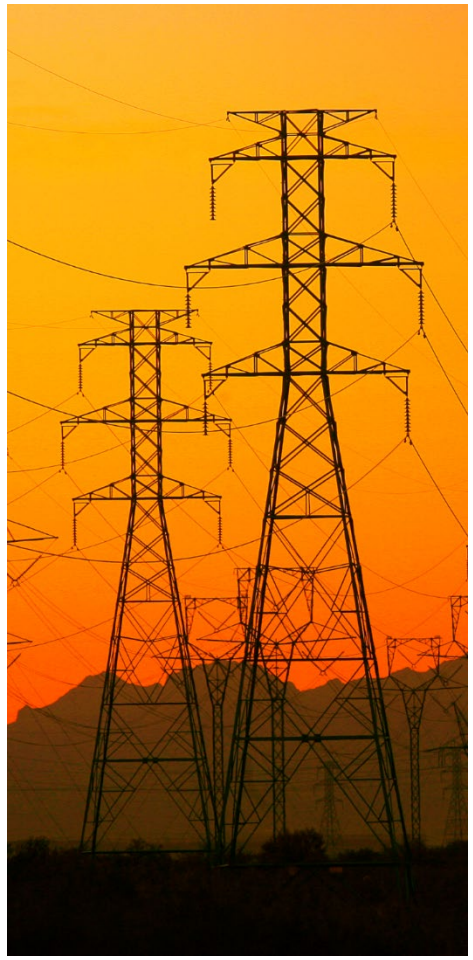
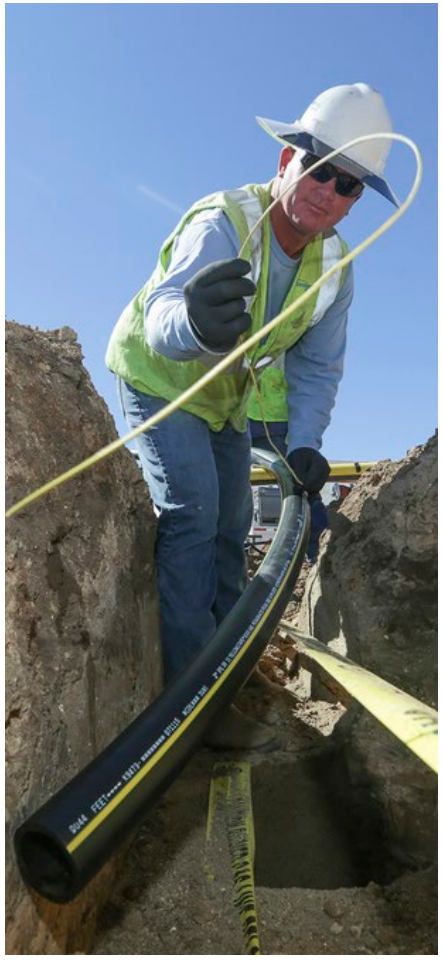
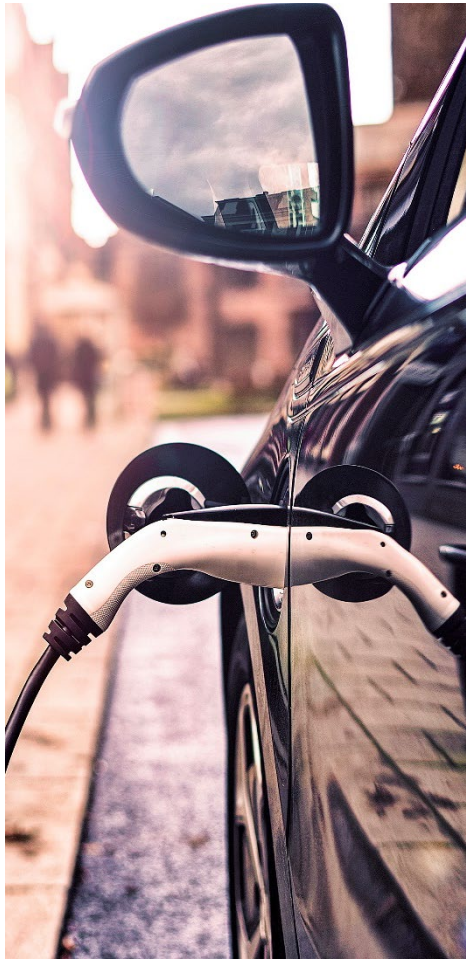





Tucson Electric Power

UniSource Energy SERVICES

Resource Planning Advisory Council Meeting

January 12, 2023

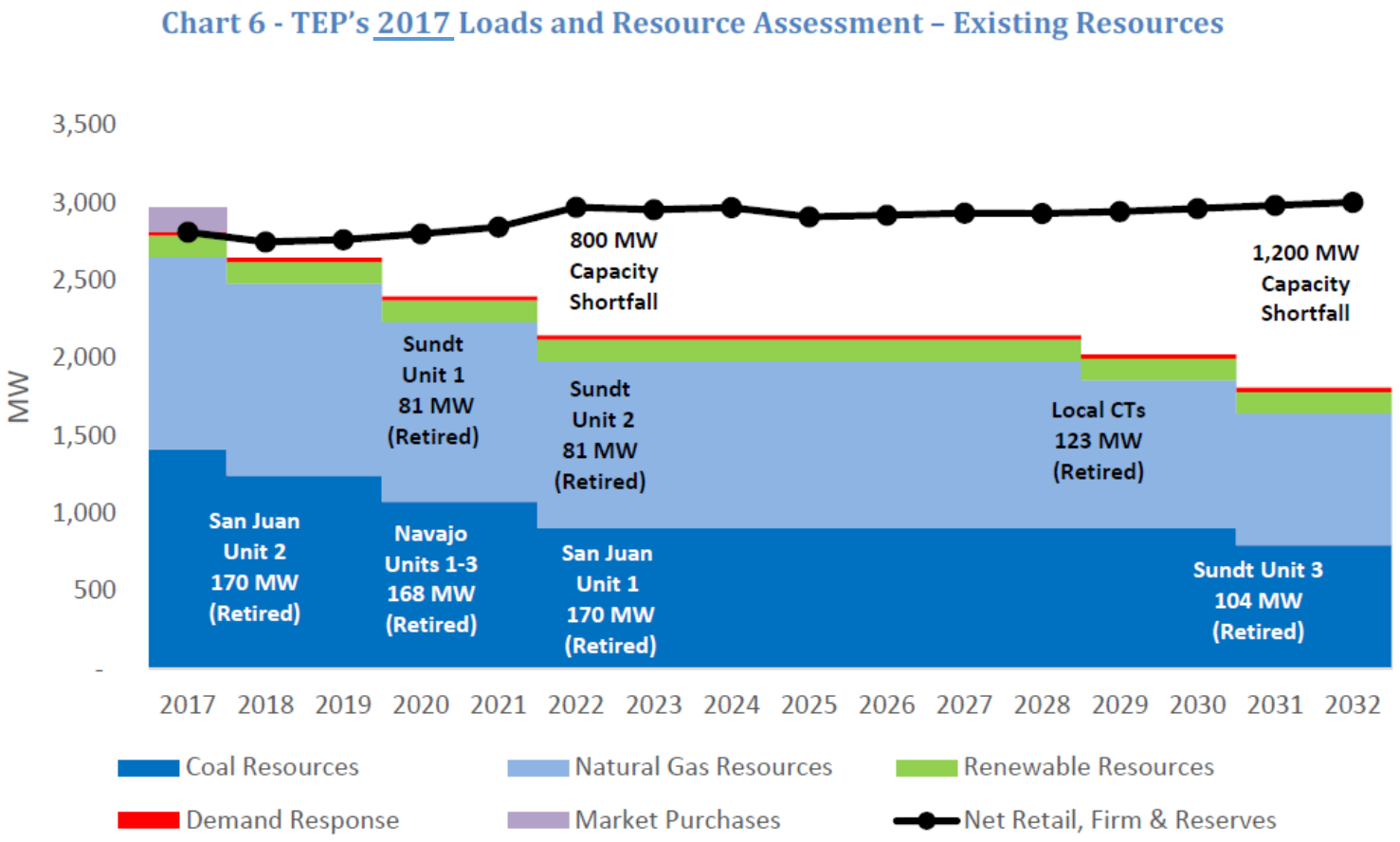
Logistics & Introductions

- Presenters will pause occasionally for clarifying questions
- Save in-depth comments and questions for discussion periods
- Raise your hand on Teams to provide comments / ask questions
- Only use chat box to report technical difficulties

Today's Agenda

- TEP and UNSE Load Forecasting (continued from 12/15/2022)
  - Current 15-year forecast and use in resource planning
  - Recap of methodology, major assumptions, and load drivers
  - Summary of plans for future forecasts and methodological updates
  - Options for creating future load scenarios
  - Q&A
- Portfolio Modeling
  - Overview of modeling software and analytical approach
  - Illustrative example of 100% clean
  - RPAC licensing options for software
  - Initial discussion of resource portfolios and scenarios that TEP/UNSE can evaluate
- Next Steps and Topics for Next Meeting

Load Forecasting for the IRP



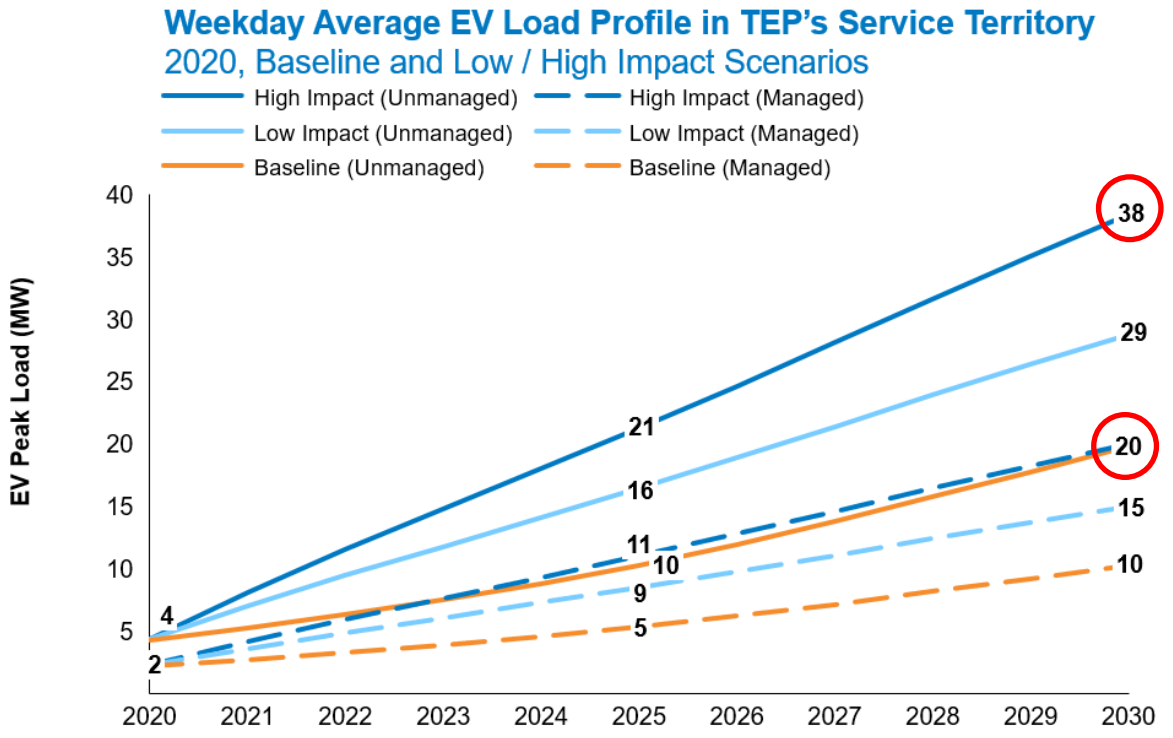
Traditionally:

