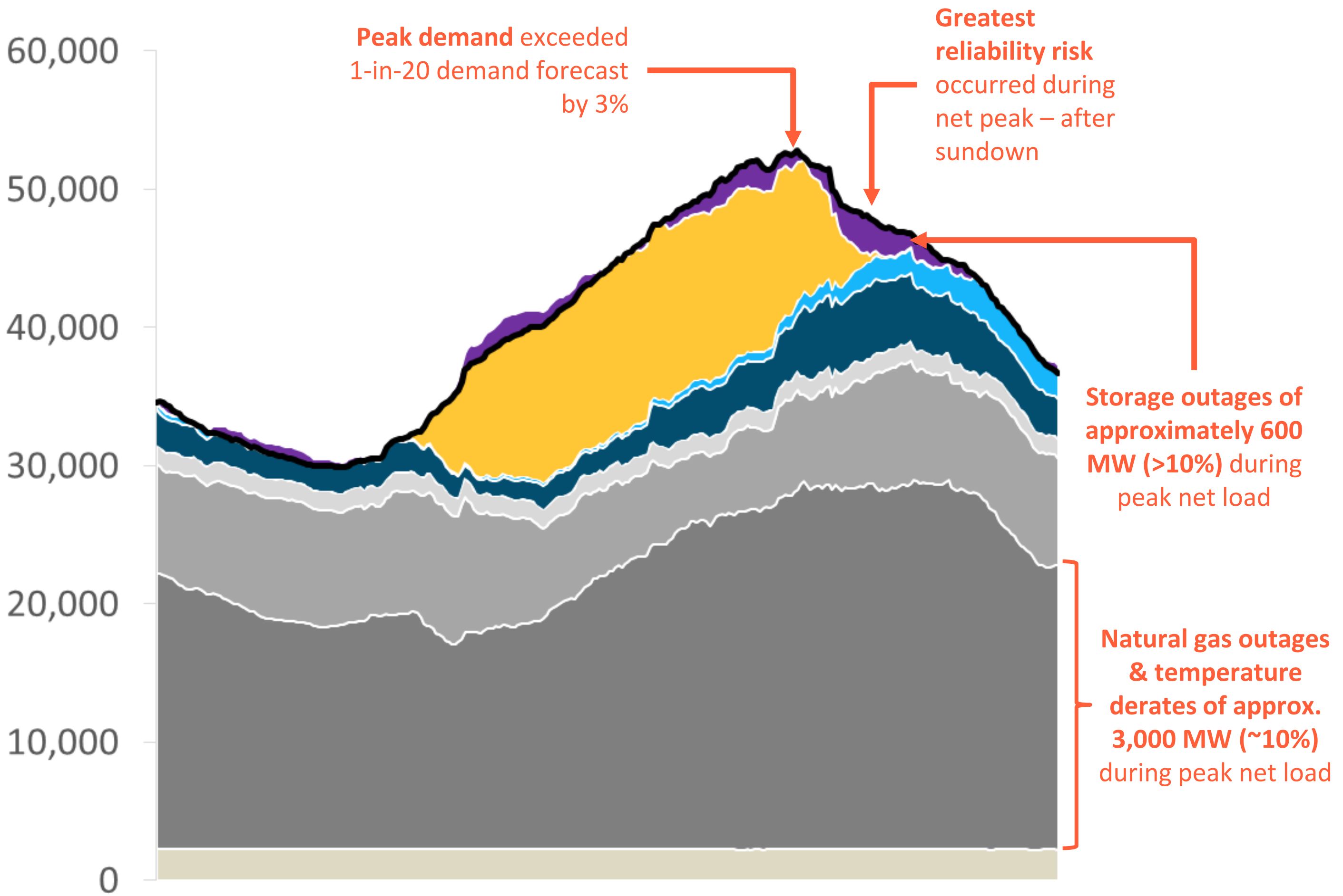
Climate Impacts

Many of the risk factors enumerated above are likely to be exacerbated as the climate continues to change; at the same time, uncertainty around climate impacts also magnifies uncertainty around reliability outcomes

Recent Close Calls in California Exemplify Increasing Complexity of Planning for Reliability

+ **In early September 2022, California experienced several days of tight grid conditions**
+ **Multiple stressors contributed to these conditions, including:**
  - Higher-than-forecast electricity demands due to heat wave
  - Decline in solar output during evening hours
  - Outages, imperfect dispatch, and constraints on state of charge of energy storage resources
  - Outages of natural gas generators
+ **Despite challenging conditions, reliability was maintained**

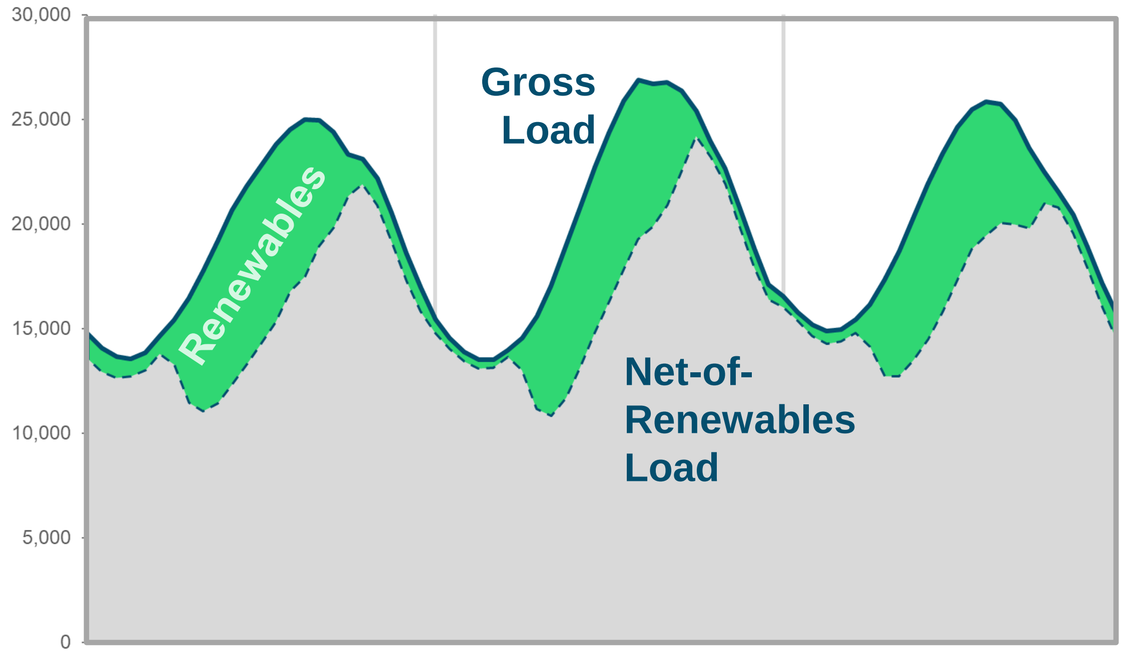
CAISO System Operations on September 6, 2022
(MW)

