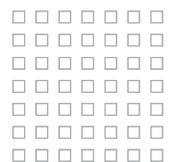


Meeting Objectives

- Recap the February RPAC meeting and provide status of previous action items.
- Provide perspective on IRP practices utilized by Utilities nationwide.
- Describe factors that can influence reliability planning and resource adequacy.
- Present RPAC IRP survey results.
- Highlight the cases being developed for the 2023 IRP.

Meeting Subject: February RPAC Meeting
 Meeting Date: 03/24/2023
 Start Time: 09:00am
 End Time: 12:00pm
 Location: Virtual

Attendees	Organization	Title/Role
Tara Beske	APS	Business Advisor, Resource Management
Yessica Del Rincon	APS	Communications Consultant
Sage Dillion	APS	Manager, Strategic Communication
Michael Eugenis	APS	Manager, Resource Planning
Brent Goodrich	APS	Consultant, Stakeholder Communications
Justin Joiner	APS	Vice President, Resource Management
Todd Komaromy	APS	Director, Resource Planning
Sarah Noll	APS	Product Development & Strategy Leader
David Peterson	APS	Advisor, Corporate Strategy
Timothy Rusert	APS	Director, Fuel Procurement and Ops
Pamela Nicola	APS	Manager, ESG Policy
Evan Lipsitz	1898 & Co.	Consultant
Matthew Lind	1898 & Co.	Director of Resource Planning
Keaton Clark	1898 & Co.	Analyst
Chase Kilty	1898 & Co.	Consultant
Steve Jennings	AARP	Associate State Director
Luke Hutchison	ACC	Engineering Supervisor
Diane Brown	Arizona PIRG	Executive Director
Nick Schlag	E3	Partner
Michelle King	Holland & Hart	Partner, Public Utilities Attorney
Sam Johnston	Interwest Energy Alliance	Policy Manager





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Hari Gopalakrishnan	Mitsubishi Power	Lead Consultant, Market Intelligence
Nicole Hill	Nature Conservancy	AZ Thrives Program Lead
Amanda Ormond	Ormond Group LLC	Principal
Dugan Marieb	Pine Gate Renewables	Regulatory Associate
Jeffery Allmon	Pinnacle West	Senior Attorney
Aaron Schwartz	Rocky Mountain Institute	Senior Associate, Carbon-Free Electricity
Sandy Bahr	Sierra Club	Chapter Director
Alondra Regalado	Stratagen	Policy Analyst
Caryn Potter	SWEEP	Arizona Representative
Autumn Johnson	Tierra Strategy	CEO
Kate Bowman	Vote Solar	Regulatory Director
Alex Routhier	Western Resource Advocates	Senior Clean Energy Policy Analyst
Claire Michael	Wildfire	Director of Climate Equity

Matt Lind (1898 & Co./Director of Resource Planning) – Introduction / Updated Meeting Guidelines / February RPAC Recap

- **Slide 4 – Following Up**
 - Comment – RPAC Member: On action items, I think we need to talk about Aurora, the NDAs, and general timeline.
 - Response – Matt Lind: We will follow up on this at the end of the meeting. We will document the question on Aurora licenses and the NDAs. We do have a slide on the timeline in the IRP Update section.
- **Slide 5 – February Meeting Recap**
 - APS provided updates on the 2023 Load Forecast. Datacenters and large manufacturing customers are expected to be the major source of load growth. Energy sales and peak forecast are planned to increase overall with a slight decrease among residential and C&I in comparison to the 2020 IRP forecast.
 - APS shared an update to the 2022 RFP. Negotiations are underway and a new RFP will 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.

Aaron Schwartz (Rocky Mountain Institute/Senior Associate) – Perspectives on IRP Practices

- **Slide 8 – About RMI**
 - RMI is a 501(c)(3) non-profit organization.
 - RMI is working in four sectors being industry, mobility, buildings, and electricity. There are five locations that the work is focused on, Cities, China, India, Global South, and the USA.
 - RMI investigates what they believe to be market catalysts which are different options and levers that they believe have the potential to accelerate the energy transition across sectors. These include policy, finance, business models, data & transparency, technology, and education & capacity.



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- **Slide 9 - Key Resources: Reimagining Resource Planning & Power Planning to the People**
 - Most of the content is built from two publications that RMI recently completed. These reports can be found on the website: <https://rmi.org/insight/reimagining-resource-planning/>
 - In the report, RMI cataloged over fifty examples of planning innovations from throughout the country.
 - The report also discusses stakeholder driven modeling.
- **Slide 10- 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.
 - Major findings were the basics of how planning needs to change.
 - Deep dive on four IRPs
 - Analyzed how each tackled cutting edge of planning topics.
 - Emissions and climate goals
 - Economy-wide assumptions
 - Reliable and resilience
 - Identify leading examples and need to reimagine.
 - Identified major challenges with resource planning.
 - Reviewed regulation and identified enhancements in practice today.
 - Tested framework with peers and practitioners.
- **Slide 11 – 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.
- **Slide 12 – Utilities in most states do resource planning**
 - Across the nation there are different planning requirements for each state.
 - There is no one-size-fits-all approach to resource planning.
- **Slide 13 - IRPs must maintain three core qualities to be effective tools for utilities and regulators to evaluate resource decisions**
 - The IRP is transparent and well vetted, with stakeholder input.
 - 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.
 - 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.