- Resource planning focused on meeting annual peak demand with resources that were fully dispatchable and not energy-limited. If demand could be met at peak, it could be met at any time.
- At TEP and many other utilities, the peak was presumed to grow steadily, except for the occasional large, new industrial customer, as seen to the left in 2022.

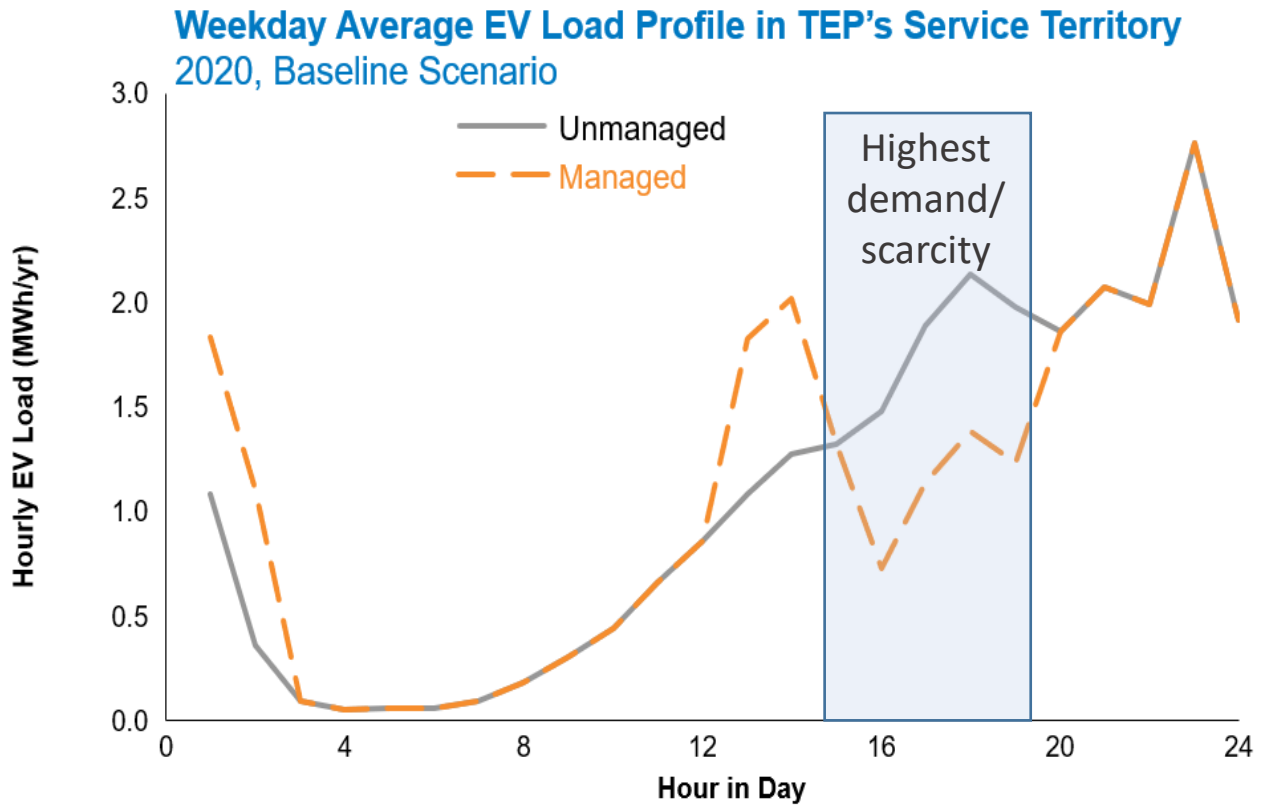
Looking Forward Today:

- Inquiries from large potential customers have proliferated, representing potentially 100s of MWs of peak "step-ups" at TEP.
- High rates of electrification can affect both the peak and the hourly load shape, adding new complexities to planning.

Load Forecasting for the IRP



Source: TEP EV 5-Yr Strategic Roadmap (2019)



Unmanaged: Natural shift of EV owners to time-of-use rates.

Managed: 40% of charging shifts outside TEP's peak demand period.