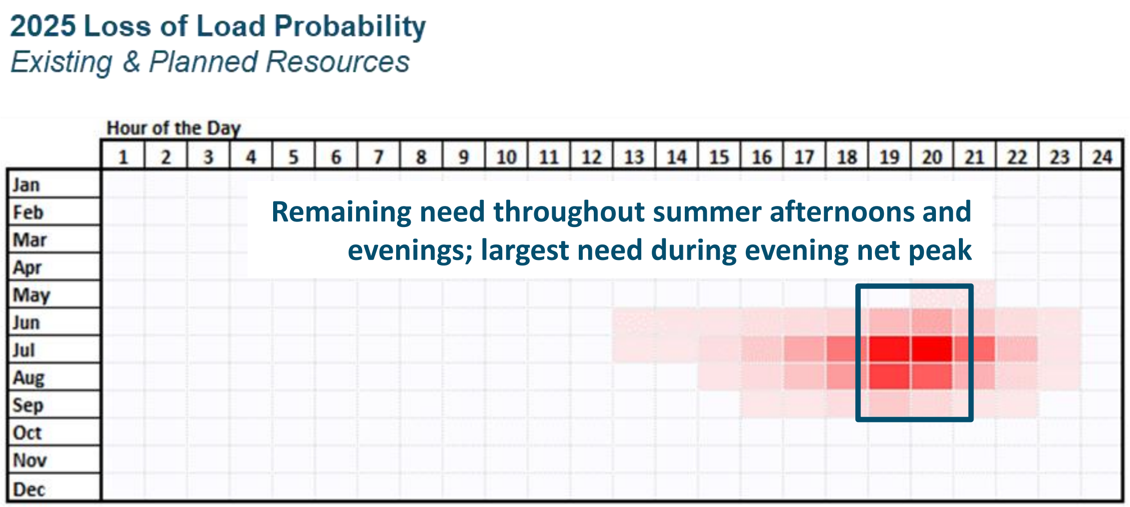


By 2025, the principal resource adequacy challenge in the Southwest is the evening "net peak"

- **With increasing penetration of solar resources, the highest "net peak" period occurs after sundown** *(i.e. the highest loss of load probability occurs when solar is not producing)*
- **This shift has direct implications for the relative capacity value of different types of resources**

2025 load & net load on representative summer peak days
(MW)





Common findings across E3's long-term planning studies

E3's work with utilities and regulators to develop long-term resource plans support three general findings:

1. **Technologies available today can enable significant progress towards ambitious state and utility clean energy objectives**
2. **A technology-neutral approach to planning and procurement will enable utilities to meet reliability and clean energy goals most affordably**
3. **Some form of firm capacity is needed for reliability even under a deeply decarbonized grid**

These findings are supported by a growing body of literature, including recent studies by the National Renewable Energy Laboratory (NREL), Princeton University, the Electric Power Research Institute (EPRI), and the Massachusetts Institute of Technology (MIT)

Blueprint for a Low Carbon Grid

Scalable Low-Cost Clean Energy Resources

Today: wind, solar, efficiency

Future: nuclear SMR, CCS

Balancing Resources

Today: batteries, pumped storage, hydro, demand response

Future: advanced flexible loads, other storage technologies

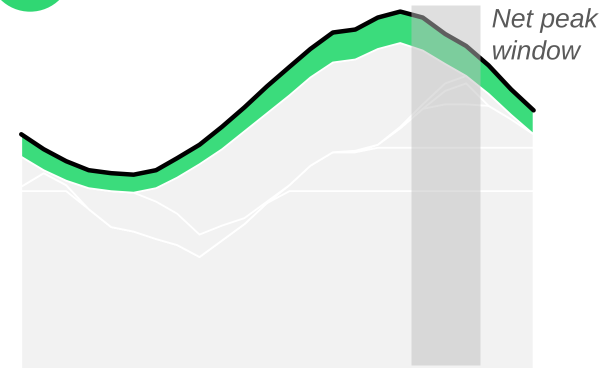
Firm Resources

Today: nuclear, natural gas, geothermal

Future: hydrogen, long-duration storage, nuclear SMR, CCS

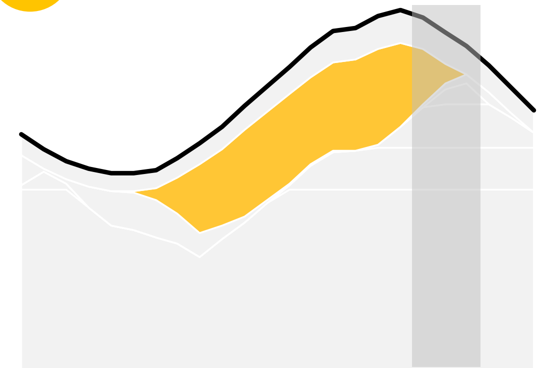
Each Resource Has Different Capabilities

1 Energy Efficiency



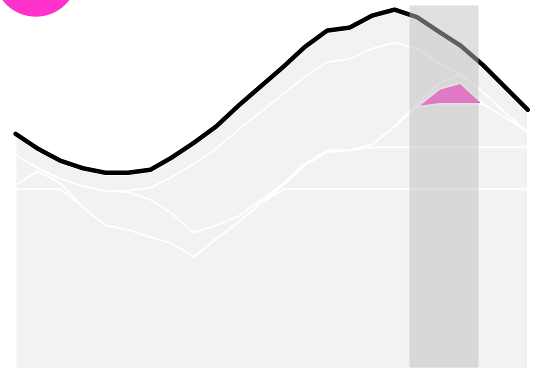
Reduces load in all hours, including peak periods

2 Solar PV



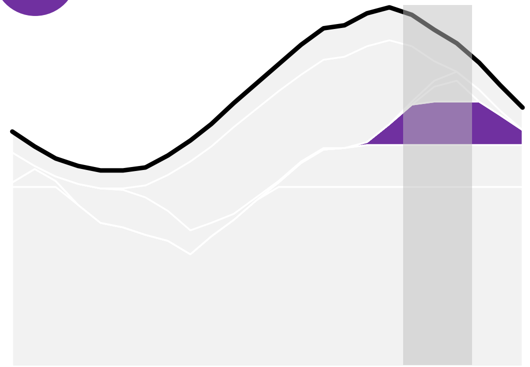
Provides low-cost, abundant energy during daylight hours

