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E000008577

Gallagher&Kennedy

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August 26, 2020

Docket Control
Arizona Corporation Commission
1200 W. Washington St.
Phoenix, AZ 85007

Re: *Arizona Electric Power Cooperative, Inc.'s ("AEPCO") Resource Planning Filing Pursuant to R14-2-703.C-F and H (the "Resource Planning Filing"); Docket No. E-00000V-19-0034*

Dear Sir or Madam:

Pursuant to the requirements of Arizona Administrative Code R14-2-703.C-F and H and Decision No. 77696, attached is the Public Version of AEPCO's Resource Planning Filing. Your assistance in relation to this matter is appreciated.

Sincerely,

GALLAGHER & KENNEDY, P.A.

By: 
Jennifer A. Cranston

JAC
Attachment
10421-93/8202317

ORIGINAL of the foregoing eFiled
with Docket Control via ACC Portal
this 26th day of August, 2020.

Arizona Electric Power Cooperative, Inc.

Resource Planning Filing
R14-2-703.C-F and H

Docket No. E-00000V-19-0034

August 26, 2020

Public Version

THIS DOCUMENT CONTAINS CONFIDENTIAL INFORMATION PROTECTED PURSUANT TO THE PROTECTIVE AGREEMENT BETWEEN AEPCO AND STAFF DATED March 22, 2019

Preface

This is AEPCO's fourth Resource Planning Filing pursuant to the requirements of R14-2-703.C-F and H of the Commission's Resource Planning and Procurement Rules (effective December 20, 2010) (the "IRP Rules"). AEPCO's previous filings were made on March 30, 2012, April 1, 2014, and May 3, 2017.

AEPCO is unique among the load-serving entities covered by the IRP Rules. First, it supplies power only at wholesale to its Class A Member distribution cooperatives. Therefore, it has no demand side role in the "integrated" resource planning process. As the Commission's decision on the initial round of IRP filings noted, "each IRP (other than AEPCO's) must meet the requirements of the Annual Renewable Energy Requirement, the Distributed Renewable Energy Requirement, and the Energy Efficiency Standard." Decision No. 73884 at page 3, ll. 11-13 (the "First IRP Order"). AEPCO's distinction from the other load-serving entities was reiterated in the Commission's next two IRP dockets. *See* Decision No. 75068 at page 3, ll. 14-16 (the "Second IRP Order"); Decision No. 76632 at page 3, ll. 7–9, page 19, ll. 1–3 and 16–18, and page 20, ll. 13–15 (the "Third IRP Order").

Further, AEPCO's supply side role is limited. In Arizona, it has all-requirements contracts (i.e., contracts requiring AEPCO to resource plan for the future demands of the member) with only two of its smallest distribution cooperative Members, i.e., the Graham County Electric Cooperative (Graham) and the Duncan Valley Electric Cooperative (Duncan). The other three and largest Arizona Member distribution cooperatives are Partial-Requirements Members (PRM). Under these PRM arrangements, AEPCO's only obligation is to furnish contractually obligated amounts of power and energy to the PRMs from existing resources, i.e., it has no obligation to plan for the future growth needs of Sulphur Springs Valley Electric Cooperative (Sulphur), Trico Electric Cooperative (Trico) and Mohave Electric Cooperative (Mohave).

The Commission recognized these and other differences between AEPCO and the other entities covered by the IRP Rules in its prior decisions. Specifically, in addition to recognizing that it plays no demand side role in the planning process, the Commission "acknowledged" the 2012 IRP but stated it would not be necessary for AEPCO to have "its future IRPs acknowledged by the Commission." (First IRP Order, Finding 14.) The Commission also stated that AEPCO should continue to submit in future IRP filings "whatever information, data, criteria, and studies it has used in its 15-year planning scenarios"—concluding that such information is sufficient for AEPCO to meet its IRP Rules' obligations given its unique and very limited role. (First IRP Order, Finding 15.) The Commission further instructed AEPCO to provide its "PRMs load forecasts to Staff on a confidential basis when it files its IRP" (Finding 16 and Second Ordering paragraph at page 8). Finally, the Commission ordered that AEPCO continue in the "IRP process but without the necessity of having its future IRPs acknowledged." (First IRP Order, First Ordering Paragraph on page 8.)

In the second IRP proceeding, AEPCO submitted an IRP conforming to the Commission's above-referenced instructions. In response, the Commission confirmed that AEPCO's IRP satisfied the requirements of the First IRP Order. (Second IRP Order, Second Ordering Paragraph on page 14.) The Commission issued a similar decision in the third IRP proceeding, again

recognizing AEPCO's unique status and its satisfaction of the filing requirements imposed by prior orders. (Third IRP Order, Third Ordering Paragraph on page 53.) In that proceeding, the Commission identified a number of additional analyses that the other Load Serving Entities would be required to include in future IRPs, but explicitly exempted AEPCO from those additional requirements and confirmed that AEPCO's obligation would remain the same as articulated in the First IRP Order. (Third IRP Order, page 47, ll. 11–17, and Ordering Paragraphs on page 48, l. 17 – page 49, l. 21, and on page 50, l. 22 – p. 51, l. 26).

Consistent with the foregoing, this fourth Resource Planning Filing complies with the requirements identified in the First IRP Order, including the "information, data, criteria, and studies" AEPCO has used in its latest 15-year planning activities. This filing also includes the analyses described in AEPCO's Preliminary 2020 IRP, filed on August 1, 2019, as well as a resource portfolio evaluation based on the forecasted resource needs of all its Class A Members (including the PRMs). Although (as stated previously) AEPCO's resource planning obligation is limited to its All-Requirements Members, this filing includes analysis of potential resources available to meet AEPCO's projection of the future needs of the ARMs and PRMs. As a result, the resource alternatives identified in AEPCO's IRP represent the variety of resource options being considered but should not be construed as a determination by AEPCO or its Members.

Finally, with reference to the First IRP Order, AEPCO has not provided the PRM load forecasts separately because this fourth Resource Planning Filing incorporates them into AEPCO's modeling scenarios.

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C.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following items of load data and analyses, which may include a reference to the last filing made under this subsection for each item for which there has been no change in forecast since the last filing:

1. Fifteen-year forecast of system coincident peak load (megawatts) and energy consumption (megawatt-hours) by month and year, expressed separately for residential, commercial, industrial, and other customer classes, for interruptible power; for resale; and for energy losses;

AEPCO has an obligation to provide resource planning on behalf of its All-Requirements Members, referred to collectively as CARM. The CARM include two Class A Member distribution cooperatives located within Arizona -- Duncan and Graham -- as well as a third Class A Member located outside of Arizona, Anza Electric Cooperative, Inc. AEPCO's obligation to its other three Class A Members, the PRMs, is limited to furnishing contractually obligated amounts of power and energy from existing resources and does not include planning for additional current or future needs. However, given that the recent resource planning studies described in this filing include modeling of total load requirements for all of AEPCO's Class A Members (both CARM and PRMs), a summary of demand and energy requirements for both groups has been provided below.

AEPCO's peak demand forecast covers the entirety of these Class A Members' loads, and does not distinguish by retail customer class. Therefore, AEPCO has not provided the peak demand information disaggregated by consumer class.

The energy tables include data concerning residential, irrigation, small commercial, large commercial, and special contracts customers (if applicable), and highway lighting derived from the load forecasts for CARM and all Class A Members. The estimated distribution losses are also provided.

AEPCO's load forecast report is provided in Tab A.

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R14-2-703. Load-serving Entity Reporting Requirements

C.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following items of load data and analyses, which may include a reference to the last filing made under this subsection for each item for which there has been no change in forecast since the last filing:

2. Disaggregation of the load forecast of subsection (C)(1) into a component in which no additional demand management measures are assumed, and a component assuming the change in load due to additional forecasted demand management measures; and

AEPCO is unique among entities covered by the IRP Rules in that it supplies power only at wholesale predominately to its Class A Members and, therefore, serves no demand-side role in the integrated resource planning process. As a result, AEPCO has no information to report concerning these components.

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R14-2-703. Load-serving Entity Reporting Requirements

C.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following items of load data and analyses, which may include a reference to the last filing made under this subsection for each item for which there has been no change in forecast since the last filing:

3. Documentation of all sources of data, analyses, methods, and assumptions used in making the load forecasts, including a description of how the forecasts were benchmarked and justifications for selecting the methods and assumptions used.

A complete copy of AEPCO's 2019 Load Forecast Report, approved by the AEPCO Board of Directors on March 7, 2019, is included behind Tab A. This document details the methods and assumptions utilized in AEPCO's load forecast development. **The information contained in the AEPCO 2019 Load Forecast Report is confidential and its use and availability is restricted pursuant to the terms of the Protective Agreement between AEPCO and Staff dated March 22, 2019.**

As shown in part C.1., this official forecast was adjusted to account for the following factors, which yield the load which AEPCO's IRP model would serve:

- Increase of AEPCO required load for transmission losses at AEPCO's network rate of 2.31%.
- Reduction of load as a result of the solar project at Apache Generating Station, in order to create consistency with the treatment of existing Member solar PPAs under the load forecast.

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R14-2-703. Load-serving Entity Reporting Requirements

D.) A load-serving entity shall, by April 1 of each even year, file with Docket Control the following prospective analyses and plans, which shall compare a wide range of resource options and take into consideration expected duty cycles, cost projections, other analyses required under this Section, environmental impacts, and water consumption and may include a reference to the last filing made under this subsection for each item for which there has been no change since the last filing:

1. A 15-year resource plan, providing for each year:

   a. Projected data for each of the items listed in subsection (B)(1), for each generating unit and purchased power source, including each generating unit that is expected to be new or refurbished during the period, which shall be designated as new or refurbished, as applicable, for the year of purchase or the period of refurbishment;

B-1 For each generating unit and purchased power contract:

a. In-service date and book life or contract period;
b. Type of generating unit or contract;
c. The load-serving entity's share of the generating unit's capacity, or of capacity under the contract, in megawatts;

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The in-service dates, Class A Member contract end dates, type, and nominal capacity of AEPCO's existing generating units and purchased power contracts are detailed below.

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With regard to "new" resources, AEPCO's IRP scenarios include certain prospective resource options. While AEPCO is not selecting a resource plan as part of its IRP submission, the resources identified in the modeling can be found in Section F, and the resource assumptions are included behind Tab B.

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B-1 For each generating unit and purchased power contract:

   d. Maximum generating unit or contract capacity, by hour, day, or month, if such capacity varies during the year;

AEPCO's maximum net generating unit capacity for its physical generating units is not assumed to vary on a material basis during the year.
AEPCO's purchase power contracts with seasonal capacities are listed on the following page:

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B-1 For each generating unit and purchased power contract:

    e. Annual capacity factor (generating units only);

AEPCO has provided projected capacity factors for each of AEPCO's dispatchable generating units, including those selected by AEPCO's resource planning model in the various scenarios considered. Prospective units, rather than those currently existing in AEPCO's portfolio, are denoted by italics. Prospective renewable projects assumed a constant capacity factor in keeping with AEPCO's assumptions for these projects, detailed behind Tab B. Storage resources were selected also in AEPCO's modeling, but as they store, rather than produce energy, do not have a comparable capacity factor to other generating units.

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1. A 15-year resource plan, providing for each year:

    a. Projected data for each of the items listed in subsection (B)(1), for each generating unit and purchased power source, including each generating unit that is expected to be new or refurbished during the period, which shall be designated as new or refurbished, as applicable, for the year of purchase or the period of refurbishment;

B-1 For each generating unit and purchased power contract:

    f. Average heat rate of generating units and, if available, heat rates at selected output levels;

Included behind Tab B are the assumed average heat rates for each of AEPCO's dispatchable generating units, as well as heat rates for prospective units considered for selection in AEPCO's resource expansion modeling.

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B-1 For each generating unit and purchased power contract:

g. Average fuel cost for generating units, in dollars per million Btu for each type of fuel;

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B-1 For each generating unit and purchased power contract:

h. Other variable operating and maintenance costs for generating units, in dollars per megawatt hour;

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B-1 For each generating unit and purchased power contract:

i. Purchased power energy costs for long-term contracts, in dollars per megawatt-hour;

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1. A 15-year resource plan, providing for each year:

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B-1 For each generating unit and purchased power contract:

j. Fixed operating and maintenance costs of generating units, in dollars per megawatt;

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B-1 For each generating unit and purchased power contract:

k. Demand charges for purchased power;

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B-1 For each generating unit and purchased power contract:

l. Fuel type for each generating unit;

Primary & Secondary Fuel Types for Each Unit

	2020-2035	
Unit	**Primary Fuel**	**Secondary Fuel**
Combined Cycle (GT1 + ST1)	Gas	None
Gas Turbine 2	Gas	Oil
Gas Turbine 3	Gas	None
Gas Turbine 4*	Gas	Oil
Steam Turbine 2	Gas	None
Steam Turbine 3**	Coal	Gas

*Secondary fuel for GT4 is permitted for emergency backup only. Limited to 600 hours per year.
** ST3 is permitted for both coal and gas fired operation, and can switch between fuels or co-fire.