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- **Slide 14 - It is important for utilities to consider each of these qualities in their resource planning**
 - 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.
 - When plans are comprehensive, utilities can adequately assess the value and risk of their potential future investments.
 - 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.
- **Slide 15 - 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
- **Slide 16 - It's time to reimagine resource planning to ensure these new expectations don't "break the camel's back."**
 - The new IRP expectations risk are like the straw that broke the camel's back.
- **Slide 17 - By ensuring utilities and regulators are proactively and repeatedly refining IRP purpose, scope, roles, and tools**
 - RMI wants to help utilities reimagine IRP's by helping equip the right tools to help in the planning process.
- **Slide 18 - RMI has identified several options to enhance resource planning practices to make them more comprehensive, trusted, and aligned**
 - Meaningfully engaging stakeholders
 - Using all-source solicitations in planning
 - Updating approaches to planning for reliability
- **Slide 19 - 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, and Implementation.
- **Slide 20 - Options for meaningfully engaging stakeholders**
 - Define how to engage stakeholders before and during plan development.
 - Create a dedicated IRP advisory group.
 - Document how stakeholders influenced the plan.
 - Reduce barriers to participation.
- **Slide 21 - Options for using all-source solicitation in planning**
 - Use all source solicitation results to inform planning.
 - Use the planning process to structure an all-source solicitation.
- **Slide 22 - Options for updating reliability modeling throughout the IRP process**
 - Redefine the goals and metrics for assessing reliability in an IRP.

- Analyze the impacts of reliability threatening scenarios, including those exacerbated by climate change.
- Understand regional reliability needs.
- Improve alignment between portfolio optimization models and reliability analysis.
- **Slide 23 - The IRA can impact resource planning by lowering clean energy costs, driving electrification and EE, lowering costs associated with fossil transition, 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.
- **Slide 24 – Thank You**
 - Question – RPAC Member: This was not on your list to speak about today, but I am wondering about the equity and environmental justice focus groups and how effective that was in helping utilities to develop more equity-centered plans or if they resulted in any changes at all.
 - Response – Aaron Schwartz: This process is still ongoing. I think the jury is out on how it will ultimately be integrated into the resource plans and incorporated. One of the colleagues on my team helps facilitate some of these conversations in developing this advisory group. I'm happy to connect you with her if you have specific questions about the process, she was truly embedded in this, and I think she would have some great perspective on how she sees this moving forward and some of the potential ways that it will be integrated.
 - Question – RPAC Member: My question is about IRA. I feel like we hear a lot that the utilities and whomever else should look at the IRA and consider the IRA and the IRP and people should avail themselves of all these benefits of the IRA. I'm wondering if all the guidance has come out for how IRA is going to be implemented and if so, how are folks doing that and do you have an update on that timeline? We don't have all the regulations around IRA so how do we put it in a pending IRP that's got to be filed within the next few months?
 - Response – Aaron Schwartz: There is a lot that is already established in the legislation. For example, one area I'm familiar with, there is still this depending rulemaking that has to do with rural cooperatives and securing some funding from USDA there. There has been some great thought leadership from my team and other organizations on current opportunities to bring IRA into planning so I can find some of those and I'm happy to share those with you as well. That is a great point. I think there are still several areas where guidance is still forthcoming, but I also think there are a lot of areas where the folks can start integrating those assumptions right now. I will find a few resources that RMI has developed to share with the RPAC.
 - Question – RPAC Member: Could APS comment on that too? Is APS finding that they have enough information to meaningfully include that in this IRP or is there still enough outstanding that it is hard to include in any way beyond the qualitative analysis?
 - Response – Todd Komaromy: Guidance on the IRA still trickling out and it would be very helpful if we had all of those answers, but we are intending to incorporate the IRA in a way that is more than just qualitative. It is going to be embedded in our quantitative analysis to the extent we can make assumptions based on what is already out there.
 - Comment – Matt Lind: I think an example of the quantitative impact of the IRA would be a resource solicitation pre and post IRA. There is some movement. Developers are providing costs based on a certain set of assumptions and it may be valuable to go back to ask for updated numbers. An example would be that there are now tax credits for standalone



storage resources and that will impact cost. Going back to ask developers for updated numbers would be an example of how you include the quantitative impact of the IRA.

- Comment – Todd Komaromy: That is true for the whole process in general, the IRP helps you set a course for your RFPs and your RFPs are when you have those independent or very specific discussions on a case-by-case basis, and that is where those final answers really come through.
- Comment – RPAC Member: Part of the point of having RMI present is for other members of the RPAC. When they presented to the TEP RPAC or TEP, they sent out some supplemental materials when they followed up with the RPAC participants. I think that would be helpful to do this time to make sure that everybody on the APS RPAC has the slides and a link to the report.
- Response – Todd Komaromy: We put them in the chat, but we can send those same links out to the RPAC at large. There will be other notifications coming out too and you will hear about them later in the presentation.

Nick Schlag (E3/Partner) – Reliability Planning for APS

- **Slide 28 – 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 risk associated with individual resources.
 - Best practices for reliability planning continue to evolve but remain rooted in loss of load probability modeling to capture resource’s capabilities and imperfections and variability in energy demand.
- **Slide 29 – 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.
- **Slide 30 – Many Uncertainties Pose Risk 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.