3 Demand Response



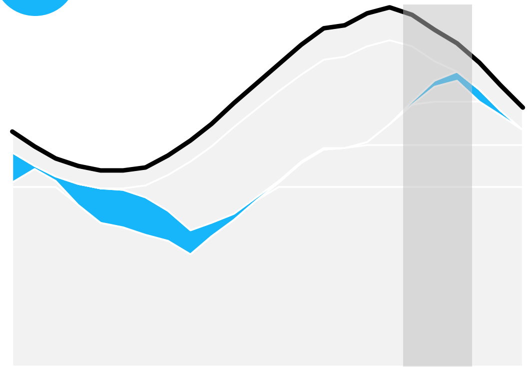
Meets peaking needs for short periods on most critical days

4 Energy Storage



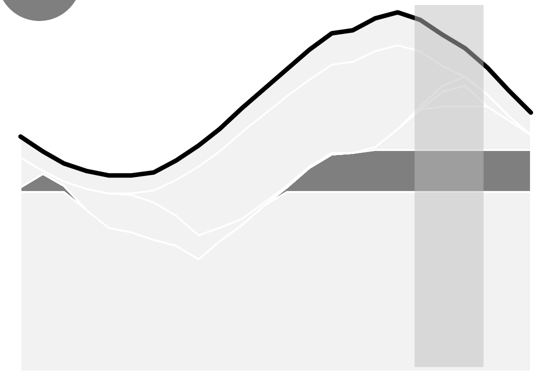
Meets peaking needs with limited duration

5 Wind



Provides low-cost energy with high variability

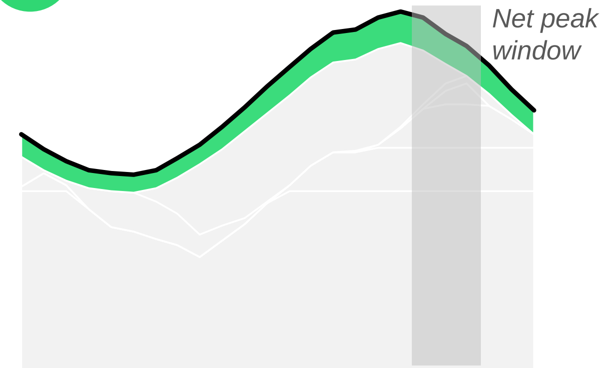
6 Natural Gas



Meets peaking needs and can generate for longer periods if needed

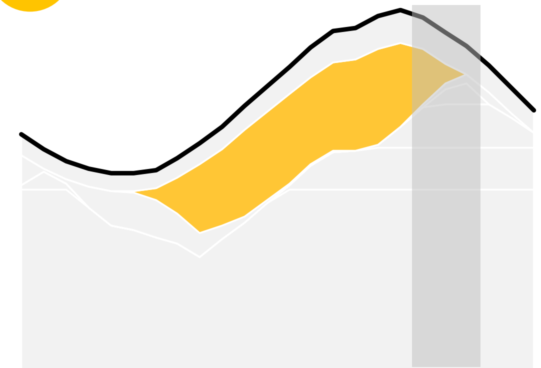
No Resource is Perfect

1 Energy Efficiency



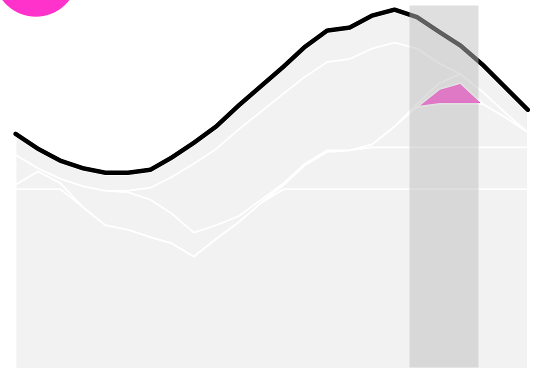
Impacts dependent on seasonality, time of day, and other factors

2 Solar PV



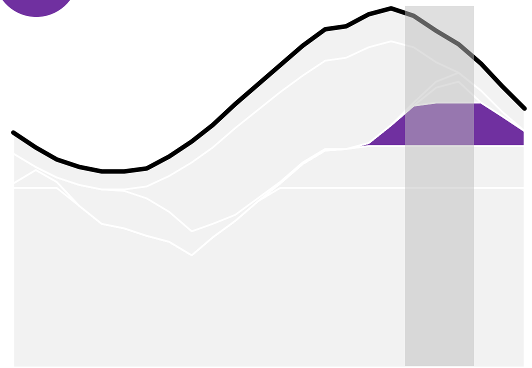
Zero at nighttime, seasonal, impacted by weather

3 Demand Response



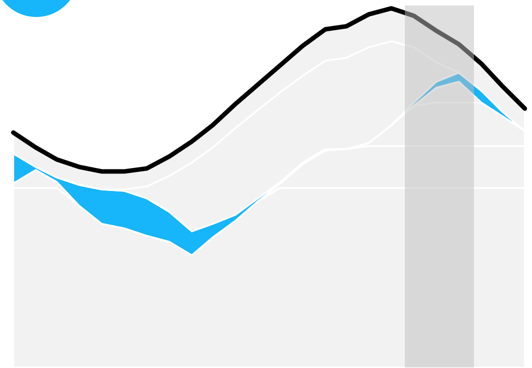
Limitations on duration and number of calls

4 Energy Storage



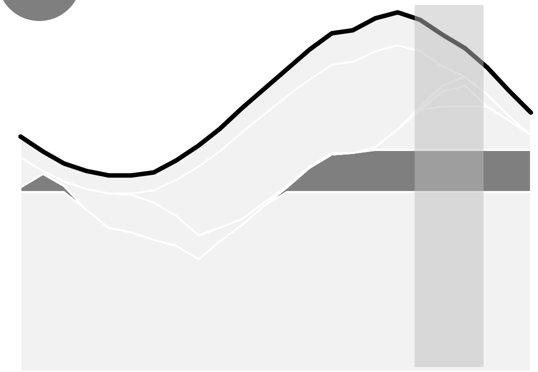
Limited duration for discharging, requires resources to charge