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1. A 15-year resource plan, providing for each year:
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B-1 For each generating unit and purchased power contract:

m. Minimum capacity at which the generating unit would be run or power must be purchased;

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B-1 For each generating unit and purchased power contract:

n. Whether, under standard operating procedures, the generating unit must be run if it is available to run;

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B-1 For each generating unit and purchased power contract:

   o. Description of each generating unit as base load, intermediate, or peaking;

Existing Units/Contracts

Combined Cycle 1 (CC1)
CC1 is a Combined Cycle unit consisting of Gas Turbine 1 (GT1), a natural gas-fired simple cycle GE MS5001D combustion turbine constructed in 1963 with a net rated capacity of 10 MW. GT1 is often operated in concert with Steam Unit 1 (ST1), a natural gas-fired boiler constructed in 1963 with a net rated capacity of 72 MW. ST1 can be operating independently or heat from the boiler burners can be supplemented by exhaust gas from GT1. Together their net rated capacity is 82 MW. Historically, this unit has served the following functions within the AEPCO generation portfolio: (i) seasonal (summer) peaking, (ii) spinning reserves and regulation during the period when the unit is on line, (iii) reliability service for ST2 and ST3 unplanned outages, and (iv) to provide firm capacity allowing AEPCO's Class A Members to make economy purchases in the real-time energy market. AEPCO plans to continue operating CC1 in the future for seasonal peaking and as well as to continue to serve as firm capacity against which market purchases can be made.

Gas Turbine 2 (GT2)
GT2 is a simple cycle GE Frame 5N combustion turbine with a rated capacity of 20 MW and was constructed in 1972. Historically, this generation resource has been utilized by AEPCO as non-spinning reserves. Under the Western Electric Coordinating Council (WECC) and Southwest Reserve Sharing Group (SRSG) procedures, any resource designated as non-spinning for reserve calculations is off-line generation capacity that can be ramped to capacity and synchronized to the grid within ten minutes of a dispatch instruction and is used to maintain system frequency stability during emergency conditions.

[Response continues on next page.]

The unit start time for GT2 is approximately seven minutes. Due to AEPCO's ability to perform these quick test starts within ten minutes this unit has been an economical option to satisfy AEPCO's regulatory non-spinning requirements. AEPCO plans to continue operating GT2 into the future primarily as a non-spinning resource.

Gas Turbine 3 (GT3)
GT3, constructed in 1975, is a simple cycle, natural gas-fired Westinghouse 501B2 combustion turbine with a rated capacity of 65 MW. AEPCO plans to continue operating GT3 into the future primarily for seasonal peaking and to provide firm capacity against which market purchases can be made.

Gas Turbine 4 (GT4)
GT4 is a simple cycle, dual fuel, GE LM6000 peaking resource rated at approximately 38 MW-net. The unit is equipped with a water injection system and selective catalytic reduction (SCR) for NOx reduction in addition to other emission controls for carbon monoxide. AEPCO plans to continue operating GT4 into the future primarily for seasonal peaking and to provide firm capacity against which market purchases can be made.

Steam Unit 2 (ST2) and Steam Unit 3 (ST3)
ST2 and ST3 are virtually identical Riley Turbo units commissioned in 1979 each having a net unit rating of 175-185 MW. AEPCO operates both ST2 and ST3 as load following resources to meet the resource requirements of the Class A Members. Post 2017, ST2 is utilized as either a load-following or intermediate unit as a result of conversion to natural-gas fired only operation in late 2017. ST3 remains coal-fired with the option of co-firing on natural gas when economic and currently has environmental pollution controls installed.

SLC-IP/Parker-Davis/Hoover Hydroelectric Purchases
The purchase power contracts for hydroelectric capacity are made available on a seasonable basis and served from the dams of the Salt Lake City Integrated Projects, Parker, Davis, and Hoover dams. This capacity is typically scheduled in advance and over peak hours to maximize the energy's value.

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Solar Resources

AEPCO's Solar Resources are dispatched as must-take generation through power purchase agreements. Other generation is dispatched in order to follow load in conjunction with fluctuations in solar output. (AEPCO has reflected existing Class A Member solar resources as load reductions in the modeling scenarios of this IRP.)

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R14-2-703. Load-serving Entity Reporting Requirements

D.) A load-serving entity shall, by April 1 of each even year, file with Docket Control the following prospective analyses and plans, which shall compare a wide range of resource options and take into consideration expected duty cycles, cost projections, other analyses required under this Section, environmental impacts, and water consumption and may include a reference to the last filing made under this subsection for each item for which there has been no change since the last filing:

1. A 15-year resource plan, providing for each year:

    a. Projected data for each of the items listed in subsection (B)(1), for each generating unit and purchased power source, including each generating unit that is expected to be new or refurbished during the period, which shall be designated as new or refurbished, as applicable, for the year of purchase or the period of refurbishment;

B-1 For each generating unit and purchased power contract:

p. Environmental impacts, including air emission quantities (in metric tons or pounds) and rates (in quantities per megawatt-hour) for carbon dioxide, nitrogen oxides, sulfur dioxide, mercury, particulates, and other air emissions subject to current or expected future environmental regulation;

[Response begins on next page.]

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B-1 For each generating unit and purchased power contract:

q. Water consumption quantities and rates;

Information is not available regarding historical water consumption as to each generating unit. For all units at Apache Station, an average of 3,933 acre feet of water was used over the past five years based on metered production well output. AEPCO continues to employ good water management practices and enhance its water measuring instruments at Apache Station.

Water needs associated with any new or refurbished AEPCO resources will be addressed on a site- and unit-specific basis.

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    a. Projected data for each of the items listed in subsection (B)(1), for each generating unit and purchased power source, including each generating unit that is expected to be new or refurbished during the period, which shall be designated as new or refurbished, as applicable, for the year of purchase or the period of refurbishment;

B-1 For each generating unit and purchased power contract:

r. Tons of coal ash produced per generating unit;

[Response begins on the following page.]

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1. A 15-year resource plan, providing for each year:

    b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2 For the power supply system;

a. A description of generating unit commitment procedures;

Commitment Procedures

The majority of AEPCO's generation is located at Apache Generating Station (AGS). AGS consists of two large steam units (ST2 and ST3, which are 175-185 MW each), one smaller gas-fired steam unit (72 MW) and four gas turbines ranging from 10 MW to 65 MW. Historically, in a normal year, Units ST2 and ST3 are both on-line except during March and/or April, when one of the units is off-line for a major or minor overhaul. When Steam Units 2 & 3 are both committed, they are dispatched economically each hour. The remaining units are dispatched seasonally or daily as needed to meet load on an economic basis. If AEPCO is able to economically purchase power against the gas units, AEPCO makes economy purchases prior to starting the gas units. One such example is the Salt River Project Purchase Power Agreement (SRP PPA), which is called upon on a prescheduled, day-ahead basis.

As a preference customer, AEPCO also has contract entitlements to Hoover, Parker-Davis hydro, and Salt Lake City Area Integrated Projects capacity (SLC-IP) (Colorado River Storage Project hydro). These hydro contracts are AEPCO's least expensive resources and are scheduled to the extent allowed in each contract against AEPCO's Class A Members' loads. This tends to level the output required from AGS and maximize station efficiency. On occasion, AEPCO will enter into take-or-pay contracts (block purchases) that are used for fuel displacement and maintenance outage coverage.

Thus, subject to availability, the units and PPAs are generally committed in economic order against the net of load minus hydro resources, short-term economy purchases, and must-take renewable output such as that from AEPCO's Solar Resources/PPAs.

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1. A 15-year resource plan, providing for each year:

    b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2 For the power supply system;

b. Production cost;

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1. A 15-year resource plan, providing for each year:

    b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2

For the power supply system;

c. Reserve Requirements;
d. Spinning Reserve;

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1. A 15-year resource plan, providing for each year:

   b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2 For the power supply system;

   e. Reliability of generating, transmission, and distribution systems;

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1. A 15-year resource plan, providing for each year:

    b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2 For the power supply system;

f. Purchase and sale prices, averaged by month, for the aggregate of all purchases and sales related to short-term contracts;

No purchases or sales pursuant to traditional short-term contracts are included in the forecast period. However, AEPCO's modeling assumes regular interaction with the local Arizona day-ahead and hourly energy market. The assumed pricing for these transactions is listed behind Tab B.

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1. A 15-year resource plan, providing for each year:

    b. Projected data for each of the items listed in subsection (B)(2), for the power supply system;

B-2 For the power supply system;

g. Energy Losses;

Projected transmission energy losses are forecast at a network energy loss rate of 2.31% during the planning period. Loads modeled in the IRP analyses include transmission losses as well as distribution side losses based on an assessment of each Class A Member distribution cooperative.

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1. A 15-year resource plan, providing for each year:

    c. The capital cost, construction time, and construction spending schedule for each generating unit expected to be new or refurbished during the period;

The following table shows the capital costs associated with the technologies modeled for capacity expansion. The construction time for the combined cycle facilities is generally expected to be 36 months, but this can vary based on permitting, siting, supplier lead times, and engineering. For the simple cycle plants, solar/wind generation, and battery storage, the estimated construction time is shorter at 18 months.

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1. A 15-year resource plan, providing for each year:

    d. The escalation levels assumed for each component of cost, such as, but not limited to, operating and maintenance, environmental compliance, system integration, backup capacity, and transmission delivery, for each generating unit and purchased power source;

AEPCO has assumed 1.82% annual cost escalation for capital cost components, prospective PPA pricing, fixed and variable operations and maintenance costs, and known environmental chemical costs for both existing and potential generation sources. This escalation aligns with the average year-over-year inflation of the Consumer Price Index (CPI) for the past 5 years of recorded data.

Other costs were projected via individual forecast or analysis, with assumptions listed behind Tab B.

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1. A 15-year resource plan, providing for each year:

    e. If discontinuation, decommissioning, or mothballing of any power source or permanent derating of any generating facility is expected:
        i. Identification of each power source or generating unit involved;
        ii. The costs and spending schedule for each discontinuation, decommissioning, mothballing, or derating; and
        iii. The reasons for each discontinuation, decommissioning, mothballing, or derating;

AEPCO's wholesale power contracts with its Class A Members currently reflect discontinuation of operations of Apache Generating Station's ST1, GT1, GT2, and GT3 units on December 31, 2025. AEPCO and its Class A Members are discussing potential contract extensions for these units beyond 2025 through 2035, and these extensions are reflected in AEPCO's modeling along with a scenario in which the contract operation of one of the units is not extended or is forced to retire.

The remaining Apache Generating Station units are contracted to the Class A Members through December 31, 2035.

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1. A 15-year resource plan, providing for each year:

    f. The capital costs and operating and maintenance costs of all new or refurbished transmission and distribution facilities expected during the 15-year period;

A summary of the anticipated expenses for AEPCO's planned projects for new or refurbished transmission infrastructure has been provided behind Tab D from its draft 2021-2024 Construction Work Plan. AEPCO does not own distribution facilities, and has no forecast of particular transmission project expenditures beyond 2024.

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1. A 15-year resource plan, providing for each year:

    g. An explanation of the need for and purpose of all expected new or refurbished transmission and distribution facilities, which explanation shall incorporate the load-serving entity's most recent transmission plan filed under A.R.S. 40-360.02(A) and any relevant provisions of the Commission's most recent Biennial Transmission Assessment decision regarding the adequacy of transmission facilities in Arizona; and

AEPCO has included an excerpt of its most recent Ten-Year Transmission Plan behind Tab C. This includes an explanation of the need for and purpose of all major transmission projects AEPCO is projecting.

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1. A 15-year resource plan, providing for each year:

    h. Cost analyses and cost projections, including the cost of compliance with existing and expected environmental regulations;

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2. Documentation of the data, assumptions, and methods or models used to forecast production costs and power production for the 15-year resource plan, including the method by which the forecast was benchmarked;

In the simulation of the various scenarios which AEPCO modeled in its IRP, AEPCO utilized a capacity-expansion and production costing model, EnCompass, to perform long-range simulations of forecasted market conditions, demand requirements, system dispatch, and energy-production costs. EnCompass is a utility-centric model which analyzes hundreds of resource combinations in order to recommend lowest-cost resource portfolios under defined assumptions. By varying the assumed conditions that AEPCO may face in the future, this tool assists AEPCO in modeling scenarios which attempt to ensure low-cost, low-risk power supply.

AEPCO has benchmarked its model by modeling scenarios with identical parameters between EnCompass and other models such as Planning and Risk (PaR), which ACES Power Marketing runs on AEPCO's behalf, as well as Ventyx Strategist and Promod, run by Burns and McDonnell.