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- Renewable variability
 - Variable resources (wind and solar) cannot always produce consistently; 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 possibly 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 stated above are likely to be exacerbated as the climate continues to change. Uncertainty around climate impacts also magnifies uncertainty around reliability outcomes.
- Slide 31 – 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 electric 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.
- Slide 32 – By 2025, the principal resource adequacy challenge in the Southwest is the evening “net peak”
 - With increasing penetration of solar resource, 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.
 - Question – RPAC Member: I feel like the utilities are a little bit reluctant to modify their TOU because it gets confusing for customers, but I think based on what you are showing, that is going to be essential going forward. I would encourage APS to be proactive in rate cases. Looking ahead, if they are every three years that will put us in 2026 and you are saying there is already going to be an issue. It is not just adding new resources, it is also managing demand. My next point, you mentioned that it is not about managing peak demand anymore, and I'm confused by the comment. I think it might just be a semantics issue and the technical definition of peak versus how I'm thinking about it. When I think about it, I think of it as a lot of people wanting to use power at a specific time, which may or may not be your historical highest usage hour. For California, my recollection for 2020 is that that was an extremely unusually hot period for California. For Texas, it was an extremely cold one. In my mind, when we are still thinking about how to keep the lights on, it is about how to deal with an immense amount of load at a given time, usually because of an extreme weather condition. To me, this highlights the fact that continuing to use fossil fuels is going to continue to contribute to extreme weather events that make it harder and harder to keep the lights on, and this is a circular kind of problem. I appreciate you saying that that the gas and solar outages were both equally 10% in the September event that you were referencing, I heard NERC present at an SRP meeting, and they presented it in a sense that renewables have greater percentage or more outages or more reliability incidences. I do not know if you have data to support that, but it sounds like you are saying that, at least in some examples that you are pulling that they are very comparable.



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- Response – Nick Schlag: I'm not going to touch on the TOU one specifically. I feel like that was a comment more addressed to APS, but I think it is a fair observation to note that this is as important to think about the load management side as it is about the resource side. With respect to it is not only about planning for peak, I think this is slightly of an oversimplification, but it has become a common refrain among many who are calling for innovation in how we think about or plan for reliability. If we drew a load summary for August, like the September 2022 event, this would look very similar in terms of the type of event that we had when we experienced rotating outages in California. I think in this example, you are right, extreme weather drives high loads across the day, but the notion that it is not only about the peak here would apply to the fact that when the California system experienced the outages that it did it was not during the 4:00pm - 5:00pm period, where demand for electricity was the highest on that day. It was during the 7:00pm – 9:00pm period when demand was still relatively high, but the solar had naturally gone down due to the sunset. The greatest strain on the grid was not the true peak demand, it was the net peak demand, load minus renewables. I will talk a little bit about your comment on with respect to the outage rates on renewables, I was not on the SRP call that you referenced so I do not have the full context of what the gentleman from NERC said on that call. I would say, our position is that it is important to account for the outage risks that are associated with all resources and whatever factors could contribute to those resources not being available at a given time, particularly during strains to reliability. We have not done a lot of research specifically on the outage rates for renewables, but largely speaking, the way that I see it is renewable outages as being meteorologically driven in the sense that solar is not going to produce at night and thereby that is what creates this challenging net peak period for reliability planning. We do know a lot more about outage rates for natural gas, we have a lot of historical data on that. The outage rates on storage remain a major uncertainty in planning just because there is not very much of a historical library to draw from there. But the more that becomes available through real data like what we have been able to get from California in its recent experience, our position would be that it all should be considered as much as possible within the modeling that leads to inputs to the IRP.
- **Slide 33 – 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:
 - Technologies available today can enable significant progress towards ambitious state and utility clean energy objectives.
 - A technology-neutral approach to planning and procurement will enable utilities to meet reliability and clean energy goals most affordably.
 - 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)
- **Slide 34 – Each Resource Has Different Capabilities**
 - Demand response and energy storage are useful to lean on but there just is not much to count on. This is where firm resources play a really important role in maintaining reliability.
- **Slide 36 – Renewables and storage provide valuable energy and capacity, but existing conventional resources are essential for reliability**
 - Reliability planning focuses on meeting demand during the most stressful hours of the year.