5 Wind



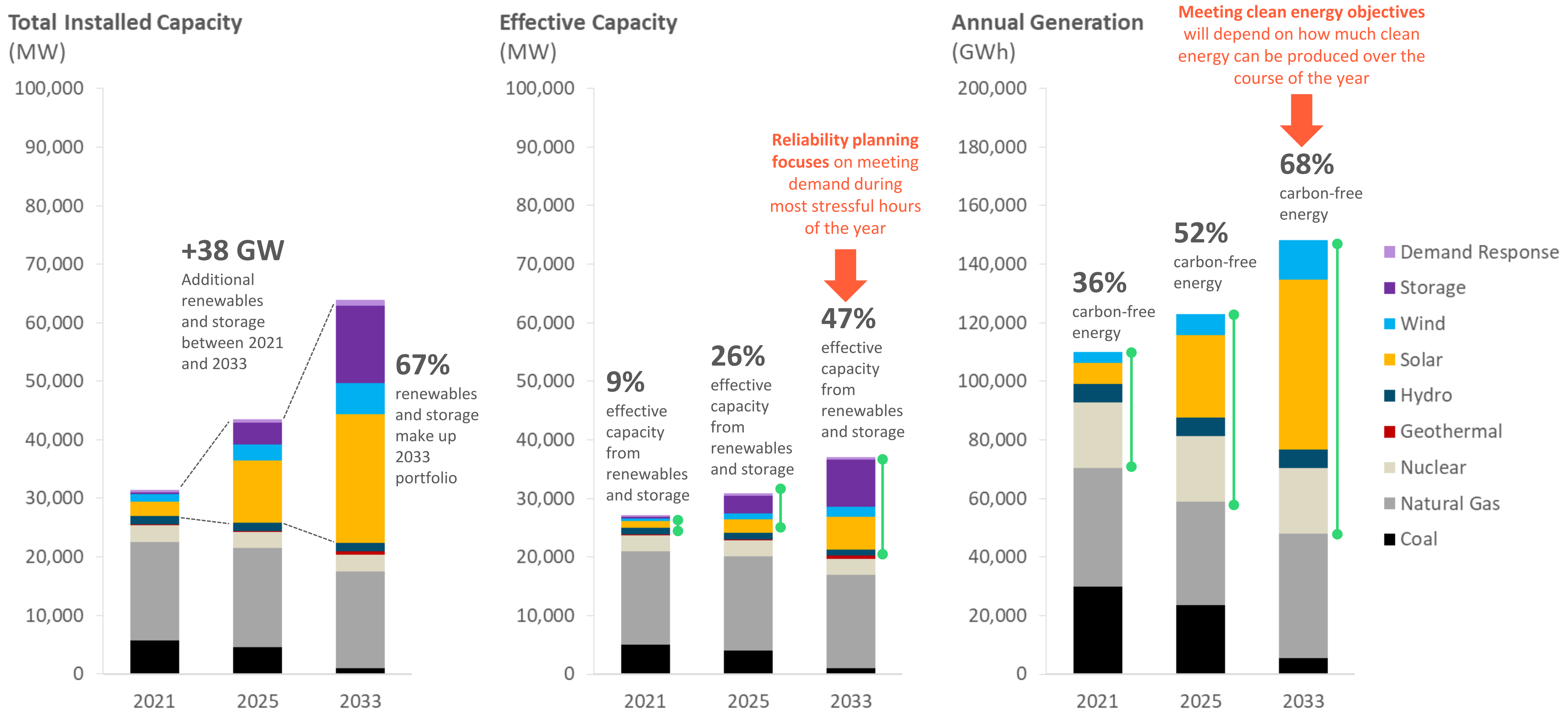
Seasonal, impacted by weather

6 Natural Gas



Derates during high temperatures, forced outages, fuel availability

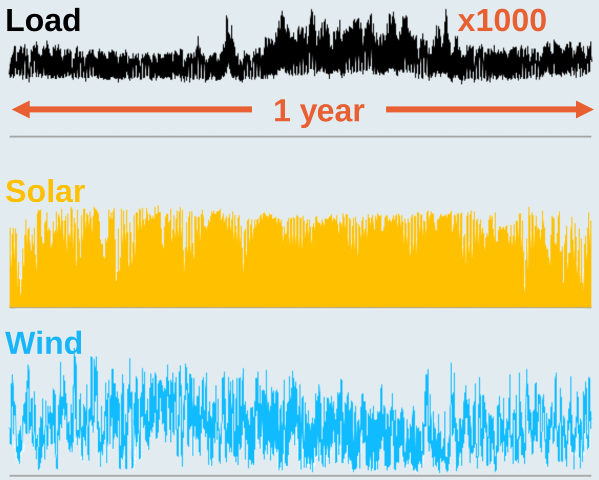
Renewables and storage provide valuable energy and capacity, but existing conventional resources are essential for reliability



Overview of Best Practices in Resource Adequacy Analysis

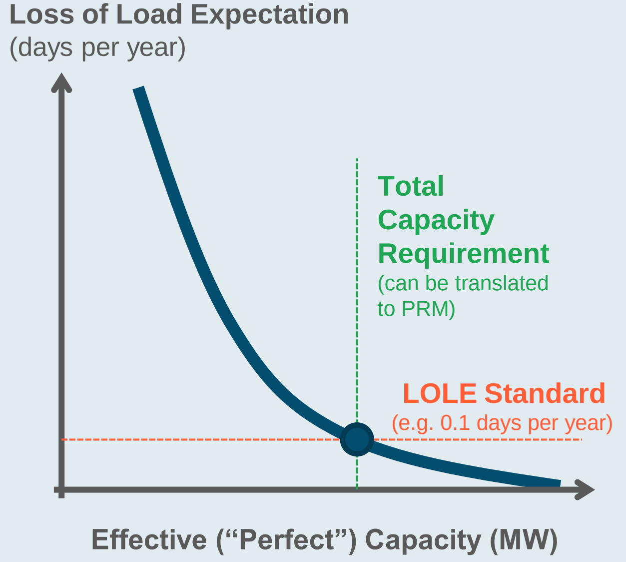
Develop a representation of the loads and resources of an electric system in a loss of load probability model

LOLP modeling allows a utility to evaluate resource adequacy across all hours of the year under a broad range of weather conditions, producing statistical measures of the risk of loss of load