Included behind Tab B are the assumptions AEPCO utilized in its production cost and resource expansion modeling software.

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3. A description of:
   a. Each potential power source that was rejected;
   b. The capital costs, operating costs, and maintenance costs of each rejected source; and
   c. The reasons for rejecting each source;

The modeling assumptions (such as costs, fuel, and type) for all resource alternatives considered can be found behind Tab B.

AEPCO's IRP studies are based on capacity expansion modeling, which forecasts energy production costs under each potential portfolio combination to select resource portfolios of lowest cost. The resource alternatives identified in AEPCO's IRP represent a variety of resource options available. This analysis is ongoing, such that selection or rejection of any potential resource alternative is not and should not be construed as a determination. Scenarios that include PRM total load do not necessarily reflect PRM resource planning and associated future resources.

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4. A 15-year forecast of self generation by customers of the load-serving entity, in terms of annual peak production (megawatts) and annual energy production (megawatt-hours);

AEPCO only supplies power at the wholesale level and therefore does not include information regarding end-use consumer self-generation.

At the distribution entity level, with the exception of meeting any state mandated renewable requirements, AEPCO's All-Requirements Members are contractually prohibited from self-generation and must take all of their power requirements from AEPCO. PRMs are each responsible to meet load above their allocated capacity (AC) in AEPCO resources and may use self-owned generation to do so.

AEPCO's Class A Members report their renewable generation to the Arizona Corporation Commission (ACC) annually in their Renewable Energy Standard and Tariff (REST) plans. The table below lists the most recent REST filing information of AEPCO's Class A Members located in Arizona.

Member Cooperative	Year	Date Filed	Docket #
Duncan Valley Electric Cooperative	2021	6/29/2020	E-01703A-20-0191
Graham County Electric Cooperative	2021	8/13/2020	E-01749A-20-0250
Mohave Electric Cooperative	2020	7/3/2019	E-01750A-19-0152
Sulphur Springs Valley Electric Cooperative	2021	6/29/2020	E-01575A-20-0187
Trico Electric Cooperative	2021	6/30/2020	E-01461A-20-0195

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5. Disaggregation of the forecast of subsection (D)(4) into two components, one reflecting the self generation projected if no additional efforts are made to encourage self generation, and one reflecting the self generation projected to result from the load-serving entity's institution of additional forecasted self generation measures;

Please see response to D.4.

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6. A 15-year forecast of the annual capital costs and operating and maintenance costs of the self generation identified under subsection (D)(4) and (5);

Not Applicable. Please see response provided in D.4.

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7. Documentation of the analysis of the self generation under subsections (D)(4) through (6);

Not Applicable. Please see prior responses.

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8. A plan that considers using a wide range of resources and promotes fuel and technology diversity within its portfolio;

As discussed in greater detail in Section F, AEPCO's IRP analysis presents a wide variety of resource alternatives available to address AEPCO's unique planning situation and promote resource diversity.

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9. A calculation of the benefits of generation using renewable energy resources;

AEPCO considered the procurement of both utility-scale solar and wind, as well as battery storage in its planning models, with costs and benefits reflected therein.

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10. A plan that factors in the delivered cost of all resource options, including costs associated with environmental compliance, system integration, backup capacity, and transmission delivery;

In 2019, AEPCO contracted with Sargent and Lundy to provide site specific all-in costs for traditional, dispatchable resource alternatives in Southern Arizona. These cost estimates have been fully incorporated into AEPCO's IRP modeling. For renewable and storage alternatives, AEPCO's modeling uses a forecast of installed costs for these resources, which was developed from cost estimates by the National Renewable Energy Laboratory (NREL) and the Energy Information Administration (EIA), with specific assumptions documented in Section E, and in AEPCO's modeling assumptions behind Tab B.

In general, it is assumed that placement of prospective resources will be adjacent to AEPCO's existing transmission system and the costs of delivery are de minimis. AEPCO's analysis of the prospective resources identified in the IRP is ongoing and before moving forward with any resource option, these costs, specific to the project in question, will be analyzed in depth.

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11. Analysis of integration costs for intermittent resources;

AEPCO has addressed the integration of intermittent resources through analysis of both the applicable capacity value provided by those resources and associated ancillary services/backup needed. These assumptions, based on AEPCO's integration analysis, are detailed behind Tab B.

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12. A plan to increase the efficiency of the load-serving entity's generation using fossil fuel;

AEPCO does not have any firm plan to increase the efficiency of its generating units over their existing design efficiency.

Please see the response to D.1.h. for a discussion of the prospective impact of the ACE rule, which may require "inside-the-fence" modifications to existing generating units.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

D.) A load-serving entity shall, by April 1 of each even year, file with Docket Control the following prospective analyses and plans, which shall compare a wide range of resource options and take into consideration expected duty cycles, cost projections, other analyses required under this Section, environmental impacts, and water consumption and may include a reference to the last filing made under this subsection for each item for which there has been no change since the last filing:

13. Data to support technology choices for supply-side resources;

As part of its IRP analysis, AEPCO has provided results on the selection of supply-side resources from its capacity expansion modeling. These results, including technology selections, are detailed and discussed in Section F, with further detail on modeling results provided behind Tab F.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

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14. A description of the demand management programs or measures included in the 15-year resource plan, including for each demand management program or measure:
    a. How and when the program or measure will be implemented;
    b. The projected participation level by customer class for the program or measure;
    c. The expected change in peak demand and energy consumption resulting from the program or measure;
    d. The expected reduction in environmental impacts, including air emissions, solid waste, and water consumption, attributable to the program or measure;
    e. The expected societal benefits, societal costs, and cost-effectiveness of the program or measure;
    f. The expected life of the measure; and
    g. The capital costs, operating costs, and maintenance costs of the measure, and the program costs;

AEPCO supplies no power at retail and, therefore, has not included demand management programs or measures.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

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15. For each demand management measure that was considered but rejected:
    a. A description of the measure;
    b. The estimated change in peak demand energy consumption from the measure;
    c. The estimated cost-effectiveness of the measure;
    d. The capital costs, operating costs, and maintenance costs of the measure, and the program costs; and
    e. The reasons for rejecting the measure;

See the response to D.14.

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R14-2-703. Load-serving Entity Reporting Requirements

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16. Analysis of future fuel supplies that are part of the resource plan; and

AEPCO's generation is connected to the El Paso Natural Gas (EPNG) Southern System pipelines, which are located in immediate proximity to the Apache Generation Station. AEPCO has approximately 21,000 Dth/day of firm transportation in the winter months and approximately 47,000 Dth/day of firm transportation in the summer months.

AEPCO uses the transportation agreements to transport natural gas from the San Juan and Permian basins to Apache Station on the EPNG Pipeline. Forecasts from these hubs were utilized to project AEPCO's natural gas fuel costs. The forecasts utilized in AEPCO's IRP scenarios were developed by IHS Markit and S&P Global, industry experts in commodity price forecasting. These forecasts are detailed on a confidential basis both in Section F and behind Tab B.

In the resource scenarios in which AEPCO is shown to acquire additional capacity from gas-fired units, AEPCO utilizes a combination approach of repurposing existing gas transportation, as well as assuming acquisition of delivered gas to the generation site, which utilizes a basis differential to account for the incremental cost of delivery.

For supply of AEPCO's remaining coal unit, AEPCO currently holds flexible contracts for coal supply sourced from Wyoming, New Mexico, and Colorado.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

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17. A plan for reducing environmental impacts related to air emissions, solid waste, and other environmental factors, and for reducing water consumption.

Apache Station is currently a zero liquid discharge facility and will maintain that status while continuing to focus on increasing process water reuse plant-wide.

AEPCO continues to employ good air pollution control practices in operating its Apache Station pollution control equipment. AEPCO maintains compliance with emission limits for total particulates, sulfur dioxide, nitrogen oxides, and mercury as per its air quality control permit which codify the MATS and Regional Haze emission limits. AEPCO's Title V Air Operating Permit was renewed in 2018 for another 5-year term.

As previously discussed, there is uncertainty regarding the future implications of the ACE rule and which, if any, improvements will need to be made by AEPCO for ST3.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    a. Demand forecasts;

The scenarios which AEPCO modeled in its IRP used the aggregate base case load forecast for all of its Class A Members. The base case load forecast represents the most likely forecast of electric demand. This base case assumes a medium expectation of local economic development, as well as average weather patterns.

As required by RUS, AEPCO also studies sensitivities to the load forecast, including low and high economic conditions and low and high weather conditions, creating a range of potential forecasts of peak demand and energy requirements. For the weather and economic bands generated around the base cases, the forecast models assume more extreme values for the weather or economic variables included in the regression equation. The bands assume constant upper and lower bounds around the base case, reflecting higher and lower loads due to either optimistic or pessimistic conditions. The purpose of evaluating these scenarios is to provide a set of forecasts that bound a range of plausible futures based upon weather and economic related influences- each of which are possible, but not assured.

[Response continues on next page.]

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By planning for the most likely electric demand rather than a higher demand, AEPCO believes it is taking a conservative view that limits its potential investments to those most likely to yield cost benefits to its Members.

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R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    b. The costs of demand management measures and power supply;

AEPCO serves power only at wholesale and so has not included any demand management programs. As discussed in E.1.a., AEPCO does perform a sensitivity analysis of aggregated Member forecasts which should reflect demand side risks.

R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    c. The availability of sources of power;

Availability of New Build Units & PPAs

In AEPCO's 2020 IRP modeling, AEPCO considered new build natural gas, renewable generation, and battery storage alternatives. AEPCO maintains contact with a variety of engineering and development firms which are involved in the design and construction of new-build assets, as well as the marketing of renewable and battery storage Purchased Power Agreements (PPAs). Based on the state of the industry and the numbers of development firms available, AEPCO perceives little challenge in the availability of any new build resource or PPA considered in AEPCO's IRP.

In addition, AEPCO also performed sensitivities which included availability of Small Modular Reactor (SMR) units. This technology is still in development, and expected to become commercial in the late 2020s. To obtain relevant cost and modeling parameters, AEPCO has worked on a confidential basis with a developer specializing in this technology. The SMR units analyzed are individually 60MW and installed in banks of five units or more. This requires that, for AEPCO and its Members to take advantage of this technology, they would need to participate in a joint project with other utilities or power producers. For this purpose, AEPCO has assumed a cost of an additional transmission wheel in conjunction with this technology.

Transmission Consideration in New Power Supply

With respect to transmission and siting, utility-scale solar is the most flexible, as it can be sited near to existing transmission infrastructure. Meanwhile, wind generation is highly location-dependent, and transmission barriers routinely exist between a utility's transmission system and a location of economic wind supply. In this IRP modeling, in lieu of particular transmission projects, AEPCO has assumed a generic Arizona wind project located near its transmission system, thereby avoiding a significant transmission expense.

New build gas must be sited near existing transmission as well as natural gas supply, which must be analyzed on both a flow and pressure perspective.

R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    d. The costs of compliance with existing and expected environmental regulations;
    e. Any analysis by the load-serving entity in anticipation of potential new or enhanced environmental regulations;

AEPCO has analyzed known or pending environmental regulatory actions as summarized in Section D.1.h.

For the projected variable costs of AEPCO's on-going compliance under existing environmental regulations, AEPCO's forecast modeling includes the most recent estimates for SF20 oxidizer, activated carbon, and urea. These costs have been estimated based on historical performance, but may fluctuate due to market forces as well as changes in the quantity needed based on the specific coal blend used at a given time.