Forecast Methodology & Results

James Elliott, Dan Bache, Jesus Samaniego, Amanda Duron

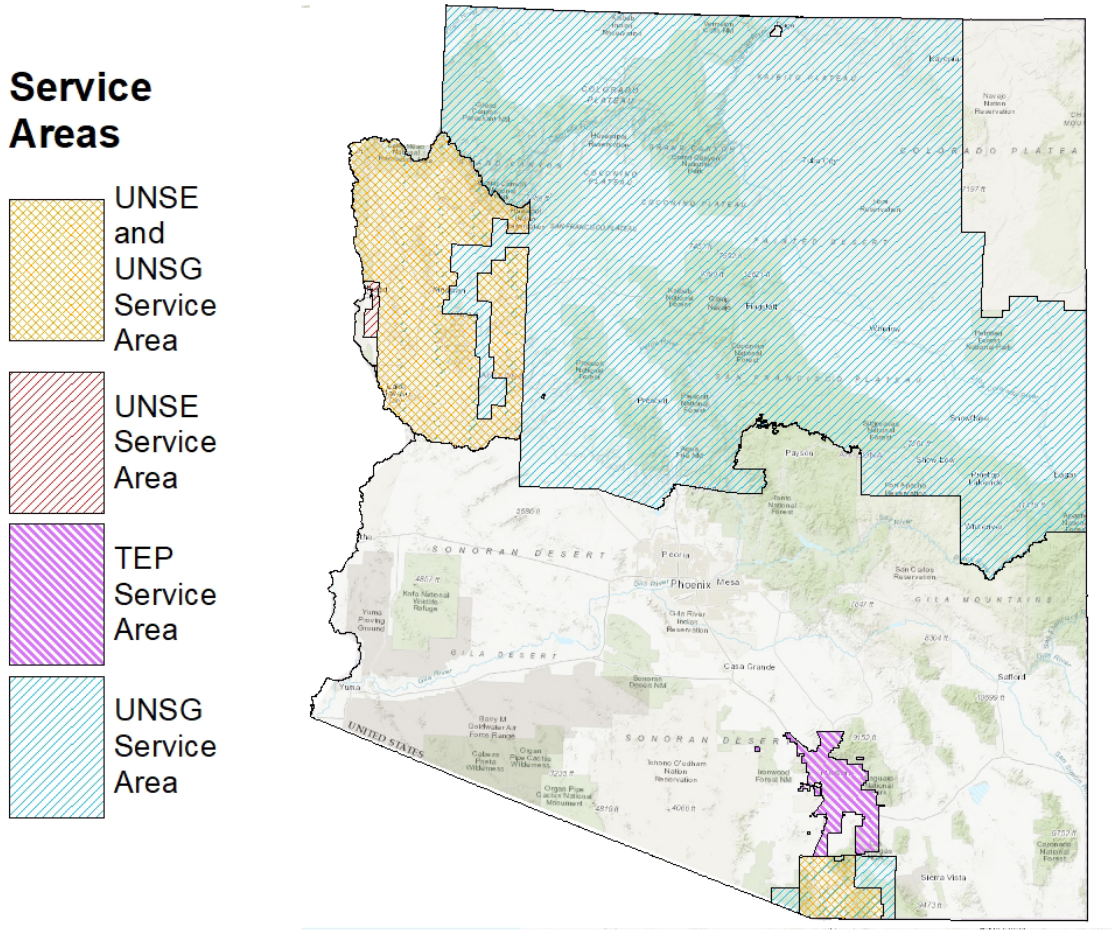
October 2022

UNS Energy Corporation
A Fortis Company

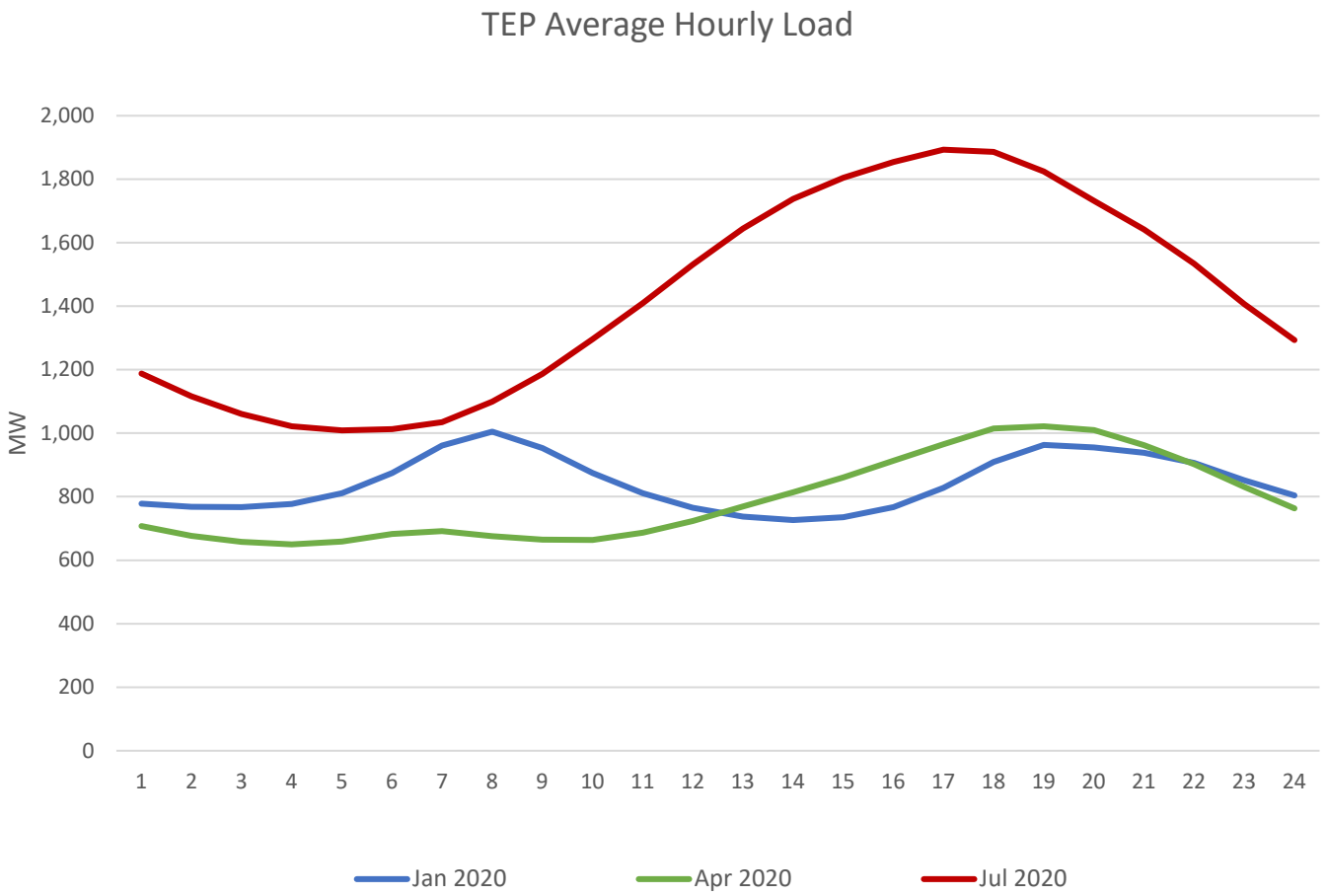
Confidential

Forecast Overview

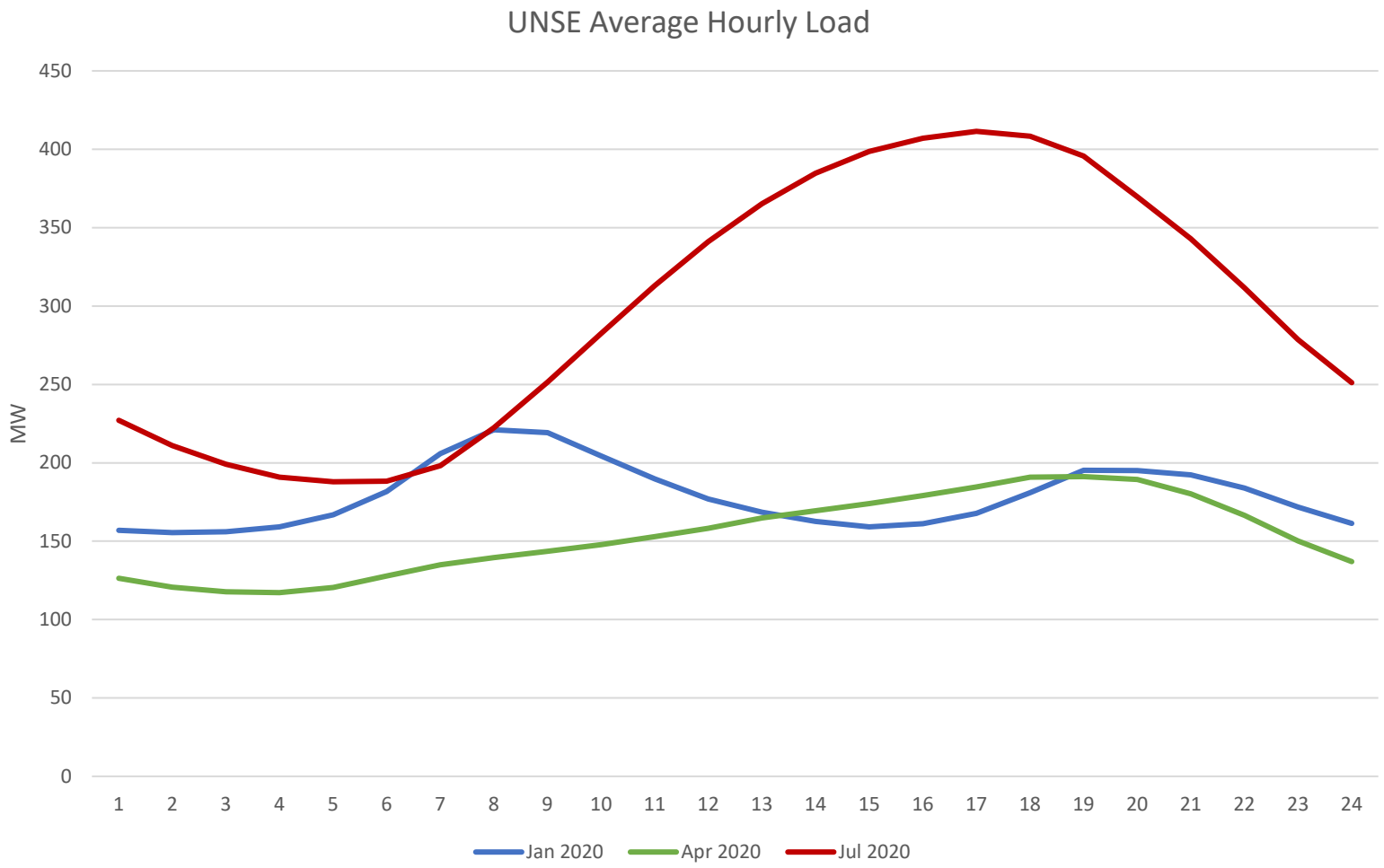
- TEP, UNSE, and UNSG Energy, Peak, Customer
  - 7 distinct geographical regions with different economies and weather
  - 3 Companies with different tariff structures and customer class definitions



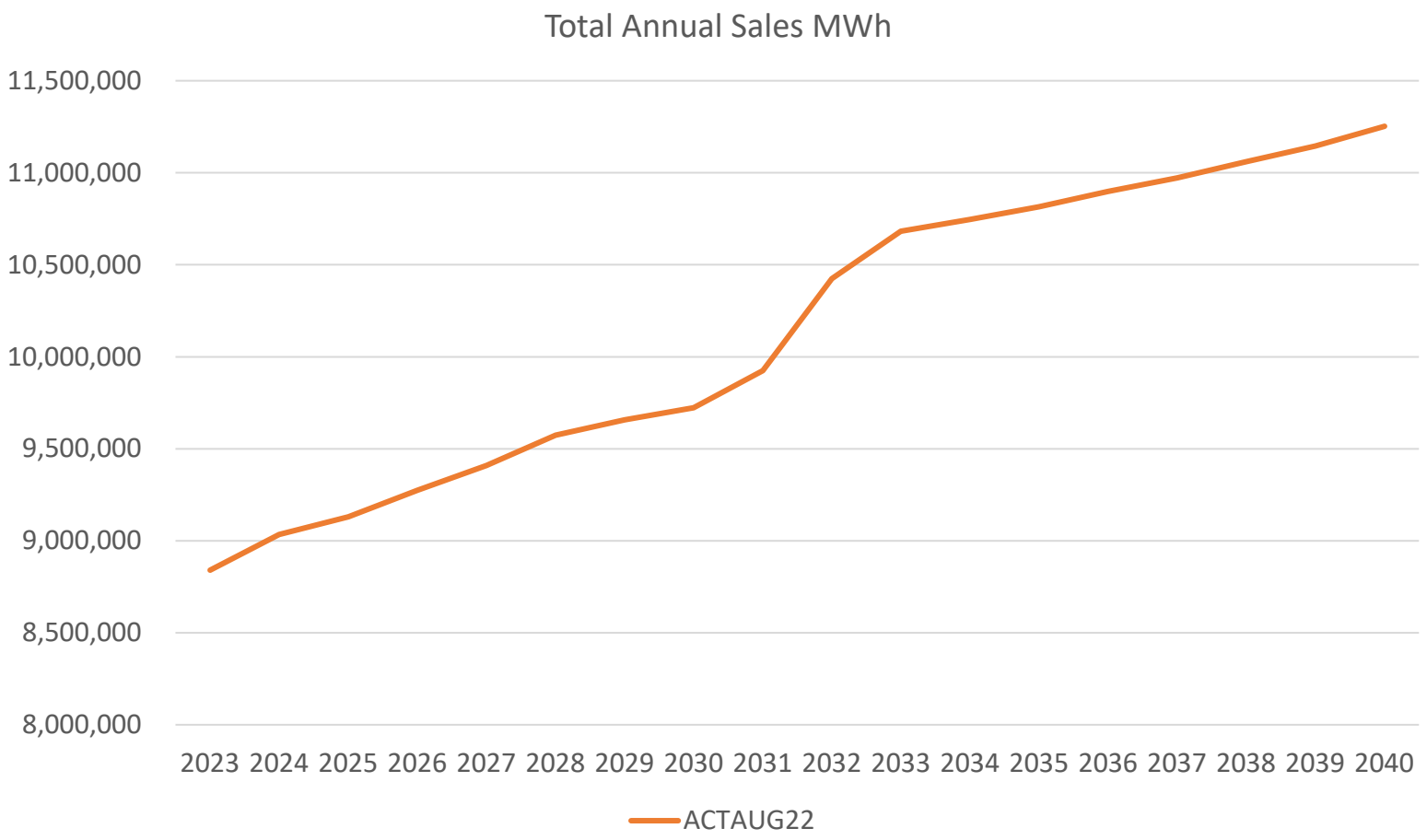
TEP Load Curves



UNSE Load Curves



TEP Total Sales



- Residential & Commercial Sales = UPC (Use per Customer) * Customer count
- Large customers modelled separately
- Incremental DG & DSM accounted for