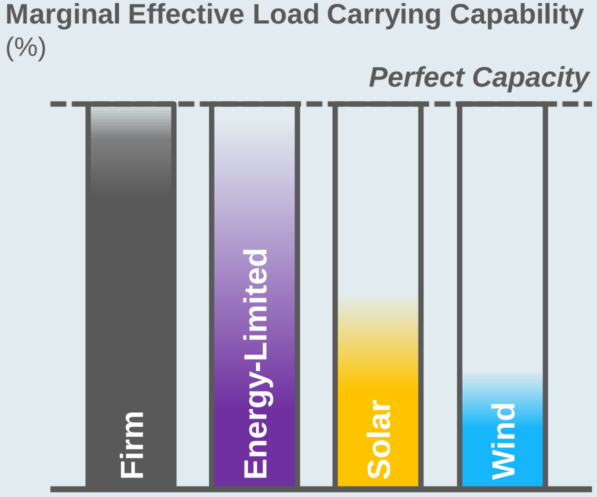
Identify the amount of perfect capacity needed to achieve the desired level of reliability

Factors that impact the amount of perfect capacity needed include load & weather variability, operating reserve needs



Calculate capacity contributions of different resources using effective load carrying capability

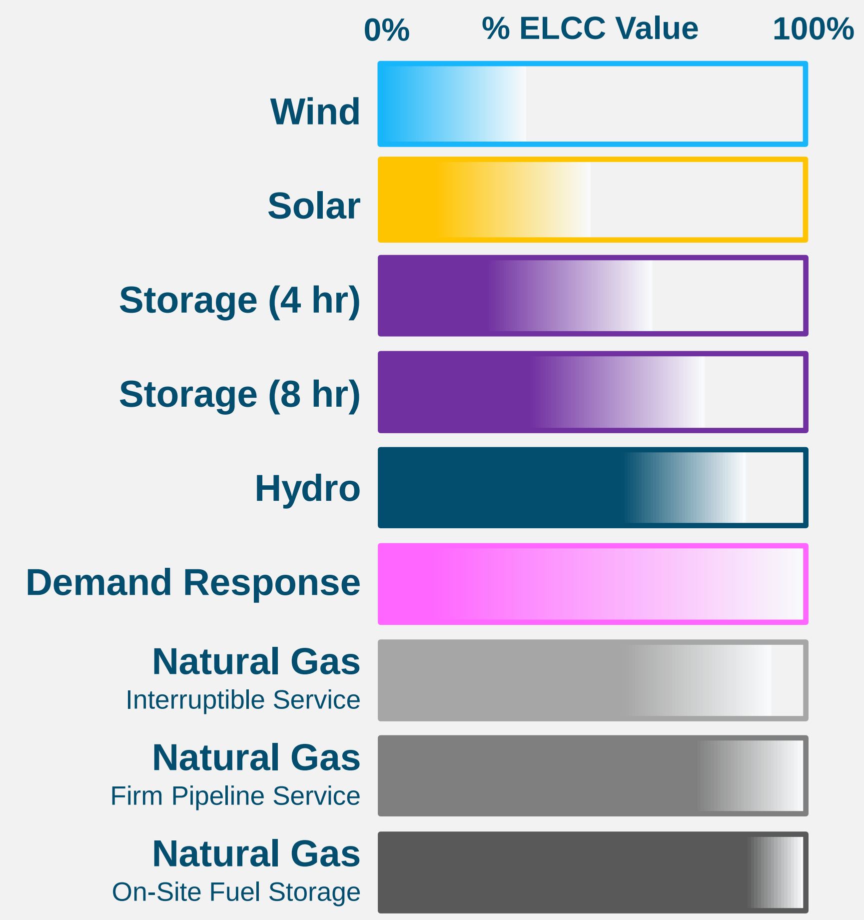
ELCC measures a resource's contribution to the system's needs relative to perfect capacity, accounting for its limitations and constraints



ELCC Appropriately Accounts for Each Resource's Capabilities and Imperfections

- **ELCC creates level playing field by measuring all resources against a perfect capacity benchmark**
- **Can account for all factors that can limit availability:**
  - Hourly variability in output
  - Duration and/or use limitations
  - Seasonal temperature derates
  - Temperature-related outage rates
  - Forced outages
  - Energy availability
  - Fuel availability
  - Correlated outage risk, *especially under extreme conditions*

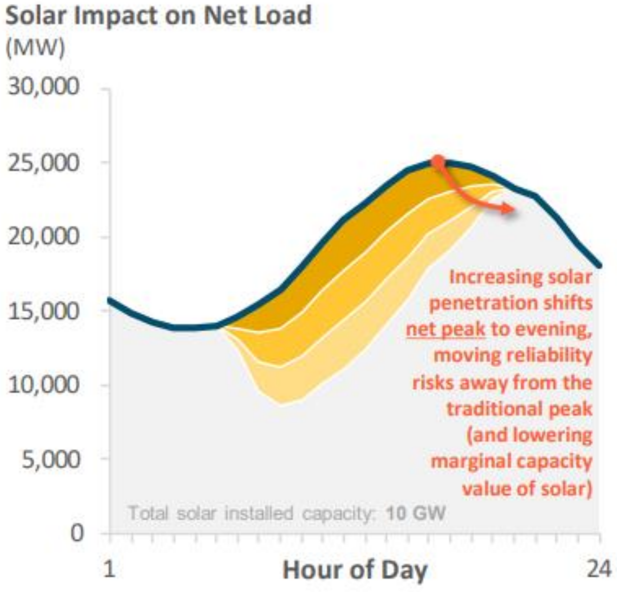
Illustrative ELCC Values Across Technologies



The ELCC of Variable and Energy-Limited Resources Changes With Penetration Levels