2020 Integrated 15-Year Resource Plan

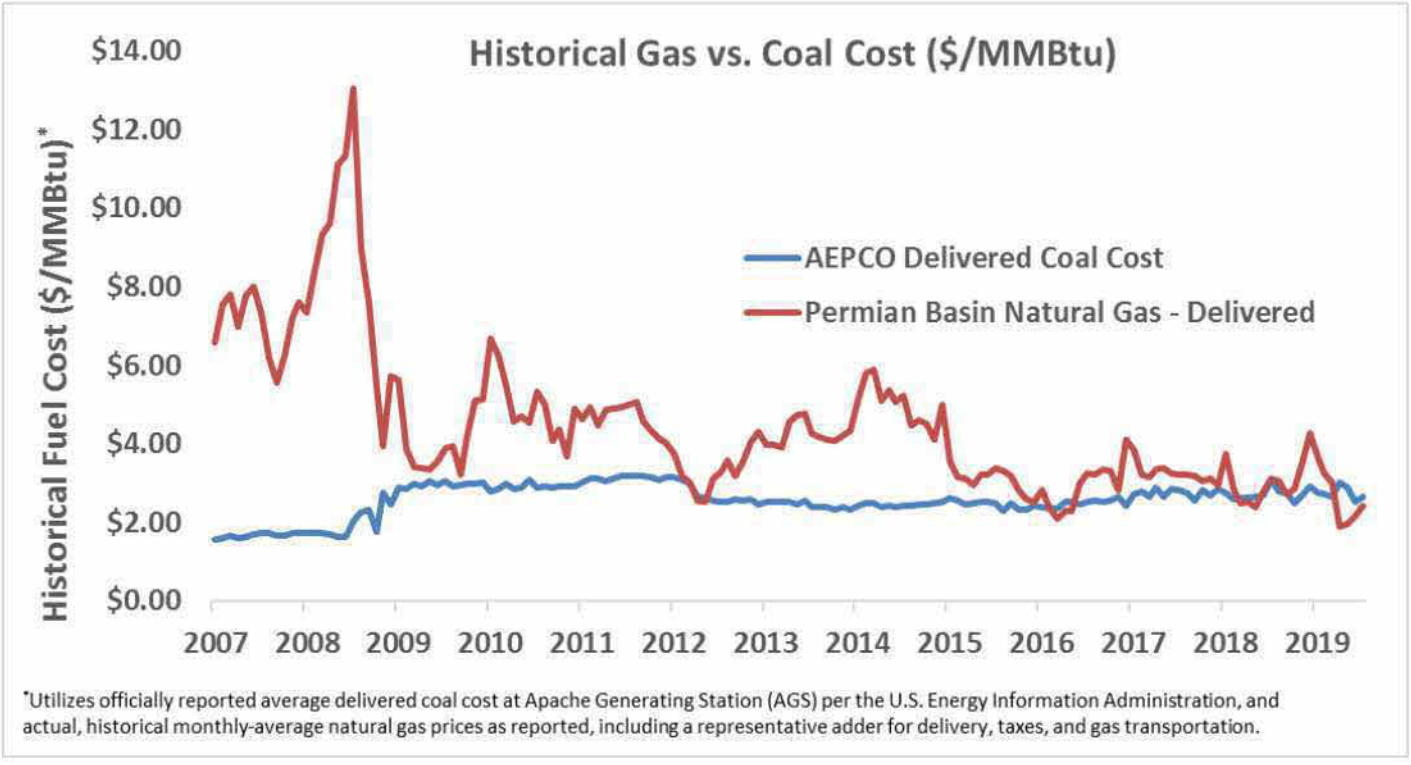
R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    f. Changes in fuel prices and availability;

In developing this IRP, AEPCO considered potential changes in fuel prices in connection with its natural gas units and one remaining coal unit, ST3. Over the last 20 years, significant market movement has been observed in the delivered cost of natural gas, while only minimal change has been observed in the delivered cost of coal. In recent years, however, the cost of natural gas to the Arizona region has been significantly more stable. This is observed in the following graph, which shows the historical cost of natural gas vs. coal at AEPCO's primary generation facility, Apache Station.



*Utilizes officially reported average delivered coal cost at Apache Generating Station (AGS) per the U.S. Energy Information Administration, and actual, historical monthly-average natural gas prices as reported, including a representative adder for delivery, taxes, and gas transportation.

To address the range of potential outcomes in the future price of natural gas, AEPCO has utilized two differing natural gas forecasts in its IRP scenario analyses. These forecasts were developed by IHS and S&P Global, both experts in commodity forecasting. AEPCO has included relevant adders to adjust for the cost of delivery to AEPCO's natural gas receipt point.

The power market is generally correlated to the natural gas market, and therefore, like natural gas, can fluctuate. The electric market is also highly sensitive to supply/demand considerations and the timing of energy production (ie. the observed duck curve phenomenon in Arizona market prices). Similar to AEPCO's approach with natural gas, AEPCO has attempted to analyze this potential for price fluctuation by utilizing a variety of forecasts of the local Arizona electric market at the Palo Verde hub. AEPCO utilizes forecasts of both IHS and S&P Global in its scenario modeling.

The gas and power forecasts utilized in AEPCO's IRP modeling are represented graphically in Section F, and further detailed in the assumptions listed behind Tab B.

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

1. Analyses to identify and assess errors, risks, and uncertainties in the following, completed using methods such as sensitivity analysis and probabilistic analysis:

    g. Construction costs, capital costs, and operating costs; and

AEPCO's assumptions for its potential resource alternatives were procured from a combination of industry experts and recent known transaction pricing.

In 2019, AEPCO's Planning and Engineering teams worked with Sargent and Lundy, an industry leader in generation deployment and cost estimation, to update its assumptions regarding new build generation costs and operating parameters (*i.e.*, capacity, heatrate curves, startup times, ramp rates, etc.).

The resulting new-build capital and Operations & Maintenance (O&M) cost values were adjusted for each year to reflect the impact of inflation by compounding of actual historical CPI inflation rate for the past 5 years, as developed by the Bureau of Labor Statistics.

Assumptions for solar, wind, and battery storage were adopted from recent studies by NREL and EIA, as shown on the following pages.

[Response continues on next page.]

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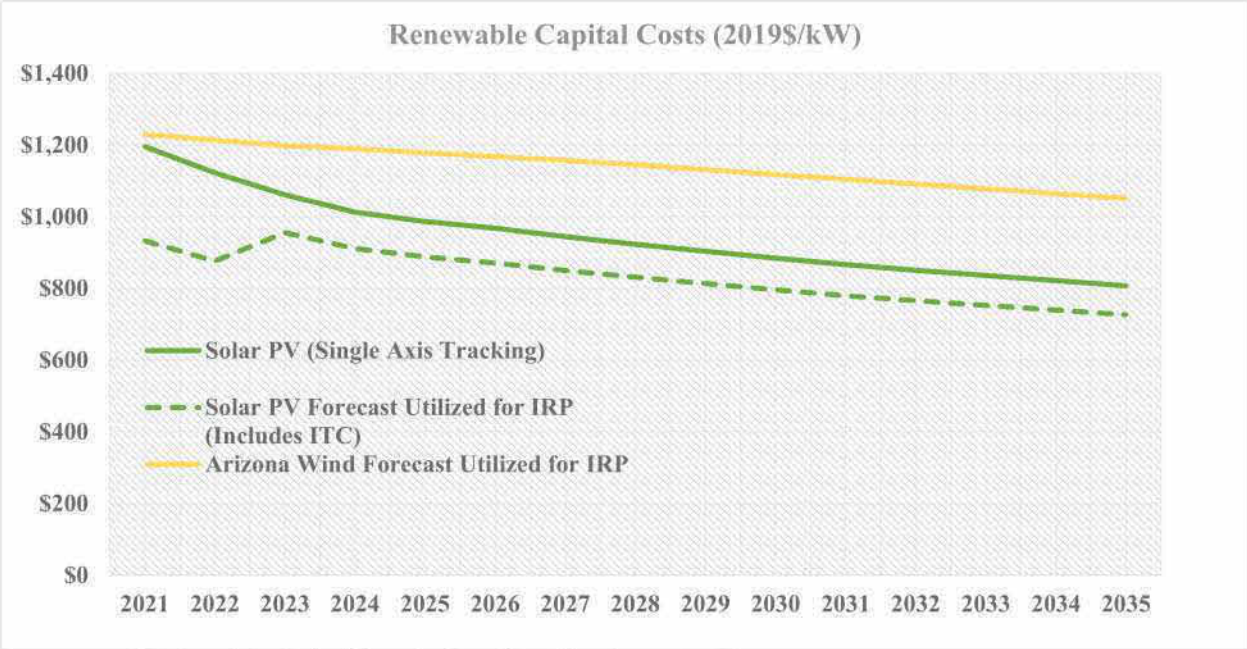
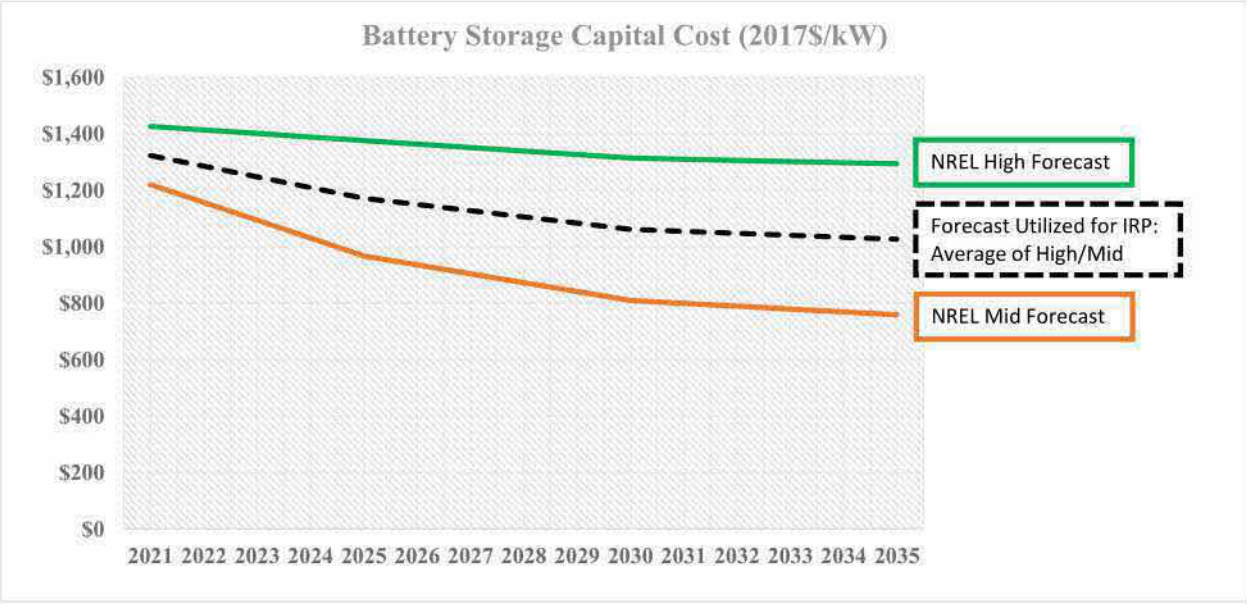


Data source: EIA Overnight Capital Costs for New Electricity Generating Plants



Data source: NREL Annual Technology Baseline for Lithium Ion Battery Chemistry

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

E.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a compilation of the following analyses and plan:

2. A description and analysis of available means for managing the errors, risks, and uncertainties identified and analyzed in subsection (E)(1), such as obtaining additional information, limiting risk exposure, using incentives, creating additional options, incorporating flexibility, and participating in regional generation and transmission projects; and

3. A plan to manage the errors, risks, and uncertainties identified and analyzed in subsection (E)(1).

Through AEPCO's normal planning activities, AEPCO regularly evaluates options and flexible opportunities to limit risk exposure in its portfolio. Specifically, on an ongoing basis, AEPCO coordinates both internally and with external entities including ACES Power Marketing to identify risks and develop hedging strategies as needed to limit exposures. This includes monitoring the forward pricing for coal, natural gas, and the local Arizona energy market, as well as partnering with ACES to identify the most economic and flexible operating plans for existing assets in order to reliably meet load obligations and minimize price risk to consumers.

Additionally, AEPCO actively seeks out opportunities to participate in regional generation and transmission projects, including those joint transmission projects identified behind Tab C.

Finally, as discussed in prior responses, AEPCO has used best efforts to develop a reliable and accurate production cost and resource expansion model, and regularly tests this model through benchmarking with other sources, and external verification of modeled outcomes. In particular, in 2019, AEPCO contracted with Burns and McDonnell to perform a verification of AEPCO's production cost and resource expansion modeling, which provided AEPCO with certain improvements over its previous process.

R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

1. Selects a portfolio of resources based upon comprehensive consideration of a wide range of supply- and demand-side options;
2. Will result in the load-serving entity's reliably serving the demand for electric energy services;
3. Will address the adverse environmental impacts of power production;
4. Will include renewable energy resources to meet or exceed the greater of the Annual Renewable Energy Requirement in R14-2-1804 or the following annual percentages of retail kWh sold by the load-serving entity:

Calendar Year	Percentage of Retail kWh Sold During Calendar Year
2010	2.5%
2011	3.0%
2012	3.5%
2013	4.0%
2014	4.5%
2015	5.0%
2016	6.0%
2017	7.0%
2018	8.0%
2019	9.0%
2020	10.0%
2021	11.0%
2022	12.0%
2023	13.0%
2024	14.0%
After 2024	15.0%

5. Will include distributed generation energy resources to meet or exceed the greater of the Distributed Renewable Energy Requirement in R14-2-1805 or the following annual percentages as applied to the load-serving entity's Annual Renewable Energy Requirement:

2007	5%
2008	10%
2009	15%
2010	20%
2011	25%
After 2011	30%

6. Will address energy efficiency so as to meet any requirements set in rule by the

Commission or in an order of the Commission;

7. Will effectively manage the uncertainty and risks associated with costs, environmental impacts, load forecasts, and other factors;
8. Will achieve a reasonable long-term total cost, taking into consideration the objectives set forth in subsections (F)(2) through (7) and the uncertainty of future costs; and

Overview of AEPCO Planning Scenarios and Methodology

AEPCO's position as a load serving entity is unique within the State of Arizona. AEPCO provides wholesale generation and transmission service predominantly to its six Class A Members. Three of the Class A Members are All Requirements Members (ARMs), while the other three are Partial Requirements Members (PRMs). AEPCO does not have an obligation to plan for the future growth needs of its PRMs, who may procure generation from sources beyond AEPCO, including, for example, independent procurement of power purchase contracts and/or construction of renewable resources. However, for modeling purposes, this IRP included analysis of potential resources available to meet AEPCO's projection of the future needs of AEPCO's ARMs and PRMs. The results from these scenarios do not in any way obligate AEPCO's Members to follow a particular resource path and are based on AEPCO's own IRP analysis. The results simply identify resource scenarios to satisfy currently forecasted Member needs considering the present market climate and assumed resource costs.