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- Meeting clean energy objectives will depend on how much clean energy can be produced over the course of the year.
- Question – RPAC Member: What does flexible natural gas mean? Does that just mean CTs? I have heard that, and SRP has started saying that a lot and it sounds like a buzzword, but I assume we are talking about CTs. Could you just clarify?
- Response – Nick Schlag: In the context of what I was presenting in terms of flexible natural gas, all I meant to convey with that was a resource that could turn on when you need it and turn off when you do not need it. The ability to turn off when you do not need it is crucial so that you can take that resource off the system when you have the clean energy resources such as wind and solar available to deliver zero marginal cost carbon free energy to the system. As soon as you do need those resources you can turn them back on. I was not necessarily meaning to imply any specific gas technology with that comment, just the notion that gas as an overall category is more flexible than a resource like coal or nuclear, those are much harder to turn on or off over time.
- Question – RPAC Member: Just curious on the 2033 section of the graph and why the natural gas seems to be as high if not higher than previous years knowing that it will be used in those hours? I guess the goal in a lot of places is to use as many renewables as possible, and you would expect that gas number to go down. Is that just because of the increased load you expect or does that mean there is a lot of curtailment of that large bar of solar? I was just curious of your thoughts here.
- Response – Nick Schlag: This is based on the collective plans of the utilities across the states of Arizona and New Mexico. At the moment in time when we did this study, those utilities each have collective clean energy goals, which are not all the same and may lead individual utilities to a different underlying fuel mix. Some of the gas that you see there you might attribute to the fact that load is growing and is expected to grow rapidly within the region and at the same time a lot of the coal resources are retiring. You can see the coal bar shrinking dramatically on each chart 2021, 2025, and 2033. Some of it you might think of as natural gas to coal replacement, but you can see the biggest change here is largely the growth in renewables as energy resources. An important finding from our study is that most additions to the system that we see most utilities planning for are largely these clean energy resources that are going to really help to transform the fuel mix on an energy basis.
- Question – RPAC Member: Historically the peak day or even the peak hour of the year has been quite predictable and as resources are changing, the climate is affecting load and we are seeing a situation now where the risk of outages is maybe at a different time of day or different season than it had been. We have these few short hours of the year where the risk is concentrated, but it is perhaps more unpredictable. My question is, it seems like flexibility to be able to meet that peak need when it happens is an important characteristic and you have presented firm resources as a category, but it seems like within that category of firm resources, one of the things that is important is flexibility. A firm resource that takes a whole day to ramp up is not as valuable to you in that peak summer, spring, fall, or winter hour as something that is available much more quickly. I'm just wondering how you think about that category of firm resources and the variety of resources within it and their ability to offer that flexibility to meet changing or maybe unforeseen circumstances. Especially as we continue to see the timing and duration of peak load change over time going forward. My second question, there are a lot of fossil resources on the system currently that are not as flexible as new resources that are being built and you showed here a lot of the coal resources are retiring, but there is variability within gas resources as well in terms of how quickly they can meet that peak. How are you thinking about what that means for transitioning to cleaner resources when you do still have those older, less flexible resources on the system?



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- Response – Nick Schlag: In response to your first point around firm resources being different. I think that is true within any of the categories of resources that we define when we introduced this notion of diversity, the low-cost clean energy resources, the balancing resources, and the firm resources within each of those categories include a range in terms of performance capabilities and the cost of those resources. This gets a little bit broader than just this question of reliability, but it gets to some of the economic trade-offs between different types of resources and how that plays into the overall portfolio planning. It is the type of question I would say that capacity expansion models are designed to answer in the sense that you throw all your options into a single tool and that model can explicitly evaluate trade-offs between flexibility and cost. I think it is a valid point. It gets a little bit broader in scope than just this focus on reliability because it really gets to the economic trade-offs that exist within all different types of resources. Trying to also remember the spirit of your second comment regarding the different levels of flexibility among existing resources. I think you hit upon what I would say is the most important point, which is that the least flexible of those resources, generally the coal ones, are already being planned to be removed from the system. Certainly within the category of natural gas, there is a diversity in terms of operating characteristics, but by and large, I think our understanding is that most natural gas generators, regardless of whether they are combustion turbines or combined cycles, have quite a bit more flexibility in terms of commitment and ramping capability than a lot of the older coal resources that we are seeing exit the system.
- Response – RPAC Member: It feels like firm resources are often talked about as if they are a single category and I'm not saying in your presentation specifically. There is this assumption that the firm resources are reliable when you need them. I think it is helpful that you have pointed out that there is an economic trade off to building resources. There may be situations where it does make sense to build a resource or keep a resource online that is only used a few hours of the year for that reliability benefit. There are also situations where the economic trade off starts to get very expensive. I think that is an interesting phenomenon that is going to become important to understand.
- Question – RPAC Member: This is a question for APS, are you doing capacity expansion modeling? My recollection is some people use Aurora for that and some people do not. It would be helpful if you could remind me if that's your intention.
- Response – Todd Komaromy: It is an early segway, but you are going to hear about that a little bit more in Mike's presentation, but the answer is yes, we are going to be using Aurora's long term capacity expansion model.
- Question – RPAC Member: I'm curious to get your perspective and how E3 is looking at other types of DSM resources and their impact on reliability. It is important to consider and include the capacity avoidance from demand response, but because that is a very different type of DSM resource in terms of its impact on load shaping for capacity in comparison to energy efficiency, I'm curious how you all are looking at energy efficiency as a capacity resource since it does have a cumulative impact on capacity avoidance over time. It has a significant impact even during peak and especially on different specific measures. I'm curious how you are looking at that and how that played into the resource adequacy analysis that you did for the southwest.
- Response – Nick Schlag: I would say that anytime we do a resource adequacy study we want to build into our assumptions around the load. Plans or expectations for all the DSM and energy efficiency programs that may be present in the system. In the context of what we did here in the Southwest, we made sure to work with the utilities to build a load forecast that not only represents the total demand for energy that they expect within their portfolios or their systems, but also what future impacts do they expect from their DSM program. Ultimately, it is very important in



any adequacy analysis to make sure that your load shape and your assumptions around load do incorporate those DSM impacts because you are right, making sure that those are there helps you make sure you have got the right amount of generation capacity on the other side of the equation. In this specific work, it was not really within our scope to evaluate additional DSM resources or efficiency resources beyond what the utilities were considering at the time. Anytime you are thinking about additional energy efficiency, I would say that it is worthwhile to think of it in an analogous framework to how we think about generation capacity in the sense that for any load reduction, we should be measuring its impact in terms of kilowatts or megawatts of avoided capacity when we are thinking about cost effectiveness.