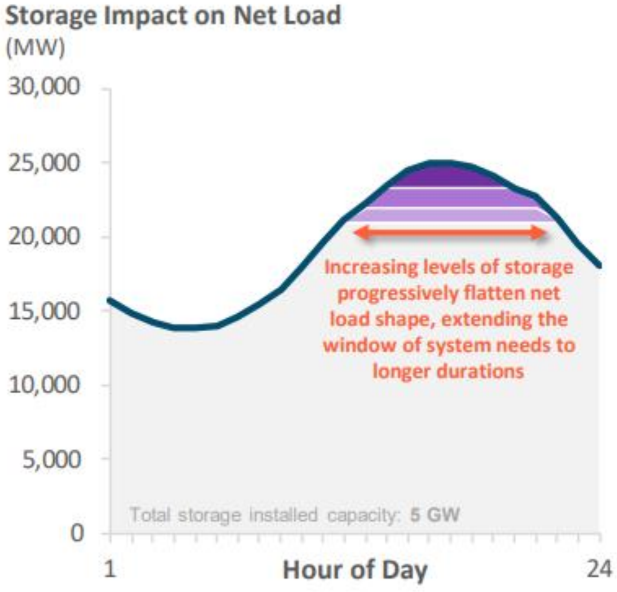
1

"Variable" resources shift reliability risks to different times of day



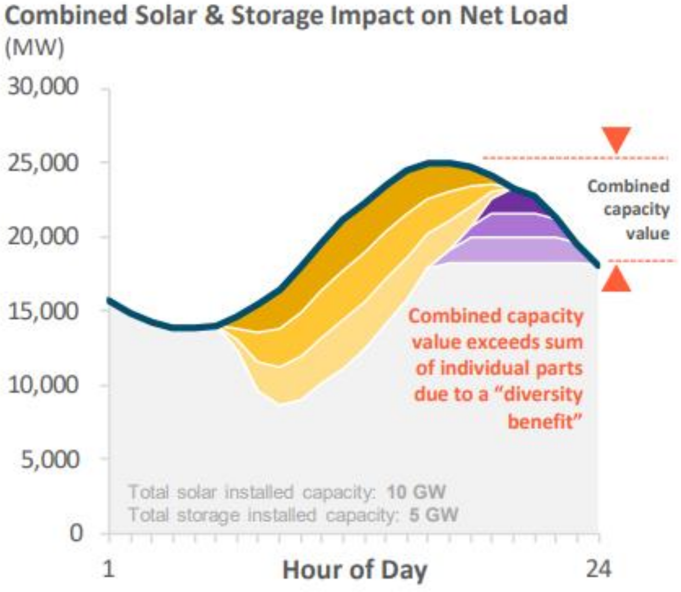
2

"Energy-limited" resources spread reliability risks across longer periods



3

A portfolio of resources exhibits complex interactive effects, where the whole may exceed the sum of its parts



Resource Adequacy Modeling Best Practices Checklist

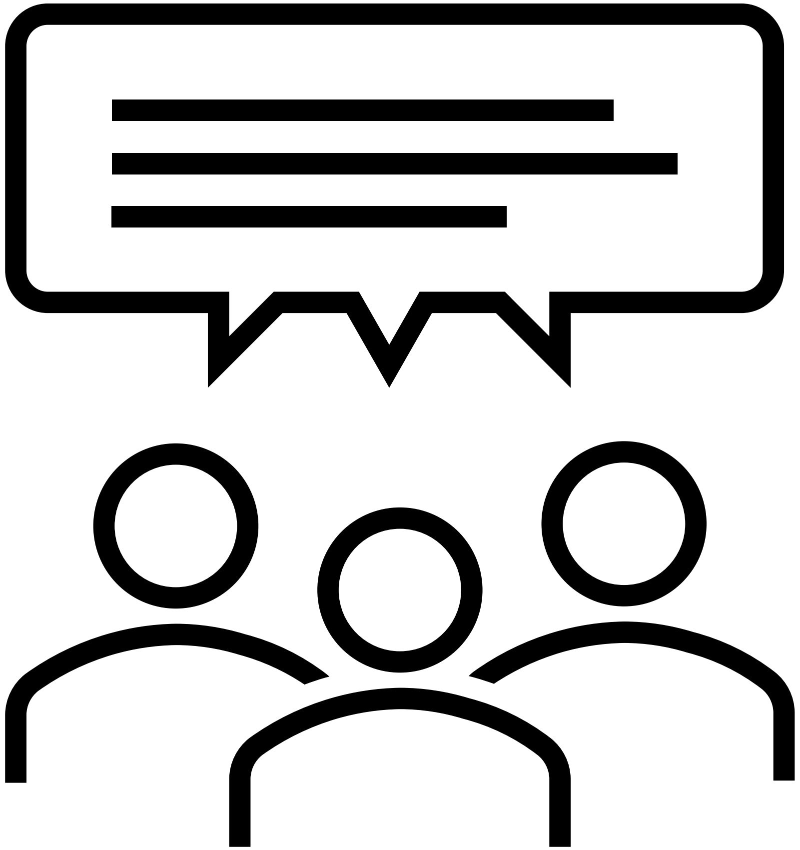
- Develop a robust loss of load probability model that considers all hours of the year and covers a broad range of weather conditions
- Establish a clear reliability target (e.g. 1-day-in-10-year standard)
- Quantify the total resource need to satisfy the reliability target (i.e. planning reserve margin)
- Use an ELCC methodology to count capacity, capturing the unique capabilities and imperfections of all resources
- Assess resilience to disruptions not captured directly in LOLP modeling (e.g. fuel security, common mode failures)