In order to provide a more complete assessment of potential resource paths, AEPCO has included six planning scenarios in its modeling. The scenarios differ from one another in four primary areas:

1. *Assumptions for future Gas/Electric Markets*
2. *Assumptions for a potential contract expiration of one of AEPCO's existing gas units.*
3. *Assumptions for a conversion of AEPCO's only remaining coal unit, ST3, to natural gas.*
4. *The Member demand required to be served by AEPCO.*

2020 Integrated 15-Year Resource Plan

The scenarios analyzed in AEPCO's 2020 IRP modeling are designed to represent a variety of potential future resource and market environments, as summarized in the following table:

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption*
1	Base Case Resources/Market	Base	IHS Markit Base Case (Q4, 2019)	IHS Q4 2019 Base Case	Full Load - 10% Mkt Exp.
2	Base Case (Limited Capacity Planning)			IHS Q4 2019 Base Case	Up to Current AC
3	Base Resources, BAU Gas/Power Prices		S&P Global/SNL (April-2020)	S&P Global/SNL (April-2020)	Full Load - 10% Mkt Exp.
4	Base Resources, BAU Gas/Power Prices (Limited Capacity Planning)				Up to Current AC
5	ST1 Non-Extension, BAU Gas/Power	ST1 Contract Expiration at YE2025			Full Load - 10% Mkt Exp.
6	ST3 Gas Conversion, BAU Gas/Power	ST3 Converted to Gas at YE2025			

*All scenarios were modeled with AEPCO Members' full load and resources for production costing, but vary between All Member Demand and current Allocated Capacity (AC) for the purpose of capacity expansion modeling.

Modeling Methodology:

In conducting its IRP analysis, AEPCO utilized a capacity-expansion and production costing model, EnCompass, to perform long-range simulations of forecasted market conditions, demand requirements, system dispatch, and energy-production costs. EnCompass is a utility-centric model which analyzes hundreds of resource combinations in order to recommend lowest-cost resource portfolios that satisfy the peak demand obligations. By varying the assumed futures AEPCO may face, this tool assists AEPCO in making decisions aimed at low-cost, low-risk, reliable power supply for its Class A Members.

Load/Demand Requirements:

AEPCO's IRP analysis considers two alternatives with respect to coverage of its Class A Members' future demand requirements. For Scenarios 1, 3, 5, and 6, AEPCO has forecast resource procurement strategies to serve all Member demand with physical capacity, except for the top 10% of annual demand, which may be met by firm purchases from the local energy market. As indicated above, these scenarios include assumptions for modeling purposes regarding forecasted PRM loads and future needs. For Scenarios 2 and 4, AEPCO has forecast resource procurement strategies for the full demand of AEPCO's ARMs, but has not assumed any obligation to plan to meet future capacity needs of AEPCO's PRMs beyond their current AC in AEPCO's units.

Relevant to all six scenarios is the fact that AEPCO's Class A Members do not have a substantial resource need until the mid-2020s when load growth and potential expiration of existing resources may create a need for capacity of roughly _____. However, if all AEPCO and Member resources are extended beyond this period, the collective capacity need of AEPCO and its Members would be _____.

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Modeling of Energy Markets

Natural gas and electric market forecasts, as displayed in the following three graphs, were obtained from S&P Global/SNL and IHS Markit- two industry experts on commodity forecasting. These forecasts provide two distinct predictions and therefore serve as bookends in AEPCO's analysis. They are incorporated into the IRP Scenarios as follows:

Base Case Market – Scenarios 1 and 2
The Base Case market forecast was developed by IHS Markit from their Q4, 2019 forecast and reflects a more aggressive perspective on future market escalation.

Business-As-Usual (BAU) Market – Scenarios 3-6
The Business-As-Usual market forecast reflects forward power market quotes as of April 1, 2020, from S&P Global/SNL. This forecast takes a conservative view of future market escalation.

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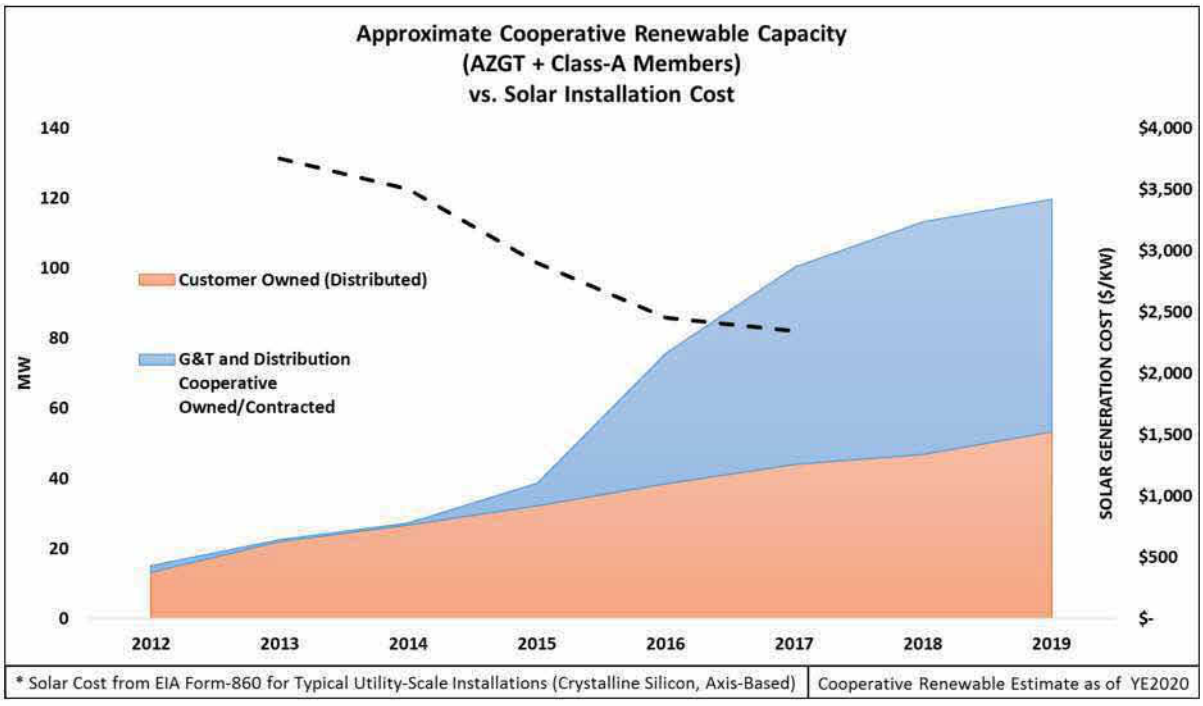
2020 Integrated 15-Year Resource Plan

Modeling of Existing and Planned Renewables and Battery Storage

As a wholesale, supply-side only utility, AEPCO is not subject to the Commission's REST, DG, or EE rules referred to in Sections F.4, F.5, and F.6 (*see* First IRP Order, Finding 5). However, AEPCO's Arizona Class A Members supply power at retail and annually submit renewable plans for approval by the Commission pursuant to R14-2-1814. Upon Commission approval of those plans, their provisions substitute for the requirements of Rules 1804 and 1805. Accordingly, AEPCO's IRP includes this renewable generation as described below.

As of the start of 2020, AEPCO and its Class A Members had approximately 120 MWs of capacity of utility grade solar in service, including both behind-the-meter and utility-owned/contracted. The following chart summarizes the progression of the solar investments, which correspond with the solar pricing reduction observed over the last 5-10 years.

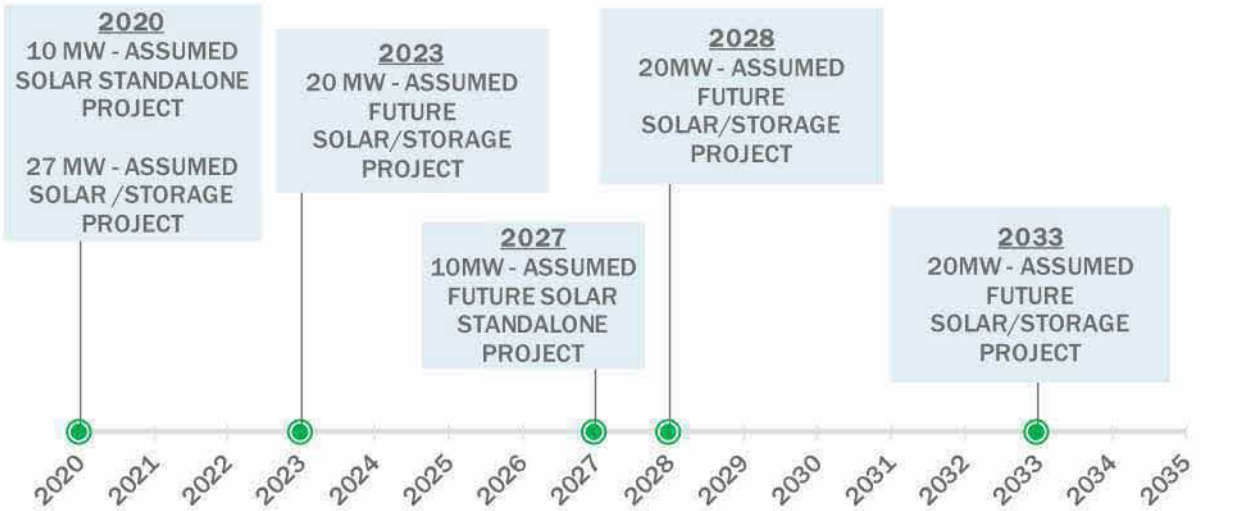


The existing solar resources reflected above, as well as the contribution from assumed growth in behind-the-meter rooftop solar, are included as a reduction in the load forecast of AEPCO's Class A Members.

AEPCO also includes in its modeling a number of anticipated future solar/storage projects, totaling 107MW, including 37MW of projects to be online by the end of 2020. These additions are reflected in AEPCO's modeling results as "scheduled" projects, and are in addition to those identified by the model for potential adoption based on least-cost capacity planning.

These assumed projects are reflected in the timeline below.

Schedule of Assumed Renewable/Storage Project Additions



*The solar and storage resources above are included in AEPCO's analysis, and modeled either as a scheduled resource or as a reduction in the Cooperatives' load forecast.

Resource Assumptions & Potential Alternatives

Given the expanded nature of this IRP, AEPCO's modeling includes all existing and planned resources owned or contracted by AEPCO or its Members directly.

In order to model new resource alternatives, AEPCO obtained new-resource operating parameters and cost data from various industry sources. For prospective thermal units, AEPCO contracted with Sargent and Lundy in 2019 to provide up-to-date information for simple-cycle, combined-cycle, aero-derivative, and reciprocating engine gas units. For prospective new-build renewable and storage resource alternatives, recent cost forecasts were utilized from published data available through EIA and NREL. Further detail on these assumptions is provided behind Tab B.

The specific generation alternatives included in AEPCO's modeling are summarized below.

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Results of AEPCO's Integrated Resource Planning Modeling

AEPCO's scenario modeling produced the following results, detailed on the proceeding pages by individual scenario. For each scenario, AEPCO has reported basic assumptions about the scenario, the future resource selections from AEPCO's planning model, and details regarding generation, load service, and costs. This information is generally presented graphically. Further numerical detail on these results may be viewed behind Tab F.

The results provided on subsequent pages are competitively confidential and, as such, are protected by the Protective Agreement between AEPCO and Staff dated March 22, 2019.

2020 Integrated 15-Year Resource Plan

Scenario 1: Base Case Resources/Market

Scenario Description:

Scenario 1 represents a "base case" view of the future, in which there are no substantial changes to AEPCO's existing resource portfolio within the planning period. Electric prices are forecasted to rise steadily with an around the clock (ATC) price annual growth rate of approximately 5% throughout the study period. Gas prices are forecasted with slightly larger average growth rate of 8% annually throughout the study period.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
1	Base Case Resources/Market	Base	IHS Q4 2019 Base Case	IHS Q4 2019 Base Case	Full Load - 10% Mkt Exp.