- **Slide 37 – Overview of Best Practices in Resource Adequacy Analysis**
 - Loss of load probability (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.
 - Factors that impact the amount of perfect capacity needed include load & weather variability, operating reserve needs.
 - ELCC measures a resource’s contribution to the system’s needs relative to perfect capacity, accounting for its limitations and constraints.
- **Slide 38 – ELCC Approximately Accounts for Each resource’s Capabilities and Imperfections**
 - ELCC creates a 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.
- **Slide 40 – 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.
 - Quantify the total resource need to satisfy the reliability target.
 - 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.
 - Question – RPAC Member: Have you tried to run any of your capacity expansion models using full chronology – 8760 chronology? That way you would not need to use the LOLP modeling. Have you considered that?
 - Response – Nick Schlag: It is something that we have considered. We have largely steered ourselves away from that in terms of capacity expansion modeling and the reason for that is that even with a full 8760 strip of generation and loads, you may be missing the conditions and the events that truly matter for reliability purposes. What I mean by that is we are planning the grid to something on the order of a one day and ten-year standard. In an average year, there



may be no risk to reliability in that system. You may not even surface an event so it is such a rare set of circumstances that defines the threshold of what is needed within reliability planning that even a single complete year may not adequately capture the strain or the conditions that you need to for the purposes of planning soundly for reliability.

- Response – RPAC Member: You can always run your capacity expansion to whatever horizon you want. Typically, we run till 2050 and we run on an 8760 granularity and the whole reason behind people using ELCC and LOLP is because they do not use chronology in their expansion. They basically use the load duration curve method and then you must give that ELCC parameter to intermittent resources, but you can overcome that if you run the full chronology. The problem is you are going run into computational complexity, but then there are mathematical ways around that.

Matt Lind (1898 & Co./Director of Resource Planning) – IRP Portfolios & RPAC Feedback

- Slide 43– 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?
- Slide 44 – Of the identified risk factors, which one is most important to you?
 - Comment – RPAC Member: I was really confused when I took the survey and admittedly, I was not at the last meeting because I had a conflict, and I went back and reviewed the slides, and I did not see explanations for what you meant by any of these things. When I'm doing a ranking of something that I do not necessarily know what you mean or how you are going to use it just arbitrarily getting made-up and I do not know if that was anyone else's reaction to the survey. I think I noted that in the survey, but I guess I would ask if we did this again in the future could there be some kind of explanation for what you mean by the terminology? I'm also curious if anyone else had that and if so, how is this going to be used since responses may or may not be well informed since there was no qualitative explanation for any of the terminology.
 - Response – Matt Lind: It is a bit of a balancing act with sharing the information and trying to get some feedback and we do recognize that to get effective feedback you have got to have a primer around what the information is that you are asking for feedback and the intention. As we think about portfolios, the IRP is going to consider a wide range of portfolios. Ultimately for APS to serve load, forecast to meet that load, to talk about a lot of the different issues that we have talked about across many of these meetings and without an exact blueprint for what it may look like. We are trying to get some feedback of what are important factors for you all that you think would be helpful in consideration of portfolios landing on what is a preferred path forward. We can look at things like cost and we compare the cost. We compared the net present value revenue requirement cost of portfolio A to portfolio B. Each of those could have their own unique building blocks of resources that make up that portfolio that serves load across the entire time horizon of the IRP, how do we compare those beyond just cost? If we think about moving different variables that could impact cost or other variables, how do how do we bring all that into the evaluation of these portfolios? Previous meetings we have presented some of these and there was a little bit of voice over of this discussion. It was not implicitly instructed in the slides and there was not an explicit blueprint of how these are going to be evaluated. We are coming into this with the fact that we want feedback, so here are things that we are thinking about to help tee up that thought process.



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- Response – RPAC Member: I would like to hear from some other folks, but I guess like for instance, how is a carbon tax different than state and federal policy? To me, we have no carbon tax, which would come from a change in state and federal policy. Some of these seem to overlap. What is power supply?
- Response – Matt Lind: I think we had diversity of technologies within the power supply. We have admittedly tried to simplify some of the labeling here to not have a bunch of words and trying to make this a bit more visual, but power supply is the different technology types that make up the power supply within the portfolio. Nuclear versus wind versus solar versus energy storage.
- Response – RPAC Member: Did anybody else on the RPAC find this confusing when you took the survey? Maybe I'm the only one.
- Comment – RPAC Member: When I took the survey, I was a little confused on some of the different categories and how you all define some of the differences between each of these categories. My bigger question for you is how you are hoping to utilize these survey responses to help mold and develop some of the portfolios and scenarios? That is the part that I was curious about. How you are using this because I think if we do this again having some definitions around this and including that in the survey could be helpful.
- Comment – RPAC Member: It would be helpful to know how you are going to use the survey before we take it.
- Comment – Todd Komaromy: There is no perfect survey and I think we knew that as we were helping inform the 1898 effort to solicit feedback and that is what we were trying to do here. We are trying to get some direction and you will hear more about this in the next segment of how this input has helped us chart a path forward in the IRP. This is just one of many tools that we have. We have been having good discussion and that helps to inform us of where we are landing in the IRP. So, if you will give us just a few slides here as Matt finishes up, I think Mike can help inform that question.
- Slide 45 – Are there other variables that you would like to see quantitatively or qualitatively measured/varied?
 - The RPAC identified various variables to consider in their survey responses including:
 - CO2 Emissions
 - Stranded Asset Risk
 - Rate Impacts and Financial Metrics
 - Renewable ELCC
 - Outage Correlation
 - DSM, EE, EV, and TOU rate impact
 - Tax Credit Utilization
- Slide 46 – Are there portfolios characteristics that could emphasize performance tradeoffs?
 - The RPAC identified portfolio characteristics to evaluate in the IRP process:
 - Federal Incentives to reduce tradeoffs.
 - Additional environmental considerations
 - Justice and equity
 - Resource Diversity
 - Avoided peak demand
 - Question – RPAC Member: How is this information going to be used?