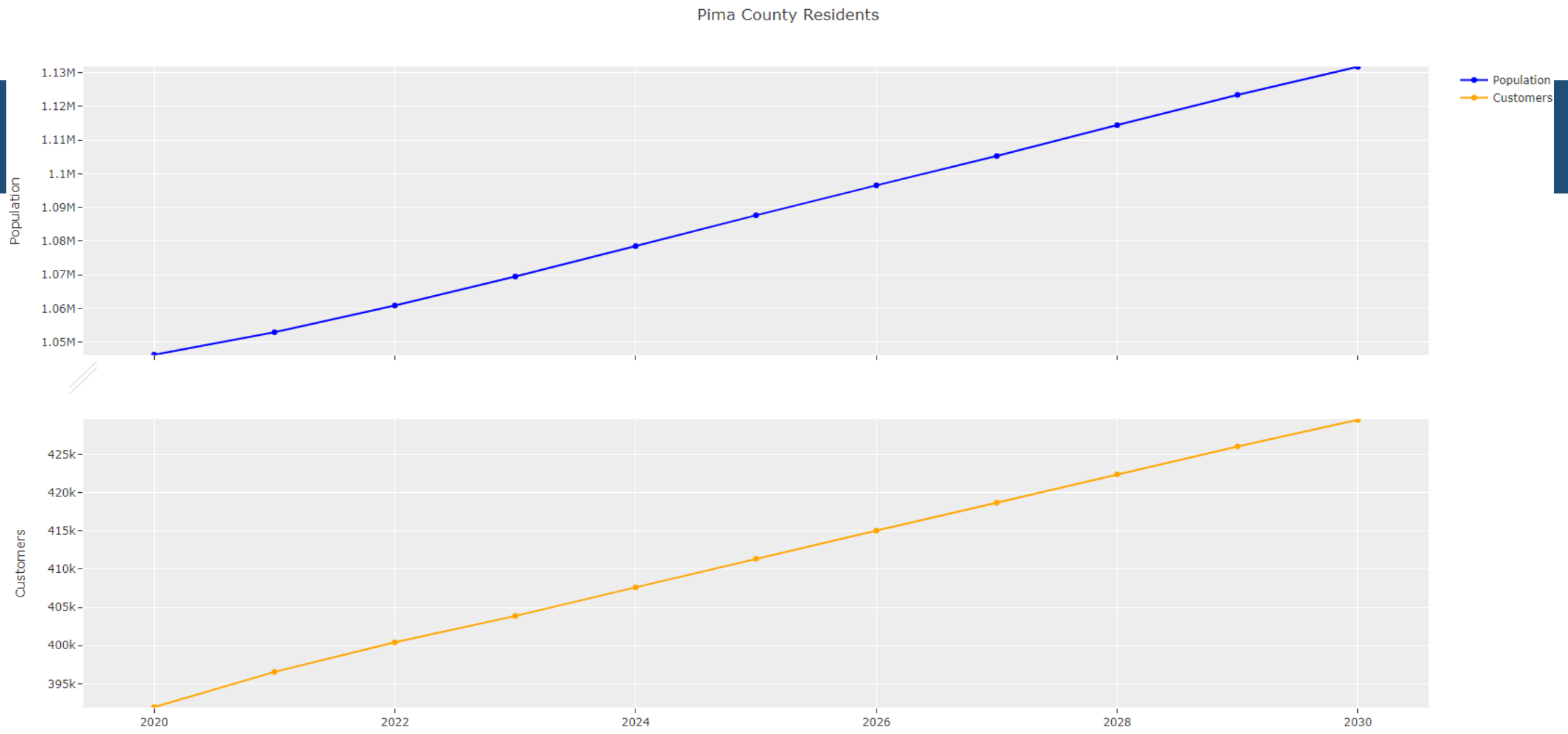
Model Drivers

- Customer Forecast:
  - The residential customer forecast is based on estimated Pima County population growth
  - Major sources are IHS Global Insight and the University of Arizona Forecasting Project
  - Commercial customer forecast is based on Pima population and residential customer forecast
- UPC:
  - UPC regressed on weather vars, employment, and real personal income
- DSM (Demand Side Management)
  - Guidehouse delivered annual DSM saving targets to match 1.3% of prior year sales
- DG (Distributed Solar Generation)
  - Econometric models used for installed capacity

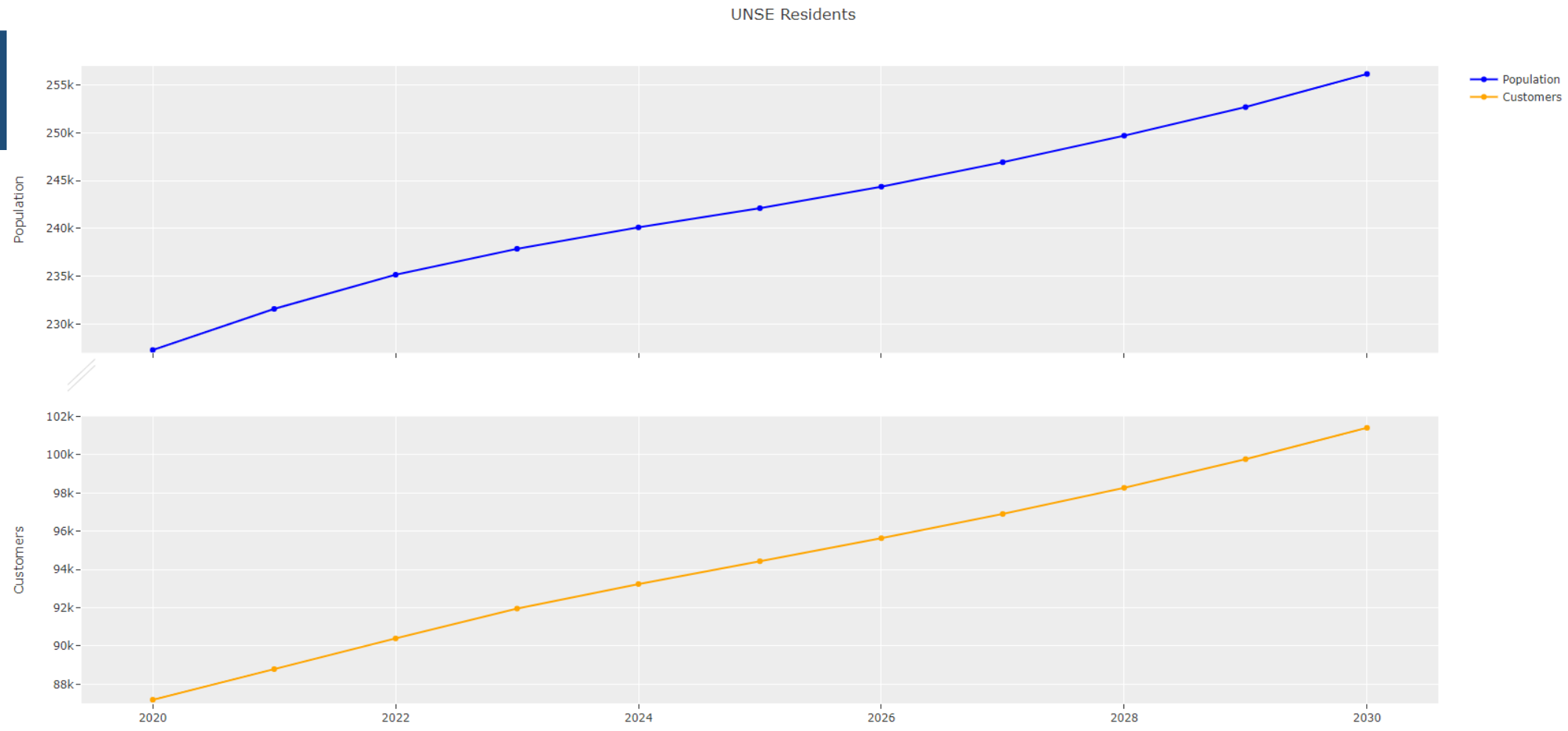
Model Drivers Continued

- Peak Forecast Methodology
  - The peak demand model is based on historical relationships between hourly load, weather, seasonal effects, and sales growth.
- EVs
  - Relies on various 3rd party forecasts to estimate EV penetration with adjustments to more closely reflect Pima county:
    - Vehicle turnover
    - Demographics
- Large Customers
  - Inputs include historic usage, customer-provided information, and internal company resources working closely with the individual customers