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 1	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2025	Recip. Engines - 18V	110	110
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2029	Solar PV	10	3.2
	2029	Battery Storage	10	10
	2030	Solar PV	10	3.2
	2030	Battery Storage	10	10
	2031	Solar PV Standalone	50	16
	2031	Arizona Wind - New Build	50	2.5
	2032	Solar PV	10	3.2
	2032	Battery Storage	10	10
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20
	2035	Solar PV	10	3.2
	2035	Battery Storage	10	10

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Scenario 2: Base Case (Limited Capacity Planning)

Scenario Description:

Scenario 2 is identical to Scenario 1 but eliminates the assumption of any capacity-planning by AEPCO for the PRMs above their current allocated capacity in AEPCO's existing units, and new resources are only recommended if they show a material cost savings. This scenario, like the other five, includes the scheduled renewable and storage resources either currently in the Cooperative pipeline or reasonably anticipated.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
2	Base Case (Limited Capacity Planning)	Base	IHS Q4 2019 Base Case	IHS Q4 2019 Base Case	Up to Current AC

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 2	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2029	Arizona Wind - New Build	10	0.5
	2030	Arizona Wind - New Build	30	1.5
	2031	Arizona Wind - New Build	10	0.5
	2032	Solar PV Standalone	40	12.8
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20
	2033	Solar PV Standalone	10	3.2

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Scenario 3: Base Resources, Business-As-Usual Market Forecast

Scenario Description:

Scenario 3 also represents a "base case" view of resources, with no contract expirations or coal to gas conversions and capacity planning for forecasted ARM and PRM loads and future needs, similar to Scenario 1. Unlike Scenario 1, however, this scenario utilizes current market forwards (Business as Usual or BAU) which forecast very little growth over the study period. The ATC electric price is anticipated to grow less than 1% annually, while the natural gas price is anticipated to grow just over 1% annually.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
3	Base Resources, BAU Gas/Power Prices	Base	S&P Global/SNL April-2020	S&P Global/SNL April-2020	Full Load - 10% Mkt Exp.

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 3	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2025	Recip. Engines - 18V	110	110
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2031	Recip. Engines - 18V	55	55
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20

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Scenario 4: Base Resources, BAU Market Forecast (Limited Capacity Planning)

Scenario Description:

Scenario 4 is similar to Scenario 3 but eliminates the assumption of capacity-planning by AEPCO for the PRMs above their current allocated capacity in AEPCO's existing units, and new resources are only recommended if they show a material cost savings. This scenario, like the other five, includes the scheduled renewable and storage resources either currently in the Cooperative pipeline or reasonably anticipated.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
4	Base Resources, BAU Gas/Power Prices (Limited Capacity Planning)	Base	S&P Global/SNL April-2020	S&P Global/SNL April-2020	Up to Current AC

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 4	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20

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Scenario 5: ST1 Non-Extension, BAU Market Forecast

Scenario Description:

Scenario 5 utilizes the same BAU market forecasts and PRM capacity planning assumption as Scenario 3, but assumes that the contract for Apache ST-1 expires at the end of 2025.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
5	ST1 Non-Extension, BAU Gas/Power	ST1 Contract Expiration at YE2025	S&P Global/SNL April-2020	S&P Global/SNL April-2020	Full Load - 10% Mkt Exp.

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 5	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2025	Simple Cycle	167	167
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2030	Recip. Engines - 18V	55	55
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20

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Scenario 6: ST3 Gas Conversion, BAU Market Forecast

Scenario Description:

Scenario 6 utilizes the market pricing and member planning assumptions seen in Scenarios 3 and 5, but includes an assumption that Apache ST3 is converted from coal (with co-firing) to run solely on natural gas.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption
6	ST3 Gas Conversion, BAU Gas/Power	ST3 Converted to Gas at YE2025	S&P Global/SNL April-2020	S&P Global/SNL April-2020	Full Load - 10% Mkt Exp.

Scenario Recommended Resource Additions:

	Year	Resource Additions Selected	Nameplate Capacity (MW)	Firm Capacity (MW)
Scenario 6	2023	Solar PV - Scheduled	20	6.4
	2023	Battery Storage - Scheduled	20	20
	2025	Recip. Engines - 18V	110	110
	2027	Solar PV - Scheduled	10	3.2
	2028	Solar PV - Scheduled	20	6.4
	2028	Battery Storage - Scheduled	20	20
	2032	Recip. Engines - 18V	55	55
	2033	Solar PV - Scheduled	20	6.4
	2033	Battery Storage - Scheduled	20	20

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R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

9. Contains all of the following:

    a. A complete description and documentation of the plan, including supply and demand conditions, availability of transmission, costs, and discount rates utilized;

As previously stated, AEPCO is a provider of wholesale generation and transmission service to its Class A distribution cooperative Members. In an effort to perform a more comprehensive IRP analysis, AEPCO has included in its planning models the future electric demand and needs of both its ARM and PRM members, even though AEPCO does not have an obligation to plan for the future growth needs of the latter. Consequently, AEPCO is not in a position to select a resource "plan" as part of this filing. In lieu thereof, AEPCO provides the following summary documentation and discussion of the conclusions from AEPCO's IRP modeling.

Key Assumptions Utilized in Modeling

The assumptions for modeled demand forecasts, prospective supply options, market conditions, and fuel supply are discussed throughout Sections E and F, as well as in the assumptions listing provided behind Tab B. Best efforts have been made to include all relevant costs for the various supply options, including cost of interconnection, balance-of-plant, and, when applicable, transmission. Notable is that the majority of resource alternatives modeled can be constructed near AEPCO's existing transmission system. Further, given the diverse location of AEPCO's wholesale Members, incremental transmission costs for prospective resource alternatives have been assumed to be de minimis with the exception of joint-participation in a future small modular reactor (SMR).

AEPCO has utilized a 5.0% discount rate, both in its resource options and in its assessment of net-present-value production expenses.

2020 Integrated 15-Year Resource Plan

Summary of Scenario Modeling Results:

The resources selected in each scenario of AEPCO's IRP modeling are shown below.

	Resource Expansion Modeling Results, By Scenario					
Year	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
2021						
2022						
2023	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2024						
2025	Recip. Engines - 18V (110MW)		Recip. Engines - 18V (110MW)		Simple Cycle (167MW)	Recip. Engines - 18V (110MW)
2026						
2027	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled
2028	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2029	Solar PV + Battery Storage (10MW)	Arizona Wind - New Build (10MW)				
2030	Solar PV + Battery Storage (10MW)	Arizona Wind - New Build (30MW)			Recip. Engines - 18V (55MW)	
2031	Solar PV Standalone (50MW) Arizona Wind - New Build (50MW)	Arizona Wind - New Build (10MW)	Recip. Engines - 18V (55MW)			
2032	Solar PV + Battery Storage (10MW)	Solar PV Standalone (40MW)				Recip. Engines - 18V (55MW)
2033	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled Solar PV Standalone (10MW)	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2034						
2035	Solar PV + Battery Storage (10MW)					

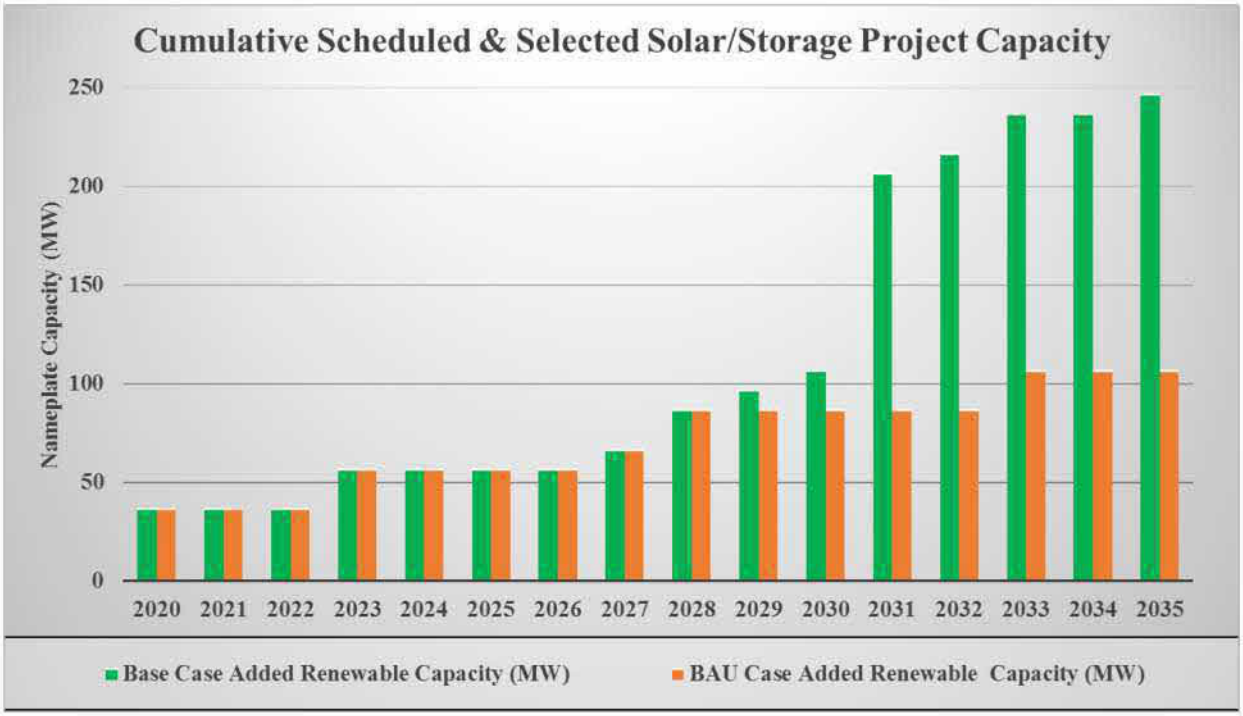
The results of AEPCO's IRP modeling had significant commonality between scenarios, and generally indicated that the least-cost solution for meeting near- and mid-term load growth and peaking needs included solar paired with battery storage and reciprocating engines.

Projected Renewable Installations and Drivers

As previously discussed, AEPCO's modeling included scheduled or assumed installation of roughly 107MW of additional solar/storage projects throughout the planning period, including 37MW which is already in the pipeline for year-end 2020. These projects account for the expectation that a certain amount of solar/storage capacity is likely to be installed by AEPCO's Class A Members, but should not be understood to reflect any defined resource plans or renewable initiatives of AEPCO's Members.

In addition to these scheduled/assumed renewable projects, the modeling results of Scenario 1 and 2 indicated the economic selection of various renewable projects as a means of supplying incremental capacity. In both of these scenarios, 50MW of stand-alone solar and 50MW of new-build wind resources are selected. In Scenario 1, which reflects a future capacity need, an additional 40MW of solar/storage projects are selected to supply capacity.

The following reflects the incremental renewable capacity as reflected in AEPCO's Base Case model results, including those built into the cooperative load forecasts and scheduled as an assumption in AEPCO's IRP modeling.



The economic selection of stand-alone renewable resources in these scenarios is substantially driven by the higher market electric prices assumed in later years of the "base case" market forecast. In particular, if market prices increase relative to forecasted renewable project costs, new-build renewables will become more economic over time. On the other hand, if market prices stay business-as-usual or continue to decrease during the period of solar production (*i.e.*, a deepening duck-curve in the market), the further addition of stand-alone solar may result in an increased net cost to members at end-of-line which is difficult to fully quantify.

Stand-alone wind generation was selected on a similar basis, and while AEPCO modeled a generic new-build Arizona wind project, opportunities for more economic wind may present themselves at any point throughout the planning period. The benefit of such opportunities are dependent on the scale/pricing of the wind project and availability of affordable transmission to connect it with cooperative loads. Accordingly, as part of its IRP Action Plan, AEPCO will actively explore opportunities to diversify its renewable mixture through the inclusion of wind resources.

The selection of solar/storage projects are driven by a combination of market economics and meeting of forecasted capacity need. While standalone renewables are effectively intermittent generation that do not perfectly align with demand peaks and must be backed-up by additional ancillary services from other resources, a solar/storage combination can be generally treated as firm capacity and capable of meeting the early evening peak that utilities now experience. As part of its Action Plan, AEPCO will work in partnership with its Members to continue exploring renewable development, considering, in particular, opportunities for additional solar/storage projects.

Least-Cost Planning for Capacity Needs

With the exception of Scenarios 2 and 4, each of the modeled scenarios indicate a potential need for capacity in the mid-2020s, due primarily to the expiration of a long-term PPA in this period. Results of these scenarios indicate that, for a capacity need between 50MW and 120MW, the least cost resource available would be a bank of reciprocating engines.