Discussion & Questions

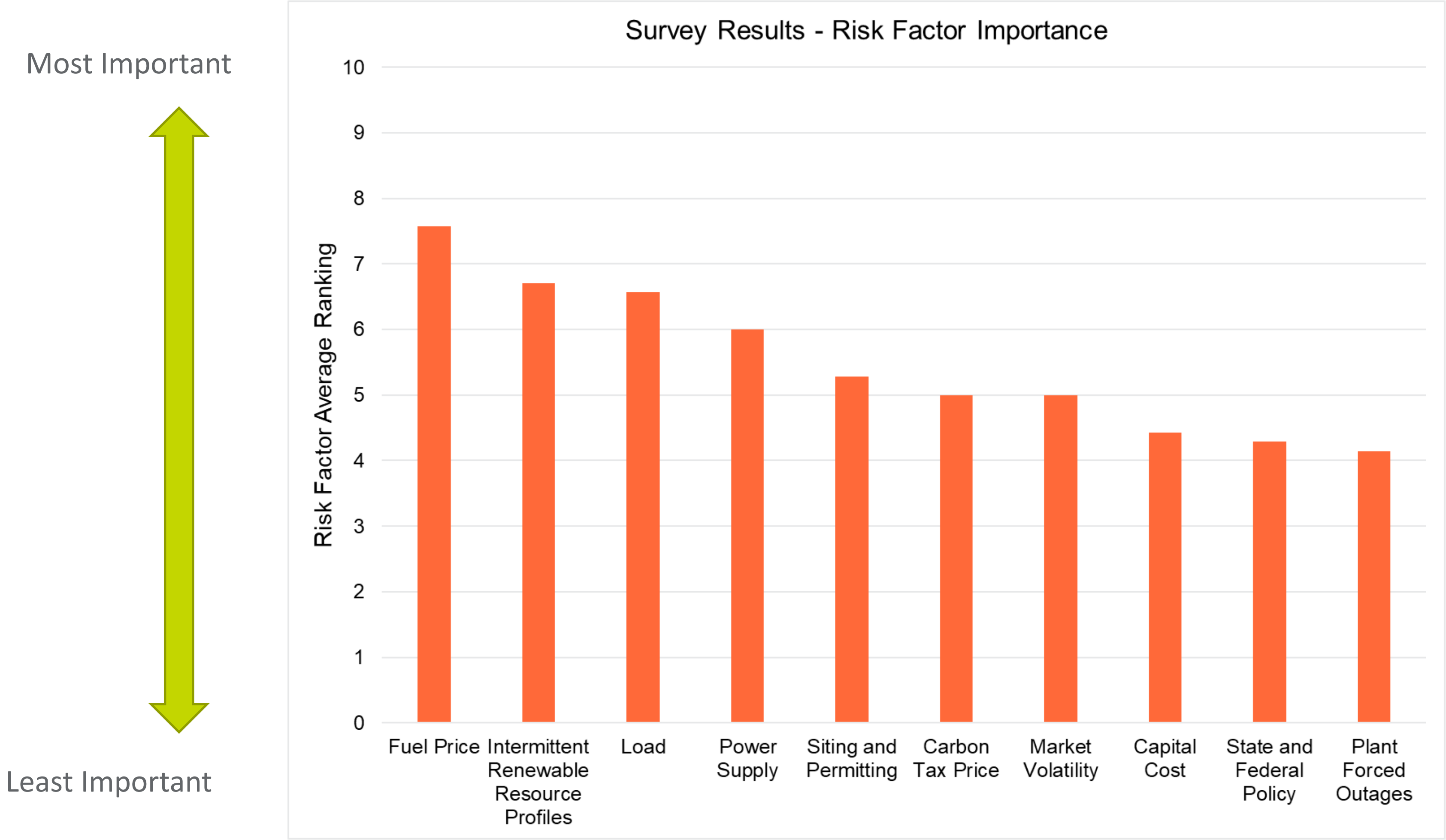
IRP Portfolios – RPAC Feedback

RPAC Survey Recap

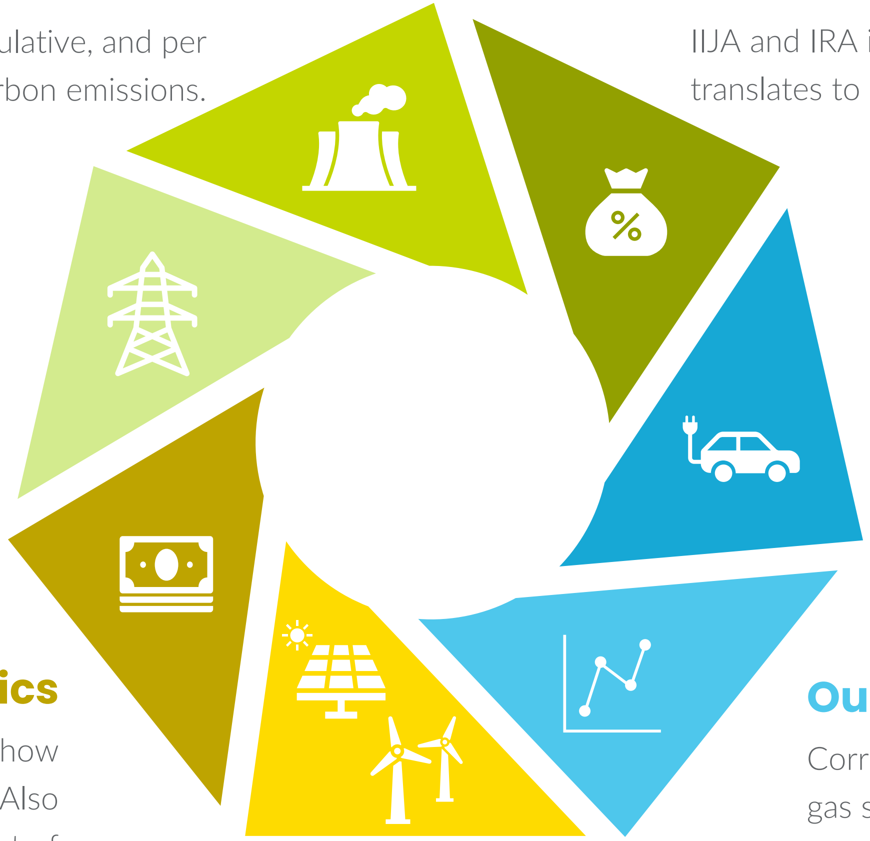
- Of the identified risk factors, which one is most important to you?
- Are there other variables that you would like to see quantitatively or qualitatively measured/varied?
- Are there portfolios characteristics that could emphasize performance tradeoffs?



Of the identified risk factors, which one is most important to you?



Are there other variables that you would like to see quantitatively or qualitatively measured/varied?



CO2 Emissions

Annualized, total cumulative, and per MWh summary of carbon emissions.

Tax Credit Utilization

IIJA and IRA impacts and how it translates to customer savings.

Stranded Asset Risk

Future market uncertainty may lead to risk of fewer or more than expected energy imports that impact stranded asset risk. Model opportunity cost of overbuilding high capital cost generation

DSM, EE, EV, and TOU Rate Impact

Avoided capital and operating costs through DSM deployment. Demand impact and cumulative energy savings through DSM programs.

Rate Impacts and Financial Metrics

Provide summary of revenue requirements to identify how much is rate base vs how much is fuel or other costs. Also include levelized cost of energy and levelized cost of reliable capacity as a qualitative metric.

Outage Correlation

Correlation of outages on the natural gas system. Outages are often modeled independently.

Renewable ELCC

Evaluate synergistic benefits of adding diverse renewable resources to APS system.

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Are there portfolios characteristics that could emphasize performance tradeoffs?

Federal Incentives to Reduce Tradeoffs

Programs like EIR and other federal incentives, this can be a win-win-win.

Additional Environmental Considerations

Inclusion of characteristics about air quality/air pollution beyond emissions. Water consumption metrics that evaluate sustainability.

Justice and Equity

Representation of underserved communities and identify demographics and risk factors of communities near power plants. Assess portfolio impact on energy costs and energy access.

Resource Diversity

A portfolio with a diverse selection of renewable energy resources across geographically diverse areas, with robust transmission investment, can de-emphasize the postulated trade-offs between sustainability and risk/reliability/affordability

Avoided Peak Demand

Risk and reliability benefits associated with avoided peak demand.

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Discussion & Questions

2023 IRP Update

APS has developed multiple cases to evaluate uncertain assumptions.