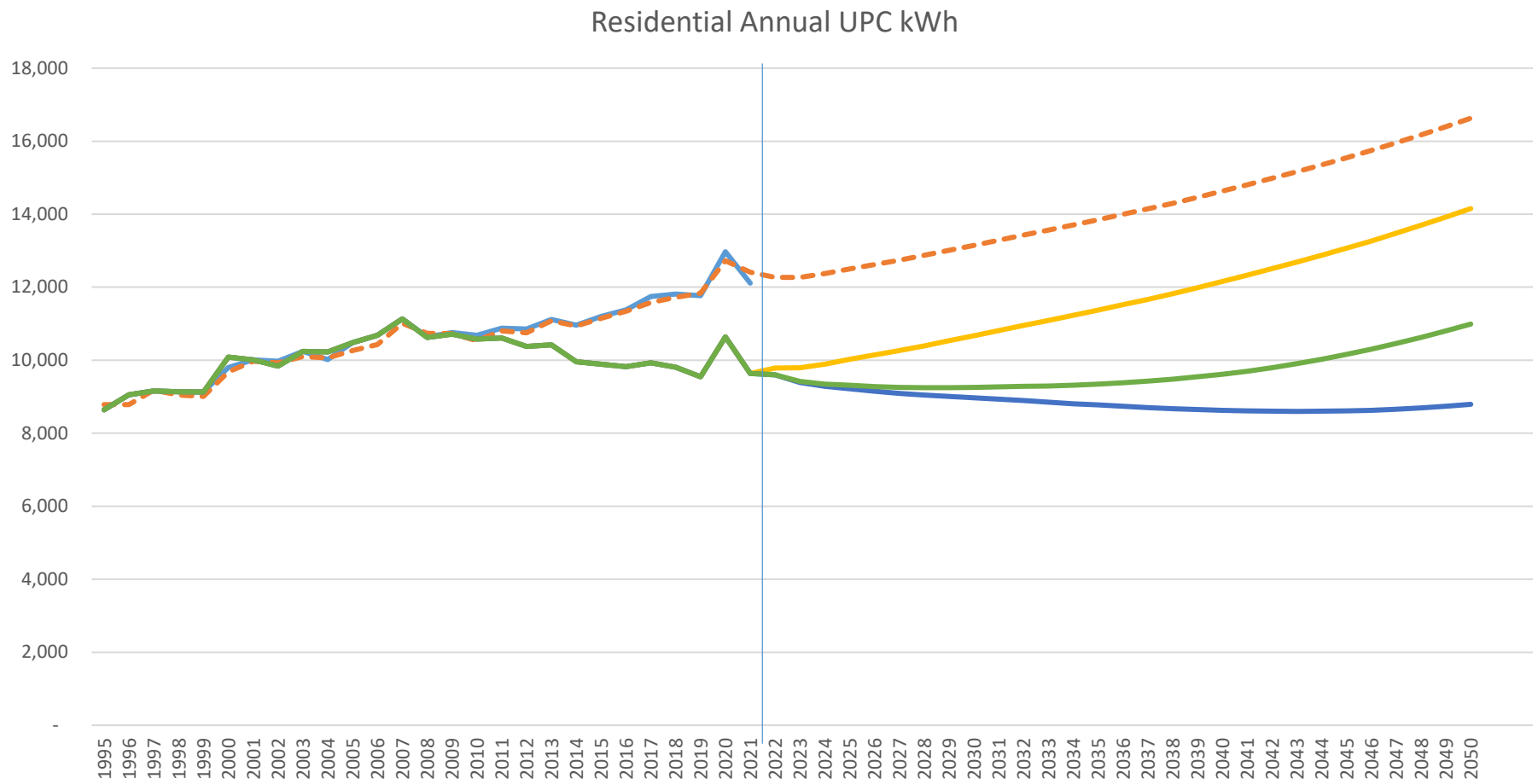
Population Growth Assumptions TEP



Population Growth Assumptions UNSE



Residential kWh UPC at Meter TEP



True BAU (No DG and DSM

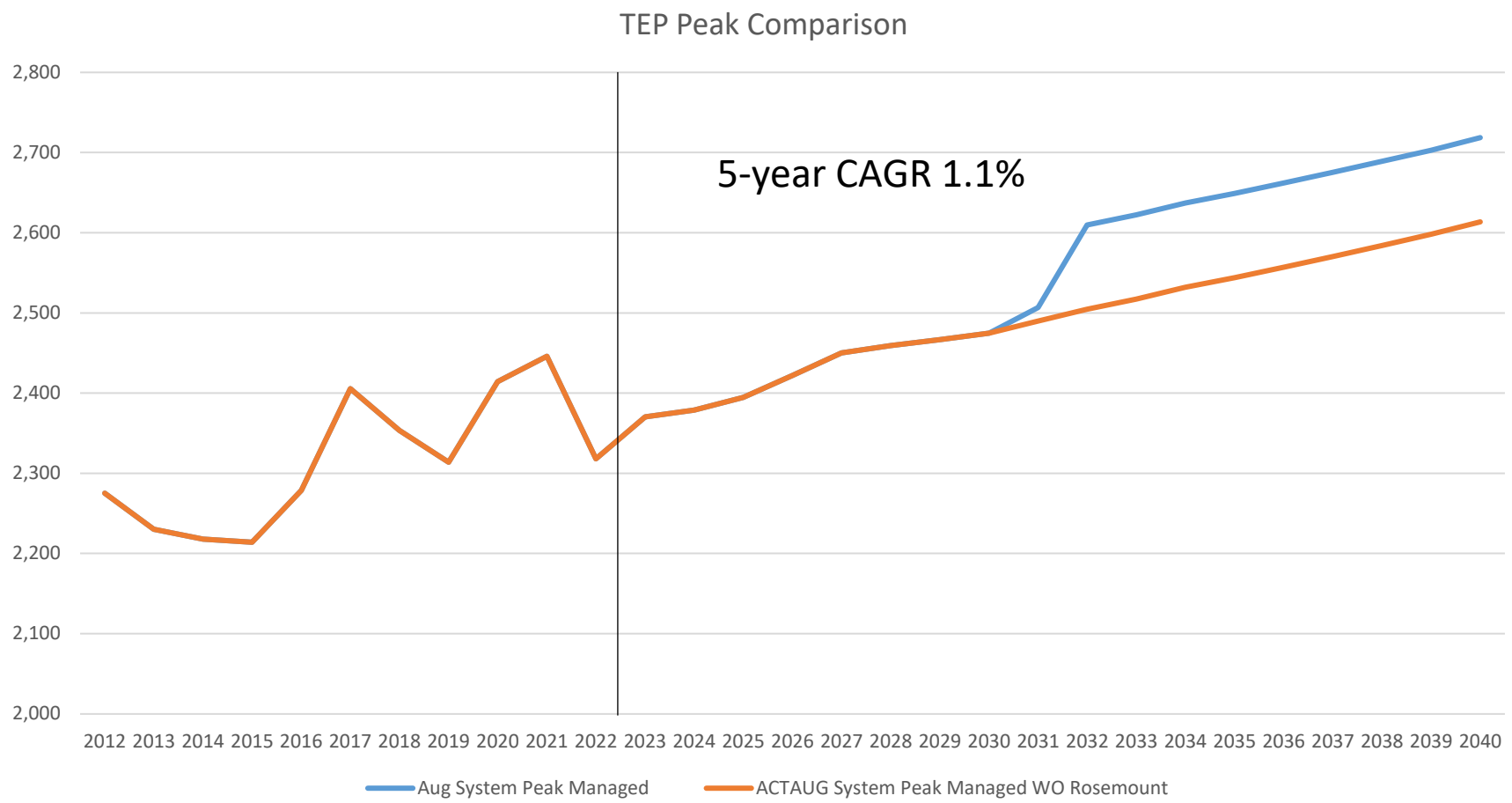
BAU (DG & DSM through 2021)

BAU - DG - DSM + EV

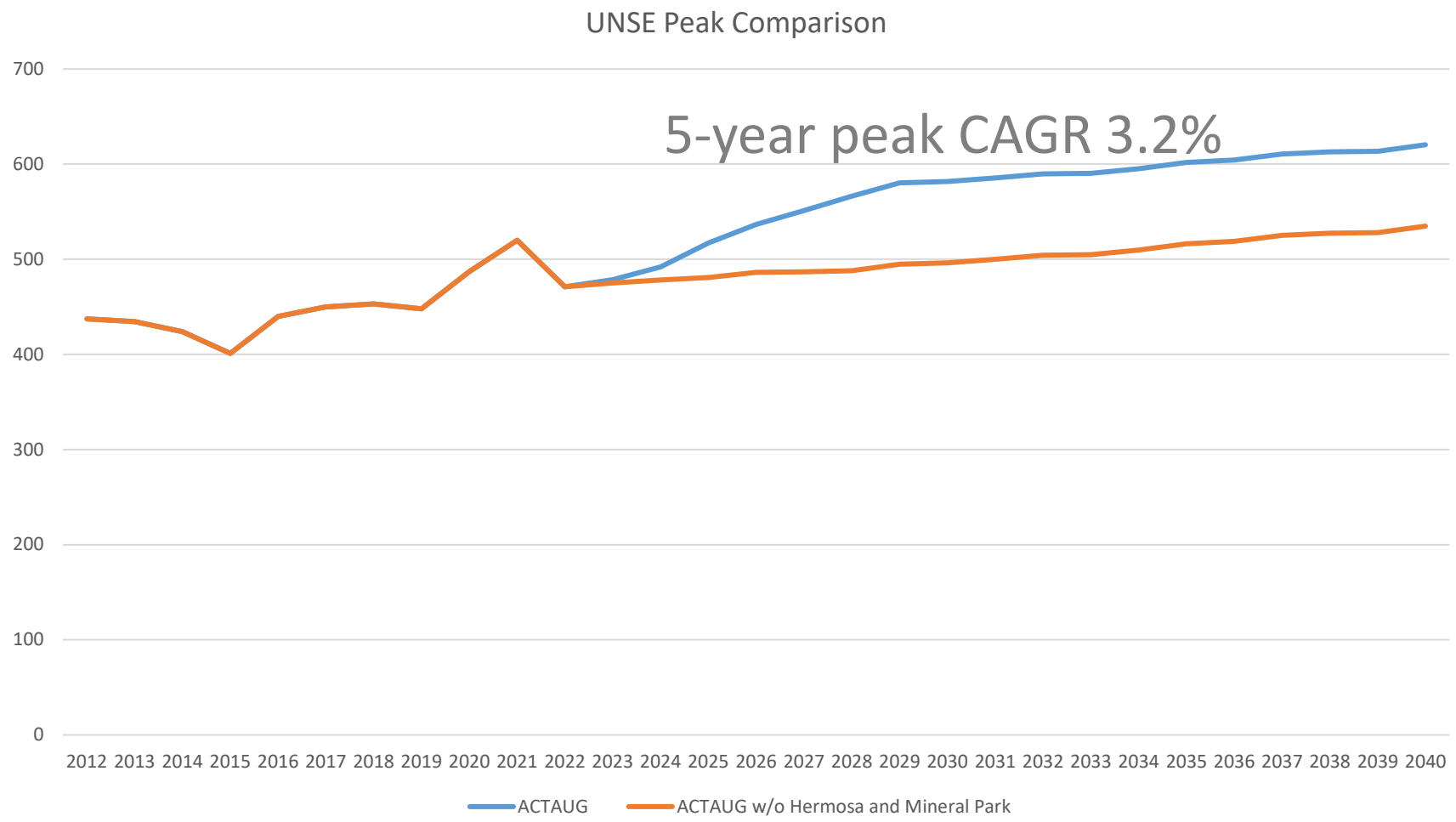
BAU - DG - DSM

BAU = Business as Usual

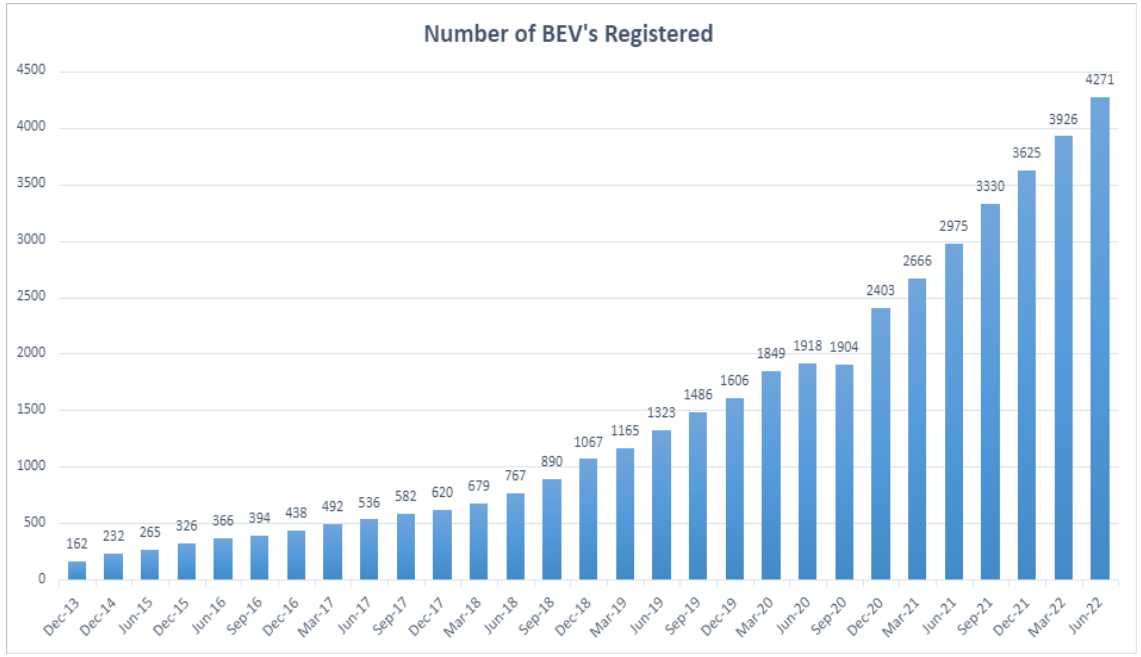
TEP Peak Forecast (MW)