Reciprocating engines provide reliability in addition to their benefit to portfolio energy cost and reduced water usage. Due to the fast-start and ramping capabilities of these units, they are able to provide ancillary services such as spin, non-spin, and regulation to the grid. These attributes are becoming increasingly valuable as intermittent resources like solar and wind are added to the grid. As the output of these intermittent resources falls, fast-ramping generation is required to make up the difference and keep up with coincident load fluctuations.

For a capacity need greater than 120MW (as seen in Scenario 5), a Simple Cycle Gas Turbine is the indicated alternative. While providing fewer of the benefits in terms of flexibility, for larger capacity needs, these turbines reflect a lower capital cost per megawatt. Should the Cooperatives encounter a larger capacity need in the mid-2020s, this tradeoff between cost and flexibility will need to be analyzed.

As indicated in its Action Plan, AEPCO will continue analyzing the potential development of reciprocating engines to address the above-referenced needs and potential benefits in coordination with its Members. AEPCO will also study the reserve and regulation needs associated with its loads and intermittent/renewable resources and will incorporate these findings into future planning studies and analyses.

Potential Conversion of AEPCO's Remaining Coal Unit

In light of the environmental regulatory risks discussed in Sections D and E, AEPCO's IRP included Scenario 6, which analyzes the potential conversion of AEPCO's remaining coal unit, ST3, to natural gas. In addition, this scenario provides insight into the continued competitiveness of this unit on both coal and gas fired operation.

By way of background, in connection with an agreement with the EPA under Regional Haze, AEPCO converted one of its coal units, ST2, fully to natural gas and installed low-NOx burners and other upgrades on ST3. Unlike other coal units, ST3 has a unique unit design which allows it to burn natural gas in lieu of coal, as well as co-fire the two fuels in combination. Since 2018, this co-firing option has been an operating condition for ST3, and has allowed AEPCO to take advantage of recent low gas pricing for the benefit of AEPCO's Members. In addition, this co-firing alternative allows for other benefits. Through continued ability to burn gas and coal in combination, AEPCO is able to utilize ST3 to:

- Maintain an on-site fuel supply for a dispatchable resource, and partially withstand interruption or deration in natural gas supply;
- Provide firm capacity and fuel diversity to help mitigate against future increases in natural gas prices, which could occur if oil fracking becomes limited; and
- Blend fuels for continued compliance with emission requirements and production cost optimization.

Scenario 6 of AEPCO's IRP modeling considers whether full conversion to natural gas would result in savings to AEPCO's Members. This scenario was performed under a BAU market assumption, in which gas prices remained low throughout the planning period. The result showed a roughly 1% savings to AEPCO's variable fuel and power costs when compared against co-fired operations, as assumed in other scenarios.

If conversion to natural gas was analyzed under a Base Case market forecast (*i.e.*, an increased gas price), an increase in fuel and power cost is anticipated, as summer gas and power prices would rise to exceed AEPCO's forecasted energy production cost when operating on coal. In addition, whereas ST3 is both dispatchable and flexible in terms of its fuel source, AEPCO can therefore optimize its operations depending on its relative cost compared to the local energy market, as well as relative costs of fuels.

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As assessed, the cost/benefit of potential conversion of AEPCO's remaining coal unit (ST3) to natural gas is roughly break-even under a BAU market, and anticipated to be negative under a Base Case Market. Further, the unit is shown to be competitive with the local electric market, and generally provides an effective hedge against both power and natural gas prices, given its flexible fuel supply.

New Technologies & Small Modular Reactor Sensitivities

As a sensitivity, AEPCO modeled each of the IRP scenarios with an additional resource alternative of a small modular reactor (SMR). Given the current development status of this technology and the need for partnership with other facility owners, there is uncertainty whether the Cooperatives will be able to procure this alternative at the cost and timing assumed. For these reasons, the SMR alternative was included in a set of sensitivities to the IRP scenarios previously discussed. The results of these sensitivities are shown on the next page.

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	Resource Expansion Modeling Results, By Scenario					
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
2021						
2022						
2023	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2024						
2025	Recip. Engines - 18V (110MW)		Recip. Engines - 18V (110MW)		Simple Cycle (167MW)	Recip. Engines - 18V (110MW)
2026						
2027	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled
2028	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2029	SMR Unit(s) - Joint Project (120MW)	Arizona Wind - New Build (10MW)				
2030		Arizona Wind - New Build (30MW)	SMR Unit(s) - Joint Project (120MW)		Recip. Engines - 18V (55MW)	
2031		Arizona Wind - New Build (10MW)				SMR Unit(s) - Joint Project (120MW)
2032		Solar PV Standalone (40MW)				
2033	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled Solar PV Standalone (10MW)	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2034	Arizona Wind - New Build (50MW)					
2035						

The above results of the SMR sensitivities indicate that the SMR is selected in Scenarios 1, 3, and 6 in the 2029-2031 period. Comparing these results against the model results without the SMR option, the SMR is selected in lieu of peaking gas/reciprocating engines/battery storage later in the planning period. This is due to the fact that the SMR will be generally online in all hours, providing both capacity and energy during peak periods.

R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

9. Contains all of the following:

    b. A comprehensive, self-explanatory load and resources table summarizing the plan;

Whereas AEPCO is not selecting a particular resource plan as part of its IRP submission, the following pages contain a load and resources table for AEPCO's existing obligations, as well as the modeling firm capacity additions for the six scenarios considered.

[Response continues on next page.]

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As previously discussed, these modeling results do not constitute firm decisions by AEPCO or its Members.

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R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

9. Contains all of the following:

    c. A brief executive summary;

Description of IRP Scenarios Modeled:

AEPCO's position as a load serving entity is unique within the State of Arizona. AEPCO is a provider of wholesale generation and transmission service, predominantly to its Class A distribution cooperative Members. Three of the Class A Member's are All Requirements Members (ARMs), while the other three are Partial Requirements Members (PRMs). AEPCO does not have an obligation to plan for its Partial Requirements Members (PRMs) beyond their respective Allocated Capacity in AEPCO existing resources. As previously described, AEPCO's PRMs may procure generation from AEPCO and/or non-AEPCO sources.

In an effort to perform a more comprehensive IRP analysis, AEPCO has included in its planning models the future electric demand and needs of both its ARM and PRM members, even though AEPCO does not have an obligation to plan for the future growth needs of the latter. Consequently, AEPCO is not in a position to select a resource "plan" as part of this filing. In lieu thereof, AEPCO provides the following summary documentation and discussion of the conclusions from AEPCO's IRP modeling.

The six scenarios AEPCO considered in its IRP analyses are summarized in the table below.

Scenario No.	Scenario Name	Resource Scenario	Natural Gas Forecast	Energy Price Forecast	Capacity Planning Assumption*
1	Base Case Resources/Market	Base	IHS Markit Base Case (Q4, 2019)	IHS Q4 2019 Base Case	Full Load - 10% Mkt Exp.
2	Base Case (Limited Capacity Planning)			IHS Q4 2019 Base Case	Up to Current AC
3	Base Resources, BAU Gas/Power Prices		S&P Global/SNL (April-2020)	S&P Global/SNL (April-2020)	Full Load - 10% Mkt Exp.
4	Base Resources, BAU Gas/Power Prices (Limited Capacity Planning)				Up to Current AC
5	ST1 Non-Extension, BAU Gas/Power	ST1 Contract Expiration at YE2025			Full Load - 10% Mkt Exp.
6	ST3 Gas Conversion, BAU Gas/Power	ST3 Converted to Gas at YE2025			

*All scenarios were modeled with AEPCO Members' full load and resources for production costing, but vary between All Member Demand and current Allocated Capacity (AC) for the purpose of capacity expansion modeling.

These scenarios are designed to represent a variety of potential energy market future environments.

- Scenario 1 represents a "base case" view of the future, in which there are no contract expirations or coal-to-gas conversions. Electric prices are forecasted to rise steadily with an around the clock (ATC) price annual growth rate of approximately 5% throughout the study period. Gas prices are forecasted with slightly larger average growth rate of 8% annually throughout the study period.

- Scenario 2 is identical to Scenario 1 but eliminates the assumption of any capacity-planning by AEPCO for the PRMs above their current allocated capacity in AEPCO's existing units, and new resources are only recommended if they show a material cost savings. This scenario, like the other five, includes the scheduled renewable and storage resources either currently in the Cooperative pipeline or reasonably anticipated.

- Scenario 3 also represents a "base case" view of resources, with no contract expirations or coal-to-gas conversions. The scenario utilizes current market forwards which forecast very little growth over the study period. The ATC electric price is anticipated to grow less than 1% annually, while the natural gas price is anticipated to grow just over 1% annually.

- Scenario 4 is similar to Scenario 3 but eliminates the assumption of any capacity-planning by AEPCO for the PRMs above their current allocated capacity in AEPCO's existing units, and new resources are only recommended if they show a material cost savings.

- Scenario 5 utilizes the same BAU market forecasts and PRM capacity planning assumption as in Scenario 3, but also assumes that the contract for Apache ST1 expires at the end of 2025.

- Scenario 6 utilizes the same market forwards and member planning assumptions seen in Scenarios 3 and 5, but adds an assumption that Apache ST3 is converted from coal (with co-firing) to run solely on natural gas.

As an additional sensitivity, AEPCO modeled each of the foregoing scenarios with a resource alternative of a small modular reactor (SMR). This technology is still in development, and expected to become commercial in the late 2020s. The SMR units modeled are individually 60MW and installed in banks of five units or more. As a result, for AEPCO and its Members to take advantage of this technology, they would need to participate in a joint project with other utilities or power producers.

2020 Integrated Resource Planning Actual Data Filing

Scenario Modeling Results:

Given AEPCO and its Members' existing resource portfolio, the resource planning/expansion model was given the opportunity to add resources for one of two reasons:

1. The portfolio required additional capacity to avoid undue reliance on short term market capacity.
2. The portfolio's production cost was shown to be reduced if the resource were added.

The model selected the following resource additions.

	Resource Expansion Modeling Results, By Scenario					
Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
2021						
2022						
2023	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2024						
2025	Recip. Engines - 18V (110MW)		Recip. Engines - 18V (110MW)		Simple Cycle (167MW)	Recip. Engines - 18V (110MW)
2026						
2027	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled	PV Standalone (10MW) - Scheduled
2028	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2029	Solar PV + Battery Storage (10MW)	Arizona Wind - New Build (10MW)				
2030	Solar PV + Battery Storage (10MW)	Arizona Wind - New Build (30MW)			Recip. Engines - 18V (55MW)	
2031	Solar PV Standalone (50MW) Arizona Wind - New Build (50MW)	Arizona Wind - New Build (10MW)	Recip. Engines - 18V (55MW)			
2032	Solar PV + Battery Storage (10MW)	Solar PV Standalone (40MW)				Recip. Engines - 18V (55MW)
2033	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled Solar PV Standalone (10MW)	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled	Solar/Storage (20MW) - Scheduled
2034						
2035	Solar PV + Battery Storage (10MW)					

With regard to the SMR sensitivity, the modeling indicated that, if available at the assumed pricing, the units would substitute for the installation of a smaller bank of peaking gas/reciprocating engines and some solar/storage capacity later in the planning period.

General Conclusions of IRP Study:

The results of AEPCO's IRP studies suggest the following conclusions:

1. Installation or contracting of additional renewable resources may have economic benefit to the cooperative portfolio, depending on associated capacity needs and market conditions in the planning period. Specifically, up to 140MW (nameplate) of new renewables were selected in the planning period under Base Case market conditions in which market prices steadily rise over time. This is in addition to the 107MW of solar/storage capacity which is either in the pipeline or built-in as an assumption in AEPCO's modeling.

2. In a number of scenarios studied, the development of natural gas reciprocating engines in the mid-2020s was the least-cost option identified for meeting capacity needs between 50MW and 120MW. In addition to modernizing AEPCO's generating portfolio, reciprocating engines would provide additional benefits to the grid and integration of further stand-alone renewables over time. However, further assessment of this course of action is required, and may be impacted by the following:
    a. Continuation or expiration of existing unit and PPA contracts in the 2020-2030 timeframe.
    b. Interest of AEPCO's Members at the scale necessary to achieve the lower capital cost per kW anticipated; and
    c. Thorough assessment of system regulation and ancillary service needs to integrate anticipated future intermittent renewables.

3. In modeled sensitivities in which participation in a Small Modular Reactor project is included, this option is selected in the 2030 timeframe. This opportunity would require partnership with other utilities and continued development of this relatively new technology.

4. Analysis of the potential conversion of AEPCO's remaining coal unit (ST3) to natural gas yielded negligible cost savings and only where persisting low gas prices were assumed. Given AEPCO's success in co-firing between natural gas and coal to take advantage of lower gas prices and maintain flexibility, the modeling results indicate that conversion to natural gas should only be considered in the face of future regulatory or environmental requirements.