Portfolio Name	Load Forecast	Gas Prices	Carbon Tax	Technology Cost	APS CEC and RPS Targets Included	Coal Dispatch	Four Corners Retirement	Storage Constraint	New Natural Gas	EE Constraint	Demand-Side Resource Constraint
Reference	Base	Base	Base	Base	Yes	Base	2031	<=25% of Peak Load + Peak Reserves though 2027	Yes	N/A	N/A
Low Gas Price	–	↓	–	–	–	–	–	–	–	–	–
High Gas Price	–	↑	–	–	–	–	–	–	–	–	–
Low Technology Cost	–	–	–	↓	–	–	–	–	–	–	–
High Technology Cost	–	–	–	↑	–	–	–	–	–	–	–
High load Growth	↑	–	–	–	–	–	–	–	–	–	–
High Carbon Tax	–	–	↑	–	–	–	–	–	–	–	–
No New Natural Gas	–	–	–	–	–	–	–	–	⊘	–	–

aps

Additional cases required by the commission will be included in the IRP evaluation.

Portfolio Name	Load Forecast	Gas Prices	Carbon Tax	Technology Cost	APS CEC and RPS Targets Included	Coal Dispatch	Four Corners Retirement	Storage Constraint	New Natural Gas	EE Constraint	Demand-Side Resource Constraint
Reference	Base	Base	Base	Base	Yes	Base	2031	<=25% of Peak Load + Peak Reserves though 2027	Yes	N/A	N/A
High Demand Side Tech	–	–	–	–	–	–	–	–	–	>=1.5%/year for 10 years	>=35% of 2020 load by 2030
Technology Neutral	–	–	–	–	🚫	–	–	–	–	–	–
Low Load Growth	<1% ↓	–	–	–	–	–	–	–	–	–	–
No Load Growth	0% ↓	–	–	–	–	–	–	–	–	–	–
Economic Coal Dispatch	–	–	–	–	–	No Must Run	–	–	–	–	–

Four Corners coal operation retirement date sensitivities will be analyzed in the 2023 IRP.

Commission Required

Portfolio Name	Load Forecast	Gas Prices	Carbon Tax	Technology Cost	APS CEC and RPS Targets Included	Coal Dispatch	Four Corners Retirement	Storage Constraint	New Natural Gas	EE Constraint	Demand-Side Resource Constraint
Reference	Base	Base	Base	Base	Yes	Base	2031	<=25% of Peak Load + Peak Reserves though 2027	Yes	N/A	N/A
Four Corners Retire 2027	-	-	-	-	-	-	2027	-	-	-	-
Four Corners Retire 2028	-	-	-	-	-	-	2028	-	-	-	-
Four Corners Retire 2029	-	-	-	-	-	-	2029	-	-	-	-
Four Corners Retire 2030	-	-	-	-	-	-	2030	-	-	-	-
Four Corners Retire 2031 Replace w/ Nat. Gas	-	-	-	-	-	-	2031 with Natural Gas Replacement	-	-	-	-

APS actively considers RPAC feedback when developing portfolios and cases.

- Representative RPAC Case

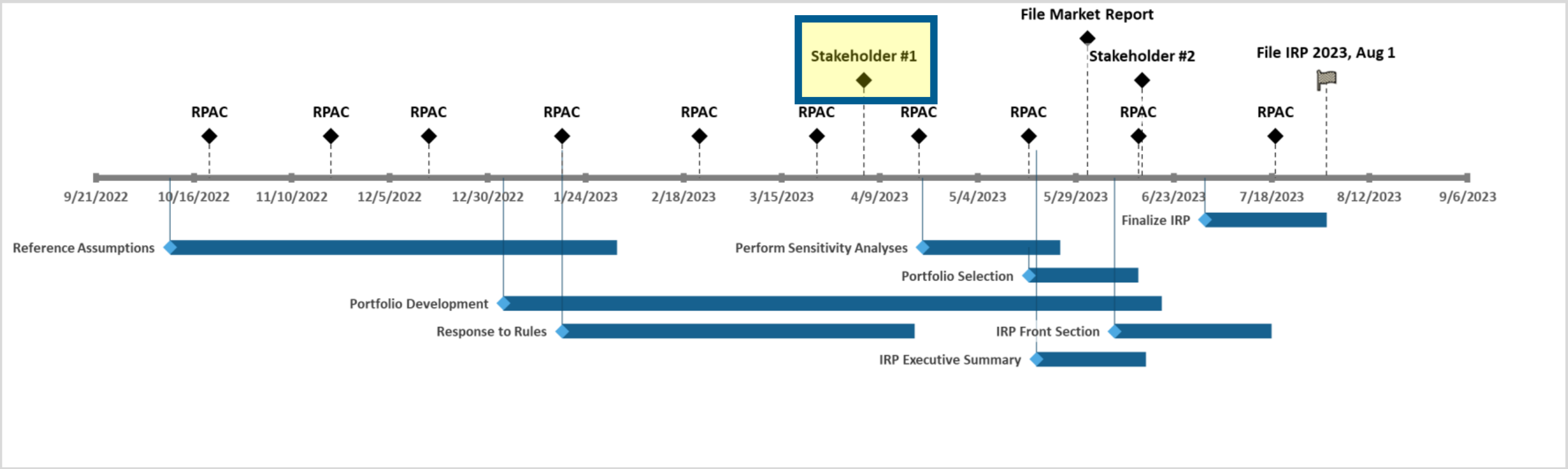
Factors considered by APS that align or are adjacent to RPAC feedback

Portfolio Name	Load Forecast	Gas Prices	Carbon Tax	Technology Cost	APS CEC and RPS Targets Included	Coal Dispatch	Four Corners Retirement	Storage Constraint	New Natural Gas	EE Constraint	Demand-Side Resource Constraint
Reference	Base	Base	Base	Base	Yes	Base	2031	<=25% of Peak Load + Peak Reserves though 2027	N/A	N/A	N/A
RPAC Load Sensitivity*	RPAC Load Forecast	↑	-	-	-	-	↓	↑	-	-	-

*Representative of potential case that can be adjusted based on RPAC feedback. Does not reflect a case that has already been created by APS.

Looking Ahead… Public IRP Stakeholder Meeting

- Date: Friday, April 7th
- Time: 9:00a-11:30a AZ Time
- Purpose: Provide updates and insights into the IRP process in addition to what has been discussed during RPAC meetings.
- **Teams broadcast link will be shared with stakeholders at later date.**



Discussion & Questions

Next Steps