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- Comment – Matt Lind: To talk a little on how APS is going to look at the different portfolios that are going to come out of the IRP process. The Commission has several different portfolios that are going to be looked at, as well as additional portfolios that will be looked at. As we look at those, how do we think about the effectiveness or the desirability of one portfolio versus another and how do we think about them and the different trade-offs between comparing costs versus comparing some of these other factors. Hearing this feedback, what we hope to do is to see how this marries up to how the evaluation process ultimately plays out. In the process, we are trying to make sure we are hearing that before the plane is built, so to speak. As the plane is being built right now, we are looking to see if there are any additional activities that can be done before it is all said and done. Overall, we are trying to capture and ask for feedback from you all.

Michael Eugenis (APS/ Manager, Resource Planning) – 2023 IRP Update

- Slide 49 – APS has developed multiple cases to evaluate uncertain assumptions.
 - The goal of the discussion is to walk through APS's thought process and where the RPAC can get involved.
 - The top three variables ranked in the results survey are evaluated in the robust approach of the IRP.
 - The reliability portion of this study has been covered well. Tools such as SERVM are insuring this analysis. The assumptions will be updated in the Aurora model to reflect the different sensitivities.
 - The Clean Energy Commitment is built into the LTCE model.
 - APS does not want to have a strong dependency based on one type of resource type.
 - Question – RPAC Member: I wanted to clarify, storage is not a single technology, and this is a 15-year plan. When you talk about constraints or different things going offline at the same time are you just talking about lithium-ion because that is the dominant technology today? And is this mostly applicable for the five-year action plan or are you saying that for the next 15 years, you are going to assume that there is one kind of storage technology?
 - Response – Michael Eugenis: No, we were very considerate of that when we thought about this constraint. It is only through 2027 and we fully acknowledge that there are going to be additional advancements in this area and that is going to ameliorate or assuage our concerns that we have with the technology that stands today. Right now, as we think about that time between today and 2027, lithium-ion is the predominant technology that we think is going to be installed on the system. We are also going to look at alternate technologies in the future as they mature.
 - Question – RPAC Member: I just want to make sure because it's a little unclear because the table is only filled in for the top row. Are you going to be doing these sensitivities for everything or it's just the reference case?
 - Response – Michael Eugenis: If you see a dash, it means there is no change in that assumption from the base case. What we look to capture here is the impact of these specific changes and then be able to compare them apples to apples. This allows us to see how that changes the resources that are picked by the LTCE modeling and then ultimately what the portfolio cost net out to be.
 - Question – RPAC Member: Some of the terms in here may mean different things to different people. I feel that it would be helpful, either now or as a follow-up, to know what the ranges are when you are talking about gas prices, technology costs, etc.
 - Response – Michael Eugenis: We will seek to provide that clarity as we move forward in this process. I wanted to get something in front of everyone today that showed the direction of these cases, but we will provide additional information on the specifics for each of these.