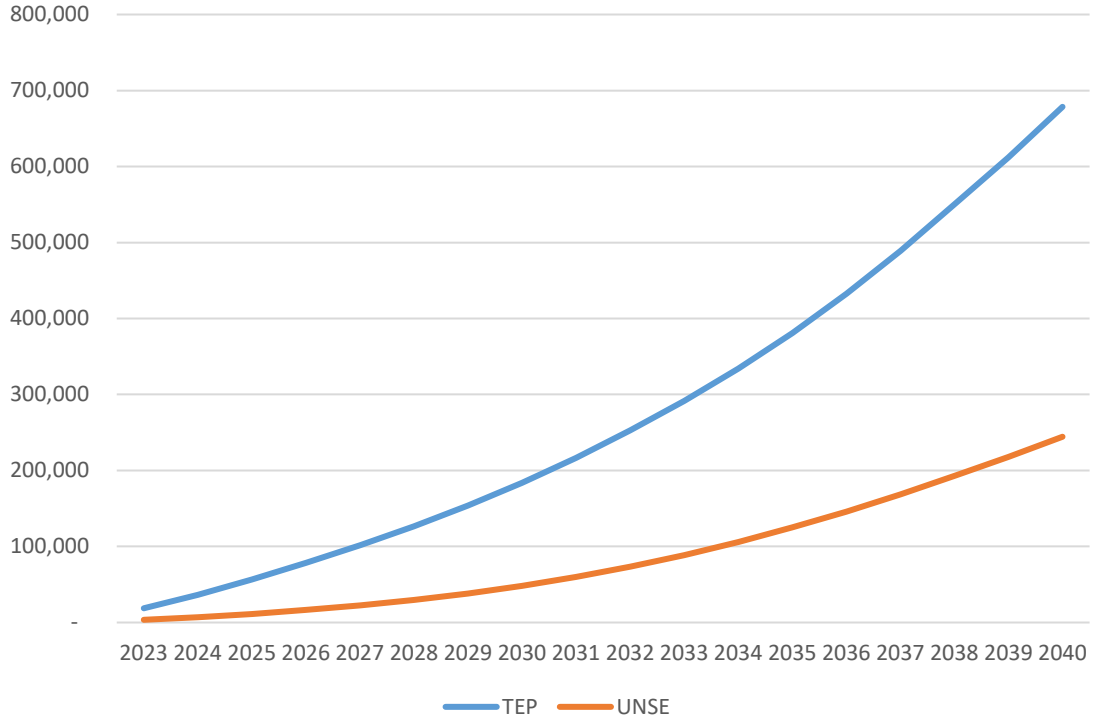


UNSE Peak Forecast (MW)

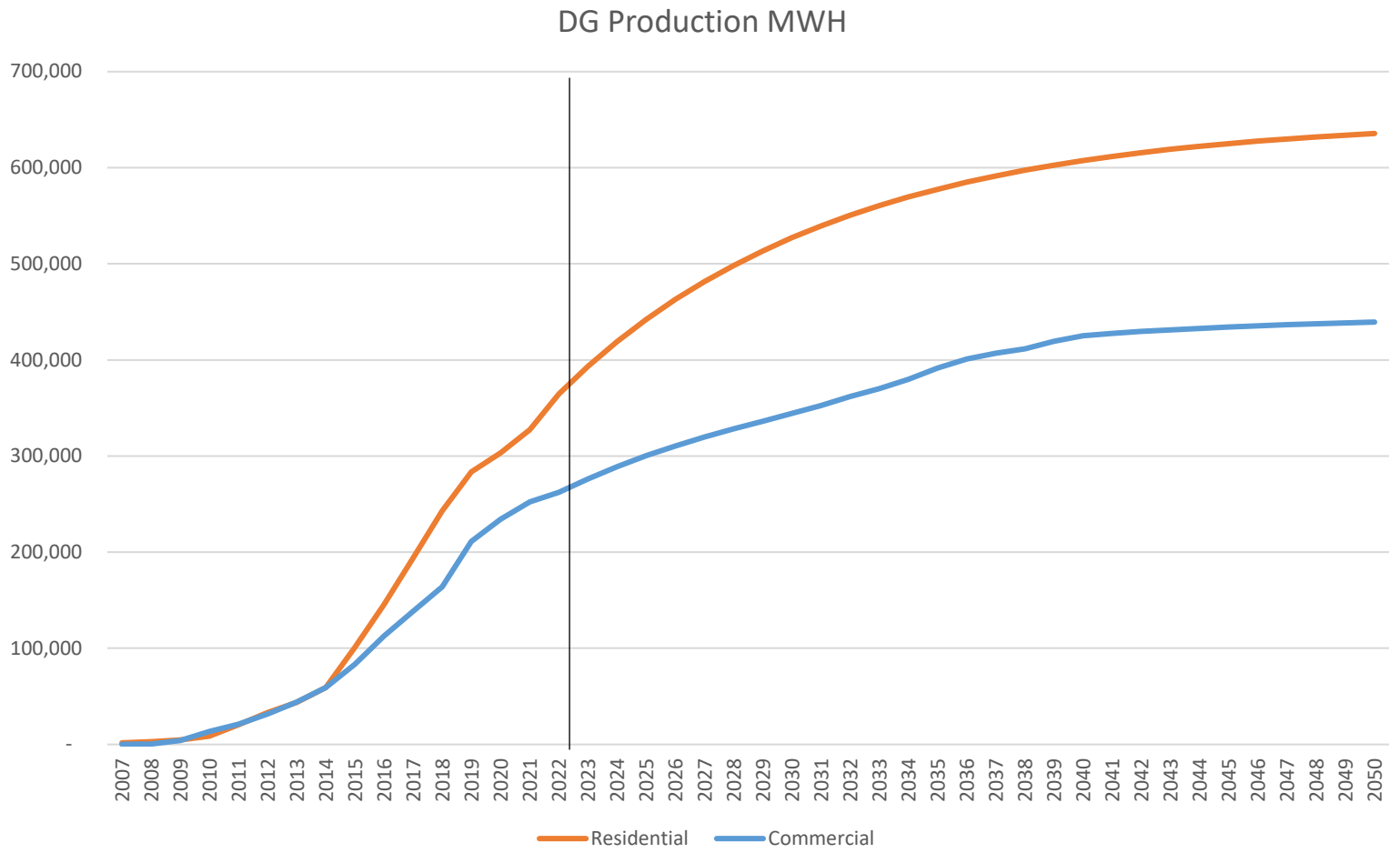


Electric Vehicle Sales Forecast





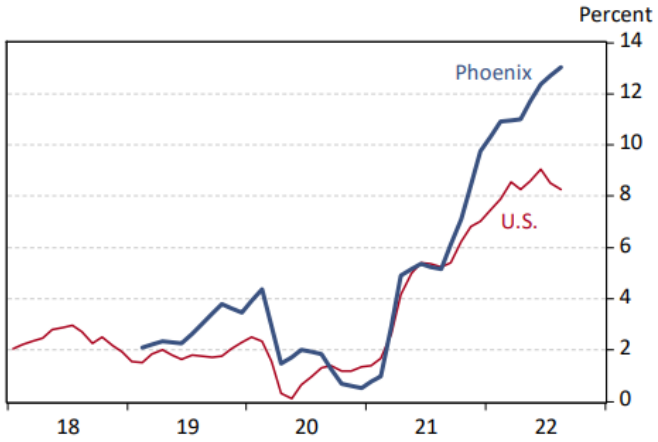
TEP DG Production



Uncertainties

Phoenix Inflation Is Outpacing the U.S.

All-Items CPIU, Over the Year



	August 2022
U.S.	8.3%
Phoenix	13.0%

- Economic Risks
  - Inflation
  - Recessionary risks
  - Adoption of EVs and DG solar
- Large Customers
  - Large mines and manufacturing do not reach full potential
- How remote work evolves in the future

Load Scenarios

Assumptions	Low	Base	High
DSM: % of prior year sales	0.8%	1.3%	1.8%
DG: Monthly installs	Minus 2 Standard Deviations	Latest Forecast	Plus 2 Standard Deviations
EVs: Total EV additions	Minus 2 Standard Deviations	Latest Forecast	Plus 2 Standard Deviations
Large Customer:	Nominal economic development	Moderate economic development	Expansive economic development
Extreme Weather: Summer peak impact	--	110°F	+5°F

Next Steps

- Next forecast update by April 2023
- New EV forecast methodology in 2023
- Large Customer Scenarios
- DSM
  - Working with Guidehouse to produce hourly forecast for base scenario (1.3%)
  - For DSM, DG< and EV, we can produce different scenarios based on stakeholder feedback.