5. Consistent with AEPCO's historical IRP analyses, under the scenarios in which AEPCO does not include the capacity needs of its PRMs, and the gas and electric market remains favorable, AEPCO's modeling identified no additional resource procurements/changes in the near term other than assumed solar/storage capacity additions or those identified for market economics.

2020 Integrated Resource Planning Actual Data Filing

R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

9. Contains all of the following:

    d. An index to indicate where the responses to each filing requirement of these rules can be found; and

Please see pages iii through viii, near the front of AEPCO's IRP submission, for the index of responses.

2020 Integrated Resource Planning Actual Data Filing

R14-2-703. Load-serving Entity Reporting Requirements

F.) A load-serving entity shall, by April 1 of each even year, file with Docket Control a 15-year resource plan that:

9. Contains all of the following:

e. Definitions of the terms used in the plan.

Abbreviation	Description
AC	Allocated Capacity
ACC	Arizona Corporation Commission
ACE	Affordable Clean Energy [Rule]
ADEQ	Arizona Department of Environmental Quality
AEPCO	Arizona Electric Power Cooperative, Inc.
AGS	Apache Generating Station
AHP	Available Hydro Power
Anza	Anza Electric Cooperative, Inc.
ARM	All Requirements Member
ATC	Around-the-Clock
BART	Best Available Retrofit Technology
BAU	Business-As-Usual
BNSF	Burlington Northern and Santa Fe Railway
BSER	Best System of Emission Reduction
CARM	Collective All Requirements Member(s)
CC1	Combined Cycle 1
CCR	Coal Combustion Residuals
CMM	Continuous Mercury Monitoring
CO2	Carbon Dioxide
CPI	Consumer Price Index
CROD	Contract Rate of Delivery
CWDF	Combustion Waste Disposal Facility
Duncan	Duncan Valley Electric Cooperative, Inc.
EIA	Energy Information Administration
EIM	Energy Imbalance Market
EMS	Energy Management System
EPA	Environmental Protection Agency
EPNG	El Paso Natural Gas
Graham	Graham County Electric Cooperative, Inc.
GT1	Gas Turbine 1
GT2	Gas Turbine 2
GT3	Gas Turbine 3
GT4	Gas Turbine 4
HRI	Heat Rate Improvement
IRP	Integrated Resource Planning

2020 Integrated Resource Planning Actual Data Filing

Abbreviation	Description
ISO	Independent System Operator
MATS	Mercury and Air Toxics Rule
Mohave/MEC	Mohave Electric Cooperative, Inc.
NAAQS	National Ambient Air Quality Standards
NGCC	Natural Gas Combined Cycle
NOx	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
O&M	Operations and Maintenance
PaR	Planning and Risk
PEMS	Portable Emissions Measurement System
PRM	Partial Requirements Member
PPA	Purchase Power Agreement
PM	Particulate Matter
REST	Renewable Energy Standard and Tariff
RFI	Request for Information
RFP	Request for Proposal
RUS	Rural Utilities Service
SAT	Single Axis Tracking
SCR	Selective Catalytic Reduction
SLC-IP	Salt Lake City Area Integrated Project
SMR	Small Modular Reactor
SNCR	Selective Non-Catalytic Reduction
SoCal	Southern California
SO2	Sulfur Dioxide
SRP	Salt River Project and Power District
SRSG	Southwest Reserve Sharing Group
ST1	Steam Turbine 1
ST2	Steam Turbine 2
ST3	Steam Turbine 3
Sulphur/SSVEC	Sulphur Springs Valley Electric Cooperative, Inc.
Trico	Trico Electric Cooperative, Inc.
WECC	Western Electricity Coordinating Council

2020 Integrated 15-Year Resource Plan

R14-2-703. Load-serving Entity Reporting Requirements

H.) With its resource plan, a load-serving entity shall include an action plan, based on the results of the resource planning process, that:

1. Includes a summary of actions to be taken on future resource acquisitions;
2. Includes details on resource types, resources capacity, and resource timing; and
3. Covers the three-year period following the Commission's acknowledgment of the resource plan.

Over the next three years, AEPCO plans:

- To work with its Members regarding the potential development of renewable resources, including opportunities for additional solar/storage facilities.
- To actively explore opportunities to diversify the Cooperatives' renewable mixture through the inclusion of wind resources, including assessment of associated transmission options.
- To continue its analysis of potential development of reciprocating engines, with the intent of:
    - Meeting future requirements for additional peaking resources.
    - Support integration of further intermittent/renewable generation in the planning period.
    - Modernizing AEPCO's generating mixture and improving the Cooperatives' position with respect to potential entrance into an energy imbalance or ISO market.
- To study the reserve and regulation needs associated with future Cooperative loads and intermittent/renewable resources.
- To monitor the development of emerging technologies for the benefit of Cooperative customers, including potential emergence of Small Modular Reactor generation.

As part of the above, AEPCO will continue to monitor its load forecasts, resource needs, and market developments, and will continue to evaluate resource options identified in this IRP.

2020 Integrated 15-Year Resource Plan

List of Information Included in Tabs/Appendices

Tab A – AEPCO 2019 Load Forecast Report

Tab B – Modeling Assumptions for AEPCO IRP Studies

Tab C – Excerpt of AEPCO 10-yr Transmission Plan: Description of Planned Projects

Tab D – Draft Construction Workplan for Transmission Projects

Tab E – Projected Emission Quantities from Modeling Scenarios

Tab F – Additional Numerical Results and AEPCO Modeling Sensitivities

Tab A – AEPCO 2019 Load Forecast Report

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Tab B – Modeling Assumptions for AEPCO IRP Studies

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Tab C – Excerpt of AEPCO 10-yr Transmission Plan: Description of Planned Projects

PROJECTS OVERVIEW

On November 9, 2016, AEPCO's Board of Directors approved the 2017-2020 CWP. The CWP identified several projects that will be included in this year's Ten-Year Plan as planned projects. Projects with projected in-service dates outside of the current CWP window with a high likelihood of construction will be included as planned projects in this report. Additional projects proposed after the approval of the current CWP will be included in this document. Projects holding a higher degree of uncertainty with no firm in-service dates will be included as "Additional Projects under Consideration."

PLANNED PROJECTS

Arizona Public Service (APS) Bagdad Interconnection Project: This project expands AEPCO's Bagdad Substation and Interconnect. The expansion includes the installation of a 115/69 kV transformer, 115 kV breaker, switches, and one-mile of 115 kV transmission line to intersect APS' Willow Lake – Bagdad 115 kV line. This connection will provide mutual backup for APS' loads in the town of Bagdad, as well as Mohave Electric Cooperative Inc.'s (MEC) loads west of Bagdad. This project will be completed and ready for service December 2019. The driving factor for this project is reliability for both APS and MEC.

Valencia to Central Arizona Project (CAP) Black Mountain 115 kV Line: This line segment was approved by the ACC Line Siting Committee on February 10, 2010, and by the Commission on April 14, 2010 (Case #152, Decision #71649), as part of the North Loop to Rattlesnake 115 kV Line Project. This project proposes the installation of a 2.6-mile 115 kV line interconnection between AEPCO and CAP. This line will extend from the existing AEPCO Valencia Substation to tie into the turning structure of the 115 kV CAP line that heads directly north two miles to the existing CAP Black Mountain Substation. This project also includes an installation of a sectionalizing breaker at Western's Rattlesnake Substation and a 14.4 MVA capacitor bank at the Valencia Substation. The driving factor for this project is reliability for AEPCO, Trico Electric Cooperative, Inc. (Trico), and CAP systems. The projected in-service date is March of 2020.

Freeport McMoRan Inc. (FMI) Morenci – Tucson Electric Power (TEP) Joint Project: This project involves FMI purchasing a new 345/230 kV 400 MVA transformer for Morenci Water and Electric's (MW&E) Copper Verde Substation. The two existing transformers at Copper Verde will be relocated to AEPCO's transmission system.

Due to a significant increase in load, FMI had submitted an interconnection request. The corresponding study identified several issues, including an overload at the existing AEPCO Greenlee SW 345/230 kV transformer. Starting in 2015, AEPCO, TEP, and FMI began discussions of reliability issues in this territory, including the aforementioned AEPCO transformer overload. Partially, these reliability issues within AEPCO's system can be attributed to the opening of AEPCO's Morenci-Phelps Dodge (PD)/Morenci 230 kV transmission line interconnection between AEPCO and FMI's Morenci mine. The opening of this transmission line was based on a Reliability Coordinator (RC)/TEP/FMI request (No interconnection requests for opening this line had been filed by FMI).

AEPCO held discussions with FMI regarding this project proposal in 2016. The discussion concluded with FMI not finding solutions to necessary construction outages and financing. FMI has since rejected invitations for further negotiations.

This project has been proposed to alleviate system overloads described in the previous paragraph. FMI, to date, has not elected to participate in this project. The driving factor for this project is reliability. Under the described circumstances and to maintain compliance with reliability standards, the existing Greenlee 345/230 kV transformer may have to be taken out of service during certain heavy loading conditions. This project currently has no scheduled in-service date.

Ft. Huachuca - Kartchner Interconnection: This project will connect AEPCO's 69 kV Kartchner Substation to TEP's 138 kV system at Fort Huachuca with the installation of a new 4.5-mile 69 kV transmission line. AEPCO, Fort Huachuca, and TEP are currently in discussions of the project agreement. The driving factor for this project is reliability. The projected in-service date is 2021.

Schieffelin Project: This Cochise County project includes looping the AEPCO Butterfield to San Rafael 230 kV line into a new substation (Schieffelin) with a 230/69 kV transformation and connection to the existing Sulphur Springs Valley Electric Cooperative, Inc. (SSVEC) Tombstone Junction Substation. Schieffelin Substation will be connected to APS' Boot Hill Substation by a 10.4-mile 69 kV line. The driving factor for this project is reliability. This project includes various SSVEC and APS sub-projects in preparation of this interconnection, including the construction of a new Hereford – Palominas 69 kV transmission line and interconnection between SSVEC and APS (2019), and various system improvements on APS' and SSVEC's systems. The project in-service date is summer of 2021.

Thornydale – Saguaro/Rattlesnake Interconnection and Marana Substation Rebuild: This project ultimately includes an interconnection from a 115 kV Thornydale Substation, with APS' Saguaro and Western Area Power Administration's (WAPA) Rattlesnake 115 kV Substations, as well as a rebuild of AEPCO's Marana Substation. This project will be completed in several phases, starting with Phase 1 in 2022 involving the 115 kV interconnection between Thoryndale and Saguaro. Phase 2, projected for 2023, involves the construction of the Adonis 115 kV Substation with the Thoryndale-Saguaro interconnection being looped into the new substation. Finally, Phase 3 project for 2024 includes a 115 kV interconnection between Thoryndale and Rattlesnake. Additionally, Marana Substation will be rebuilt and reconfigured with connections to WAPA's Electrical District 5 (ED5) and Rattlesnake Substations, removing the Marana Tap configuration. Currently, this project is undergoing additional discussions with neighboring utilities. The driving factor for this project is reliability. The overall projected in-service date is 2024.

ADDITIONAL PROJECTS UNDER CONSIDERATION

AEPCO continues to study the feasibility of additional projects for inclusion into future Ten-Year Plans that have been deferred from previous Ten-Year Plans, for various reasons.

A brief description of each of these projects is for information purposes only. A driving factor is provided for each of these projects per the ACC's Biennial Transmission Assessment recommendations. These projects are under consideration but have not advanced far enough to have a projected in-service date.

AEPCO will continue to hold discussions with potential project participants throughout 2020, and if refined project scopes have been established with agreements from project participants, and with approvals from governing boards, these projects may be reflected in the next Ten-Year Plan.

Apache/Hayden to San Manuel 115 kV Line: This project has been presented in previous AEPCO Ten-Year Plans, but has been deferred beyond the Ten-Year Plan horizon. It was approved by the ACC on June 26, 2018 (Decision #76765). This project proposes the installation of a 4.5-mile 115 kV line from the existing AEPCO Apache to Hayden 115 kV line to the existing APS San Manuel Substation. Currently, this project is under study as a result of a large generator interconnection request to APS. This project will require an agreement with APS and additional studies. The driving factor for this project is reliability.

CAP 115 kV Line Tap to AEPCO Sandario Substation: This project proposes that a new 0.6-mile 115 kV line be tapped off of the existing CAP Sandario to Brawley 115 kV line, to tie into the existing AEPCO Sandario Substation. This line project will require an agreement from CAP and additional studies. The driving factor for this project is reliability.

Tab D – Draft Construction Workplan for Transmission Projects

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Tab E – Projected Emission Quantities from Modeling Scenarios

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Tab F – Additional Numerical Results & AEPCO Modeling Scenarios

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