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- Question – RPAC Member: Talking about the no new gas case and looking at the cost impacts of that, I'm curious what your time horizon is on the cost impact? If the model tells you that you need to build a new gas plant in 2035, APS has zero carbon goals for the future, and you may be creating stranded assets if you are not looking at the correct time horizon on your cost impacts. I'm curious If it does tell you to build new gas, how are you ensuring that you are not creating a stranded asset by building gas in the in the last year of the plan?
- Response – Michael Eugenis: It is a 15-year time horizon that we are going to be looking at. The case will stretch out into future years and there is the potential that gas is selected in the later years because we are not going to be capturing the production cost modeling for the entire 2050 period as a part of this IRP. What is beneficial though is understanding the resources that the model picks during that period. We know that we are going to have additional information prior to when we are going to have to move forward on those resource choices. While the model will come up with what we think are the most economic resources during that period with the data today, that is not something that is going to immediately inform an RFP for that capacity. We utilize the IRP to inform the RFP process that we go through to get resources and we typically procure resources a handful of years into the future depending on the development timeframe of those new resources coming online. There is nothing that we are pursuing right now that would require us to make a commitment today for a 2035 resource.
- Slide 50 – Additional cases required by the commission will be included in the IRP evaluation.
 - There are a few cases that are required by the Commission through existing IRP rulings as well as the 2020 IRP.
 - There is a high demand side case that will ensure that energy efficiency will be greater than or equal to 1.5% of total energy sales demand for the first 10 years. Demand side resources will be greater than or equal to 35% of 2020 load by 2030.
 - There is an ACC mandated technology neutral case.
 - Two load cases are sale-based cases where the load is held beneath the sale target into the future.
 - The economic coal dispatch case is most significantly related to the modeling of Four Corners.
- Slide 51 – Four Corners coal operation exit date sensitivities will be analyzed in the 2023 IRP.
 - There is a lot of conversation regarding Four Corners. APS has elected to study the years 2027 through 2030 in addition to 2031.
 - APS creates cases that evaluate the coal exit at each of these years and how it affects the system.
 - The final case is exiting coal operation at Four Corners in 2031 and replacing it with natural gas.
- Slide 52 – APS actively considers RPAC feedback when developing portfolios and cases.
 - APS is committed to including the RPAC's feedback. This case covers some of the factors most interesting to the RPAC members.
 - This case will be based on RPAC member input and will be input and run in the LTCE software.
 - A lot of the cases have been limited to a single change. This is done to help analyze the impact associated with modifying the individual factors. For the RPAC input case, more than one factor can be manipulated.
 - Question – RPAC Member: Does this mean that there is going to be an RPAC specific portfolio or how do you see this playing out in the modeling?
 - Response – Michael Eugenis: Our intent is to be able to take something that is formed by the broader group's opinion and include it as part of our report.



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- Question – RPAC Member: When you call it RPAC load sensitivity does that harken back to 2021 or will it be an entirely new thing that we're starting from scratch?
- Response – Michael Eugenis: I would like to leverage the work that we have done in the past. I think that there was a ton of effort that went into that. I think the result is still valid and emblematic of what the broader group is interested in. The reason why I put that is because I think it would be wonderful for us to include that as part of the work in this particular case, and I'm also open to if there are other pieces of this that we would like to adjust.
- Question – RPAC Member: Will the August RFP be based on the 2023 IRP or the 2020 IRP?
- Response – Michael Eugenis: The upcoming RFP is going to be developed in the next couple of months. I do not think we are going to have any finalized results from the 2023 IRP effort by then. However, in the near term our needs are more defined and there is less variability in what I would anticipate the outcome of these cases to be. We will be leveraging any study work that we do have in informing that decision. There are many requirements that we need to address in this current RFP with the commission. The commission has asked to include things like a coal community addendum or call out in the RFP this year.
- Question – RPAC Member: Could you comment whether the RPAC will be reviewing the RFP before release like you did last time or are you using that same feedback for the new one?
- Response – Todd Komaromy: The intent is to step on the shoulders of the work that was accomplished during last year's process and then add any learnings that we have undergone throughout the process and bring that back to the RPAC and have them help out before the launch of the 2023 RFP.
- Question – RPAC Member: Given the pending rate case, does APS intend to consider as part of its resource planning process, any rate mitigation measures in its initial filing, and if not, do you intend to solicit the bids and then determine what rate impacts that might have from there and any subsequent rate mitigation measures on the tail end of that, or is the company going in with any sensitivity about rate mitigation?
- Response – Michael Eugenis: What do you mean by rate mitigation or what that might look like?
- Response – RPAC Member: In other jurisdictions I know that there are limitations on what the retail rate impact might be from a procurement in an electric resource plan. My thought was, would the company be amenable to considering that the net impact from rates, granted this has to do with over what course of time those rates are spread, but would the company be open to considering a not to exceed “X” percent increase on rates as a result of implementing that resource plan?
- Response – Michael Eugenis: As we approach the IRP and the IRP planning process, we are trying to answer the question “what is the portfolio of resources that is necessary in the future to maintain reliability for our customers?”. We have numerous sensitivities around load and other constraints that we test for, but ultimately, we are searching for that least cost portfolio. There are least cost resource blends that are going to continue to meet the reliability constraints for our customers. The rate impact of that portfolio is not necessarily part of the scope of the IRP itself but if the modeling is determining the least cost portfolio that is available to us, or if these resources essentially represent the best way that we can spend customer money and invest customer money to maintain reliability, lower rate impacts are downstream of that implementation. The RFP process is when we have the most information when we are acquiring new resources and that is when you get to the point of comparing executable contracts with each other, and you have the best idea of what the price impacts of those executable contracts. The RFP provides you with the best insight into what is going to be the best way for us to invest those funds in the nearest term in the action window.



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- Question – RPAC Member: Can you share with me a little bit about APS's thinking of how it treats consideration of market activities in its resource planning process?
- Response – Michael Eugenis: We are part of a broader study effort to look at markets. APS is very engaged in what the potential benefits of markets are in the future as well as the governance structure associated with those markets and, ultimately, who are the participants and what will the value be that is brought by different participants into a broader market structure. There is dedicated study work that seeks to address that on an interconnection level basis. That look takes in information from all the impacted utilities, their loads, their planned resources, transmission impacts between those and better understands what the value and benefits of those market structures are going to be. On a quantitative basis within our cases that we have provided to you today, we are not going to address that piece of it because this is really focused on the APS balancing area and our native load. However, we will have a qualitative section that speaks to those benefits and to that study work in the IRP itself. That transition to a market structure is going to inform the resources that we pursue into the future and ultimately other investments that we make, whether it be in transmission, to enable a market into the future as well as maintaining a more regional resource adequacy perspective. To condense the answer back down, we do have study work that is going to address markets. We will have results from that study work or certainly discussion around that study work within the IRP. The cases that we are explicitly studying within my team are localized to the APS area.
- Question – RPAC Member: Is that study work done through the WRAP or within a different group?
- Response – Michael Eugenis: There are a couple components to it. There is both the WRAP component and a more regional study that looks at the day-ahead markets. WRAP is a component of that but not necessarily the same.