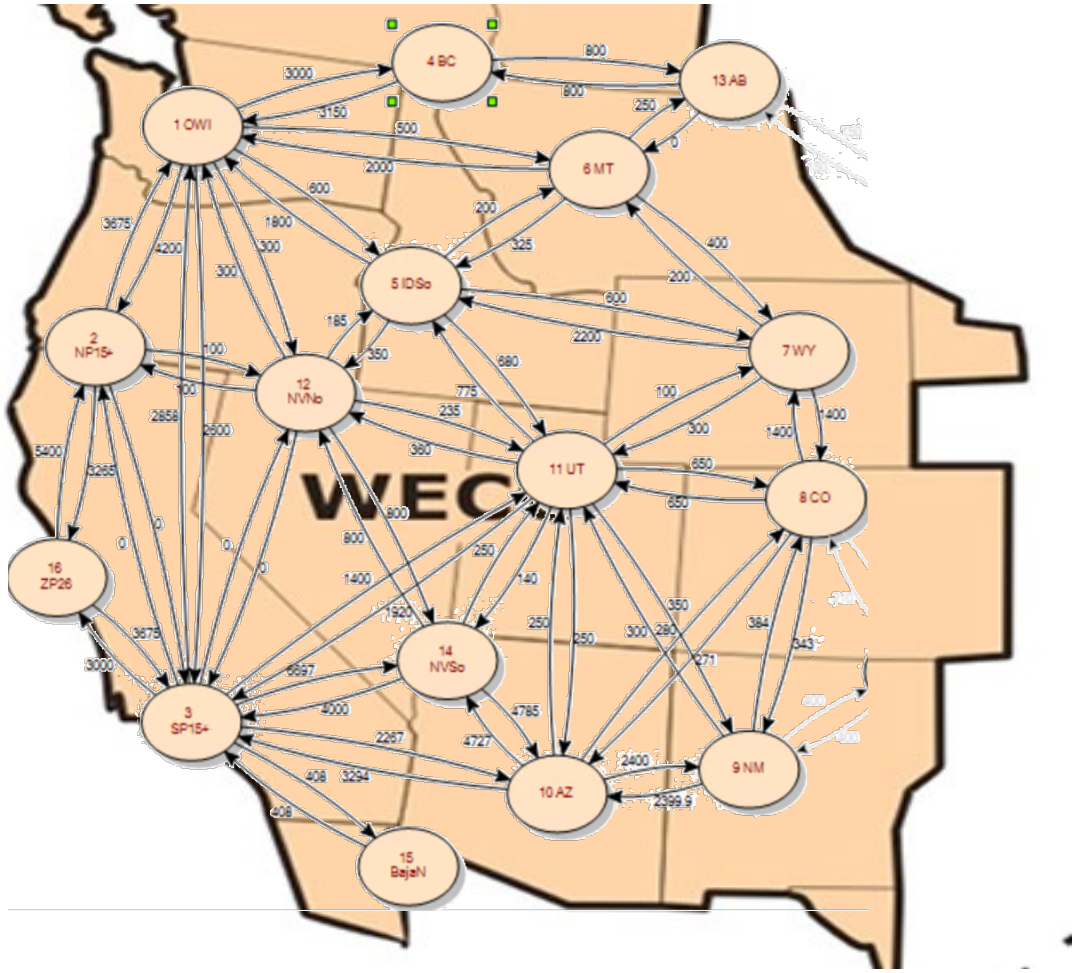
Portfolio Modeling

- TEP/UNSE (and APS and SRP) use a proprietary electricity market simulation model as a basis for forecasting the amount of conservation, generation, and wholesale market transactions needed to serve load every hour for the next 15 years
- Although expertise is required for these simulations, assumptions and cost inputs can be easily modified to evaluate different resource mixes, market conditions, and policy objectives, such as maintaining electric reliability, minimizing costs, and reducing pollution and water use

AURORA Energy Exemplar

Aurora Major Inputs

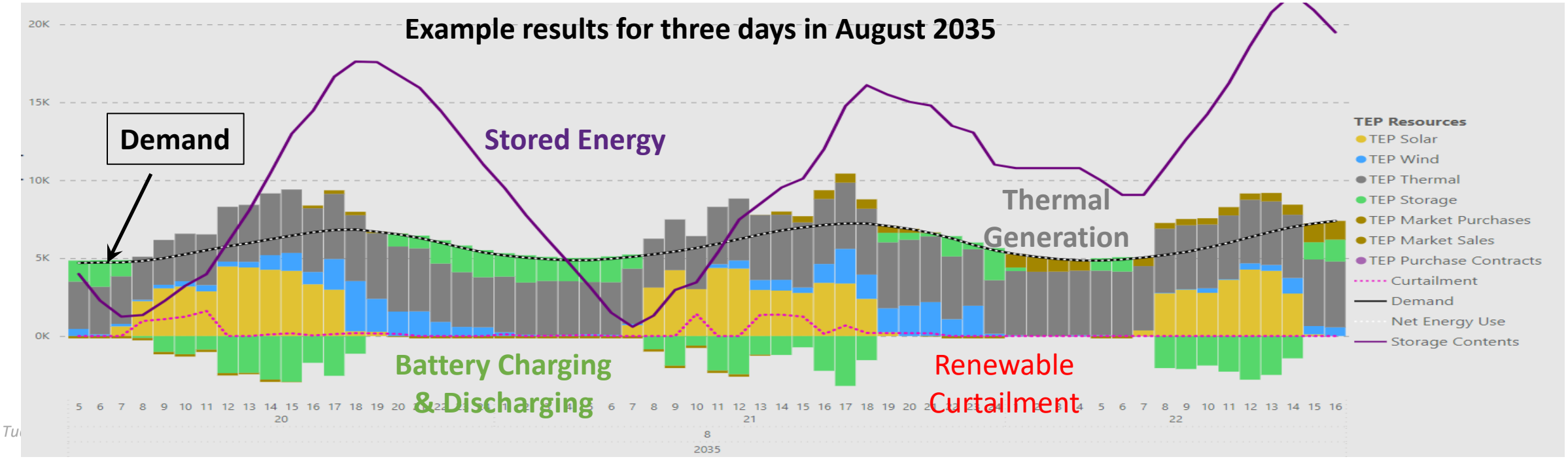
Simplified representation of the Western Interconnect



- Electricity demand
- Fuel costs
- Power purchase & sale agreements
- Generator operating costs and performance
- Energy conservation measures
- Transmission costs and limitations
- Emission and water consumption rates
- Maintenance and forced outages
- Reserve requirements
- Various constraints & requirements on individual units and the system as a whole
- Various options and settings that affect unit commitment and dispatch results

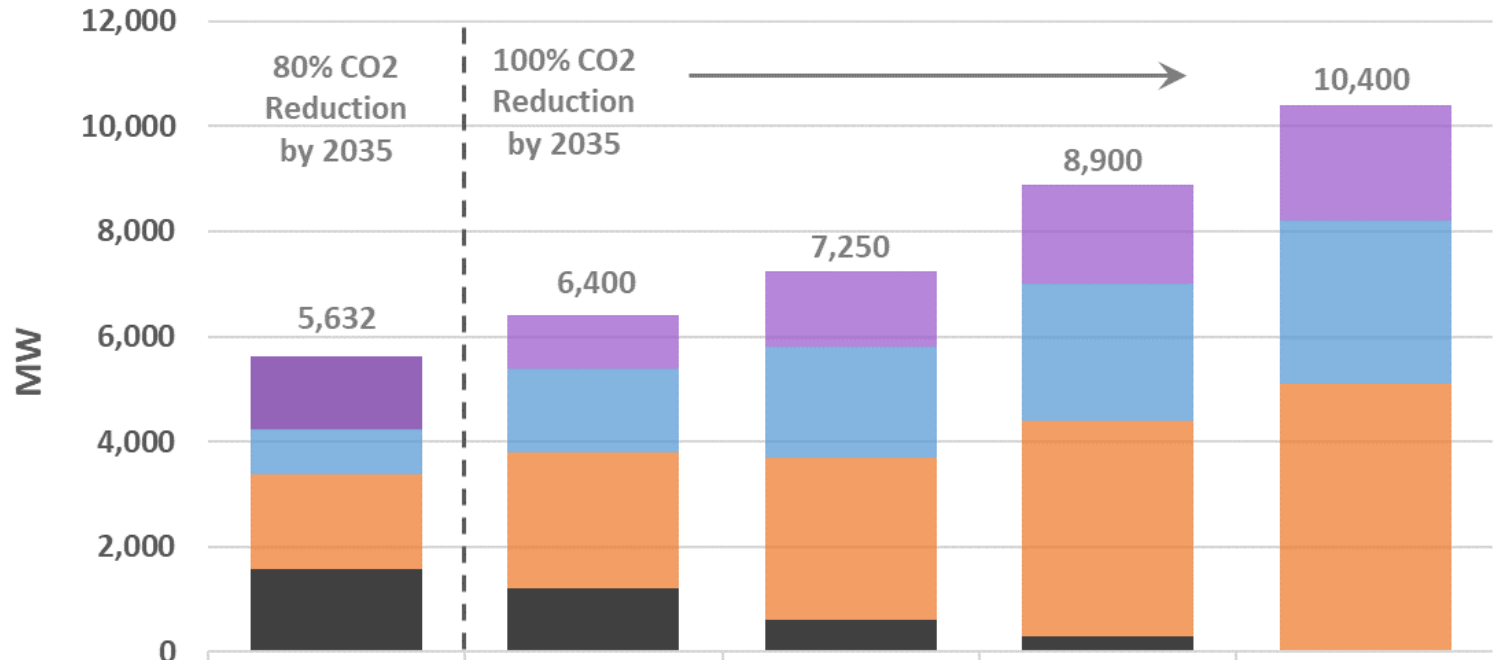
Aurora Major Outputs

- Detailed costs, output, and performance of each resource and the system as a whole
- Transmission costs, revenues, and congestion
- Expenses and revenues from contracts and spot market transactions
- Market prices, power flows, and fuel use
- Renewable energy curtailment
- Water use and air emissions
- Allocation of reserves
- Load shed when energy supply or reserves are insufficient
- Proper assessment requires Aurora in combination with Excel and other visualization tools (PowerBI)



Illustrative Example of Resource Requirements for a 100% Clean Portfolio

- TEP re-analyzed the 2020 resource plan with its most up-to-date data and model to ensure it was adequate for obtaining its clean energy objectives
- For exploratory and testing purposes, TEP further modeled a 100% clean portfolio using the same types of resources as in the 2020 plan, except for 8h storage in lieu of 4h, since longer durations will be needed to replace traditional resources that are not energy-limited.
- **Results indicate that 1 MW of firm capacity can offset the need for approximately 3 MW of renewables and storage.**



	IRP Portfolio / Ref Case	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Storage 4hr	1,400	-	-	-	-
Storage 8hr	-	1,000	1,450	1,900	2,200
Wind	850	1,600	2,100	2,600	3,100
Solar	1,800	2,600	3,100	4,100	5,100
Firm Resource	1,582	1,200	600	300	-