- **Slide 53 - Looking Ahead... Public IRP Stakeholder Meeting**
 - APS has been receiving NDAs over the last couple of weeks. We are still looking for a handful of NDAs, but APS is still very much getting ready to share the data and making sure that the data is in a good place before it is shared with the RPAC.
 - Comment – RPAC Member: My question is about the timing for Aurora and the NDAs. I'm increasingly concerned as your Gantt chart shows you all are picking your preferred portfolio in May, and it sounds like we are not going to have access to Aurora until the end of April. APS has known since February of 2022 that they need to provide the licenses to the stakeholders, and I'm concerned that the timing keeps slipping and from my perspective, the point of the modeling is that we can hopefully have a more informed discussion on the preferred portfolio. If we are not going to get into the Aurora modeling until May and we do not even have the training until the end of April, I think it defeats the purpose of having it. I would like you to comment on why that is taking so long and if there is room to push back the preferred portfolio conversation so that we can have a little bit more of an informed discussion. Many of us are not resource planners and have not used Aurora before. I think the point is to make us more informed in the conversation. Secondly, if someone can comment on the NDA process, I'm really confused about this. Several of us are working with consultants to help us better understand the outputs from Aurora. I think it is unclear to me if just we need the NDA. Does the consultant need the NDA? Does anybody else sponsoring the study need the NDA? Where does the NDA line begin and end?
 - Response – Michael Eugenis: As far as the NDAs are concerned, we are having anybody who has access to the data that we are providing as part of the case sign an NDA. We are excluding developers from the NDA process and their ability



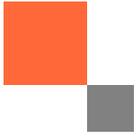
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to participate in the data and the modeling that we are providing because of a clear conflict of interest that it would result in. What is important for us is that we are able to protect contract information and ensure that our counterparties do not have additional risk from us sharing this information. The NDA should apply to those that are going to have access to data associated with modeling as well as results that will come from the model output.

- Comment – RPAC Member: Everyone is going to have access to results, right? Is that not the point of the portfolio analysis and what you are going to be filing? If you are going to be in Aurora and you are going to see the hard data and the inputs, then you need to sign the NDA. I just do not know if we are working with GRIDLAB or RMI or whomever and they are going to be putting together an analysis, where does the aggregation of the data end and the NDA no longer applies?
- Response – Michael Eugenis: We are providing aggregate data as part of all these different portfolios to everyone as part of the public IRP process. I do not know if I have a bright yellow line that I can share with you as far as what level of aggregation demarks when you do not have to have an NDA versus you do.
- Comment – Todd Komaromy: I think the answer is who is sharing the data? If we're providing it outwardly, then that is going to be the public facing data. Those that are part of the RPAC are the ones that get this special treatment and have access to the Aurora tool and the inputs as denoted by the commission. That is my best answer as far as the line, but we can talk more about it.
- Comment – Michael Eugenis: We are going to be revising and readjusting our timeline as we get further into this process to better account for where we are at and the progress that we have made so far. I would not expect the portfolio selection to be a hard date at this point and time. I anticipate that there is going to be flexibility in that going forward and we are very interested in feedback from the broader RPAC group. We realized that timeline is a concern and I share your concern on a deep level, even on our side of the house too.
- Comment – Todd Komaromy: On the broader stakeholder session, it has been listed on this timeline slide in previous sessions. We are filing that notification of when it is going to be, and I certainly would encourage anyone that would like to attend. We will be sending that direct link to the RPAC mail list that we have. I will say that most of the information is going to be things you have already heard. This is also going to have a bit of a primer on the process and then a lot of the information that this group has already been privy to, probably even a level up given we tend to go into more back and forth discussions with you all.
- Question – RPAC Member: When are you expecting entities that are conducting or gaining access to the model to sign the NDA? When are you expecting organizations to be able to present their results to the RPAC?
- Response – Todd Komaromy: We can talk more about that. It is a more life cycle of events based on when we get information. We can talk more about the best path forward there.
- Comment – RPAC Member: That would be great. Maybe it is a special meeting, or we can utilize one of the meetings that you already have scheduled on this timeline. If we can lock in what those dates look like for entities that are going to be doing that work, we can plan to get that ready for the rest of the RPAC.

Matt Lind (1898 & Co./Director of Resource Planning) – Next Steps

- Next RPAC meeting Friday, April 21st
 - Time: 9:00a-11:30am AZ Time
- Public Stakeholder meeting on Friday April 7th



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- Time: 9:00a-11:30am AZ Time

Action Items:

- Include update on Aurora licenses, NDAs, and general timeline of the IRP in the action items of the next RPAC meeting.
- Follow up to RPAC members with the links to RMI reports and key upcoming dates.