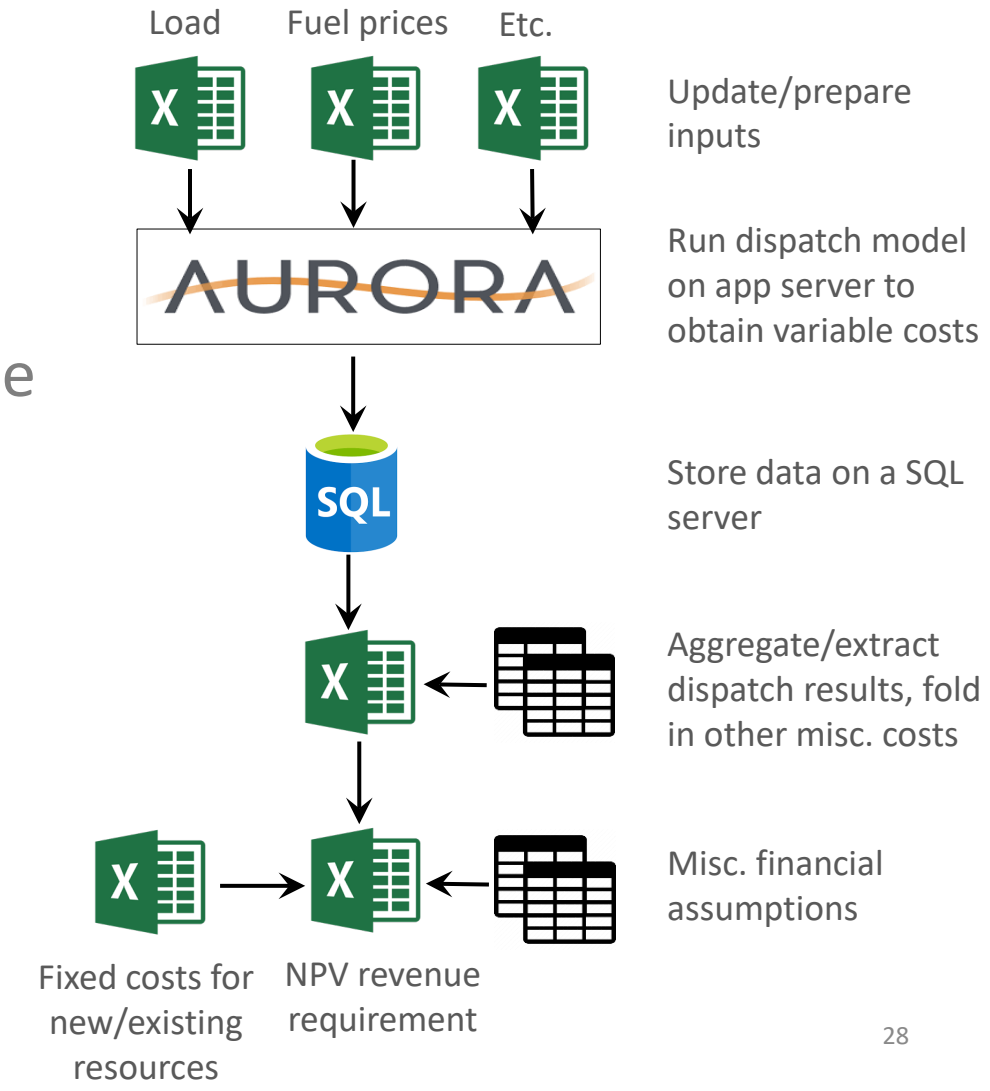
E3 Resource Adequacy Presentation to the California Energy Commission Last Month

Achieving a fully zero-carbon grid will require new technologies

- **Firm, carbon-free resources will be crucial for reliability if gas resources are retired**
- **Candidates include:**
  - Enhanced geothermal
  - New nuclear (e.g., Small Modular Reactors)
  - Fossil generation with carbon capture and sequestration
  - Very long-duration storage energy storage
  - Clean fuels such as renewable natural gas, hydrogen or synthetic gas
- **These technologies have not yet been proven to be safe, resilient, and cost-effective and are not yet commercially available**
- **One or more must emerge to enable a zero-carbon grid**

Aurora Licensing Option for RPAC Members

- TEP can pay for intervenor's license and 8hrs of training for RPAC members
- TEP/UNSE input data can be shared with stakeholders under this arrangement, although the confidentiality of the data needs further review and a non-disclosure agreement would be necessary
- Any interest in obtaining a license should be expressed soon
- Alternatively, TEP can perform the modeling in close coordination with interested members
- TEP repeats the process shown here for each portfolio and scenario evaluated
- "Batteries not included" …… be mindful of IT.



Portfolios Modeled in 2020 IRP

Portfolio Identifier	Source	Design Element
P01	ACC - Commissioner proposals to Energy Rules Docket	(a)80 (b)100 percent Clean Energy by 2050
P02	ACC - Commissioner proposals to Energy Rules Docket	(a)80 (b)100 percent Clean Energy by 2050; 50 percent Renewable by (a)2028 or (b)2030
P03	ACC - Commissioner proposals to Energy Rules Docket	80 percent Clean Energy by 2050; 40 percent renewables by 2035
P04	Decision 76632 to 2017 IRP	Fossil fuel no more than 20 percent of all resource additions
P05	Decision 76632 to 2017 IRP	Energy Storage equal to 20 percent of demand; 50 percent "clean" energy resources; 25MW of biomass; 20 percent DSM
P06	ACC - Draft Energy Rules	45 percent renewables by 2035; 30 percent clean energy during peak by 2035
P07	Advisory Council - SWEEP	Higher reserve sharing
P08	Advisory Council - Sierra Club	(a) Retire all coal by 2027; (b) Retire Springerville 1 in 2024; (c) Retire Four Corners in 2024

Portfolios Modeled in 2020 IRP

P09	Advisory Council - Western Resource Advocates	CO_2 Reduction #1 (based on 2005): 50 percent below by 2025; 60 percent below by 2030; 70 percent below by 2035
P10	Advisory Council - Western Resource Advocates	CO_2 Reduction #2 (based on 2005): 40 percent below by 2025; 50 percent below by 2030; 60 percent below by 2035
P11	Arizonans for Electric Choice and Competition	Buy-through as a resource option
P12	Advisory Council - Sierra Club	100 percent Renewables by 2045
P13	Advisory Council - RUCO	Demand Response 40 percent of peak (low cost)
P14	Advisory Council - RUCO	Demand Response 40 percent of peak (high cost)
P15	Advisory Council - RUCO	Model specific DSM program penetrations (smart thermostats, water heaters, pool pumps)
P16	TEP	Coal supply limits
P17	TEP	Preferred portfolio

ACC Requirements for Portfolio Modeling

- TEP and UNSE shall include in future IRPs:
  1. "an analysis of at minimum, **10 resource portfolios that are designed to evaluate the range of resource procurement actions, and their respective costs and benefits, that can be taken to achieve the emissions reductions goals** specified by each in its 2020 Integrated Resource Plan. The analysis and presentation of these resource portfolios should be used to support [TEP and UNSE's] desire to achieve significant emissions reductions."
  2. "include one or more ***portfolios*** which achieve **at least 40 percent cumulative energy savings by 2030** from a broad portfolio of energy efficiency measures and using a 2010 baseline."
  3. "an analysis of a technology agnostic resource ***portfolio***, which is the **least-cost method** of safely and reliably meeting customers' energy needs without regard for their emissions reduction goals or any renewable or carbon emissions standards."
  4. "include one or more ***portfolios*** which **eliminate coal unit must-run designations**."
  5. "one or more ***portfolios*** which **remove modeling restrictions** that limit the amount of energy efficiency that can be selected as a resource option."
  6. "one or more ***portfolios*** which **remove modeling restrictions** on the economic cycling and economic retirement of coal units."
- By January 1, 2030, TEP's resource ***portfolio*** shall, "include a demand-side resource capacity equal to at least 35 percent of TEP's 2020 peak demand. The portfolio for demand-side management measures shall include rate-enabled, load-shifting technologies, including, but no limited to, demand response, energy storage, and smart thermostats, that provide customer bill savings and clean energy benefits."

* Perhaps include the blue requirements in all portfolios, so they effectively create no need for portfolios of their own.

ACC Requirements *That Can Be Addressed* Through Portfolio Modeling

- TEP and UNSE shall include in future IRPs, "***a comprehensive analysis*** that presents the **costs and benefits of their emissions reduction commitments, compared to an approach absent these commitments**, to their ratepayers."
  - Satisfy with portfolio requirement #3 on previous slide
- TEP and UNSE shall in future IRPs, "***study and report upon*** the **value of distribution grid-connected resources as compared to transmission-connected**, to determine the optimal mix of renewable energy and energy storage interconnected to distribution versus resources interconnected to transmission. Factors to consider include constraints in the transmission grid, the cost and process of siting and building new transmission, and the benefits of distribution connected resources such as reduced line loss and resiliency."
- TEP shall, "demonstrate **1.3 percent annual energy efficiency** measured by megawatt-hour savings over its next three-year planning period and shall report its annual energy efficiency savings in its 2023 Integrated Resource Plan.

Potential Starting Point for Defining and evaluating Alternative Portfolios

#	Name	Description
P01	Reference Case (2020 IRP)	Basis for proceeding towards clean and diverse energy goals Reference for comparing common attributes among portfolios
P02	Heavy Solar	Assume solar outcompetes (or becomes favored over wind for other reasons) and comprises a heavier portion of resource mix
P03	Heavy Wind	Vice versa
P04	Heavy DER	See, for example, the distributed grid-connected requirement on previous slide
P05	Long Duration Storage	1,000 hours of continuous, full-capacity discharge
P06	Trans-Mid-Term	Optimization of existing networks and markets
P07	Trans-Long-Term	New transmission facilities foster access to a better energy sources
P08	Clean-Firm-Mid-Term	For example, enhanced geo and nuclear power
P09	Clean-Firm-Long-Term	For example, hydrogen and renewable gas
P10	???	

Potential Scenarios for Testing the Robustness of Portfolios Under Evaluation

- Natural gas and power prices
- 80% vs 100% CO2 reduction
- Load growth and shape

Load Drivers	Peak Impact	Energy Impact	Shape Impact
Extreme heat	●	○	○
Demand-Side Management	◉	●	●
Electric Vehicles	○→●	○→●	○→●
Distributed Generation	○	○	●
Large Customer Growth	●	◉	◉

○ Low
◉ Med
● High

Next Steps and Topics for Next Meeting

- Possible topics include:
  - Further discussions/decisions on portfolios to examine and scenarios to be consider
  - Capital cost assumptions for transmission and new resources
  - Fuel and market price assumptions
  - Providing for a just and equitable clean energy transition
  - Pursuit and use of Inflation Reduction Act funding and tax incentives
  - All-source RFP update
  - Other?