

INTEGRATED RESOURCE PLAN UPDATE // SPRING 2019



FOCUSED ENERGY. For life.

1. Executive Summary	1
2. Compliance Overview	2
2.1 Purpose of Annual Updates	2
2.2 Ameren Missouri’s Approach to its Annual Update	2
2.3 Implementation of Current Preferred Resource Plan	3
3. Planning Environment	6
3.1 Environmental Regulations	6
3.2 Supply-Side Resource Review.....	10
3.3 Transmission and Distribution Review	17
3.4 Demand-Side Resource Review	20
3.5 Uncertain Factors.....	23
3.5.1 Price Scenarios.....	23
3.5.2 Scenario Modeling	28
3.5.3 Independent Uncertain Factors.....	29
3.5.4 Coal Price Forecasts.....	29
3.6 Energy and Peak Forecasting.....	30
4. Compliance References	32

1. Executive Summary

Ameren Missouri continues to execute on the preferred resource plan presented in its 2017 Integrated Resource Plan (IRP) filing. Our plan is focused on transitioning our generation fleet to a cleaner and more fuel diverse portfolio in a responsible fashion and achieves reductions in CO₂ emissions of 35 percent by 2030, 50 percent by 2040, and 80 percent by 2050, compared to 2005 levels. The plan includes continued customer energy efficiency program offerings, retirement of approximately half of our coal-fired generating capacity, which will be reaching the end of its useful life, and expansion of renewable generation, including the addition of at least 700 MW of wind generation by the end of 2020 and 100 MW of solar generation by 2027. By executing our plan, we will ensure that our customers' long-term electric energy needs are met in a safe, reliable, cost-effective and environmentally responsible manner.

Key steps that Ameren Missouri has taken since the filing of our 2017 IRP include:

- Received approval from the Missouri Public Service Commission (the Commission or the MoPSC) for the construction and acquisition of two wind projects – the up to 400 MW Terra-Gen High Prairie wind facility in northeast Missouri and the up to 157 MW EDF Brickyard Hills wind facility in northwest Missouri.
- Continued to work with developers for the acquisition of further wind projects to bring total wind resource additions to at least 700 MW by the end of 2020.
- Received approval from the MoPSC for our third three-year portfolio of customer energy efficiency programs and the addition of demand response programs under the Missouri Energy Efficiency Investment Act (MEEIA).
- Continued projects to close coal ash basins and switch to dry handling of coal ash ahead of EPA mandated deadlines.
- Published our report on climate-related risks, *Building a Cleaner Energy Future*, in March, 2019.
- Began to evaluate the proposed Affordable Clean Energy (ACE) rule regulating carbon dioxide emissions from electric energy centers.
- Filed our Smart Energy Plan with the Commission pursuant to Senate Bill 564. This forward-looking plan is designed to upgrade the electric grid and bring significant benefits to customers for decades. The plan includes \$5.3 billion of electric and \$1 billion in wind investments from 2019 through 2023 that will, among other things, accelerate our investment in smart grid technologies and renewable energy as we build the grid of the future, while keeping electric rates stable and predictable through the state's first-ever rate caps. The plan also

accelerates smart energy infrastructure construction that will drive job creation and economic development in Missouri.

2. Compliance Overview

2.1 Purpose of Annual Updates

Annual updates are required by 4 CSR 240-22.080(3). The rules indicate that the purpose of annual updates is to ensure that members of the stakeholder group have the opportunity to provide input and to stay informed regarding the items listed below.

- The utility's current preferred resource plan (see section 1)
- The utility's progress in implementing the resource acquisition strategy (see section 2.3)
- The status of the identified critical uncertain factors (see section 3.5)
- Analyses and conclusions regarding any special contemporary issues identified by the Commission (see Compliance References at the end of this report for the location of specific discussion on each issue)

Ameren Missouri has created this annual update report to satisfy the intended purpose established in the IRP rules and has updated its assessment of general planning conditions. Each item explicitly cited in the rules is addressed in the referenced chapter or section of this report as noted above.

2.2 Ameren Missouri's Approach to its Annual Update

In its Order in File No. EO-2012-0039 establishing special contemporary issues to be evaluated by Ameren Missouri in its 2012 IRP Annual Update, the Commission noted that, "the requirement to examine special contemporary issues should not be allowed to expand the limited annual update report into something more closely resembling a triennial compliance report." Ameren Missouri agrees with the Commission that the scope and depth of an IRP Annual Update should not be comparable to that for a triennial IRP filing. Also in its Order in File No. EO-2019-0065 establishing special contemporary issues for Ameren Missouri's 2019 IRP Annual Update, the Commission stated if the Company believes it has already adequately addressed some of these issues in its IRP filing or some other filing, then it does not need to undertake any additional analysis because of the special contemporary issue designation. The Commission stated the same approach is acceptable if the Company intends to address any of the issues in a future IRP filing.

Ameren Missouri

On that basis, Ameren Missouri has relied heavily on the groundwork developed in its 2017 IRP as a basis for reviewing its assumptions and analysis and reporting its findings.

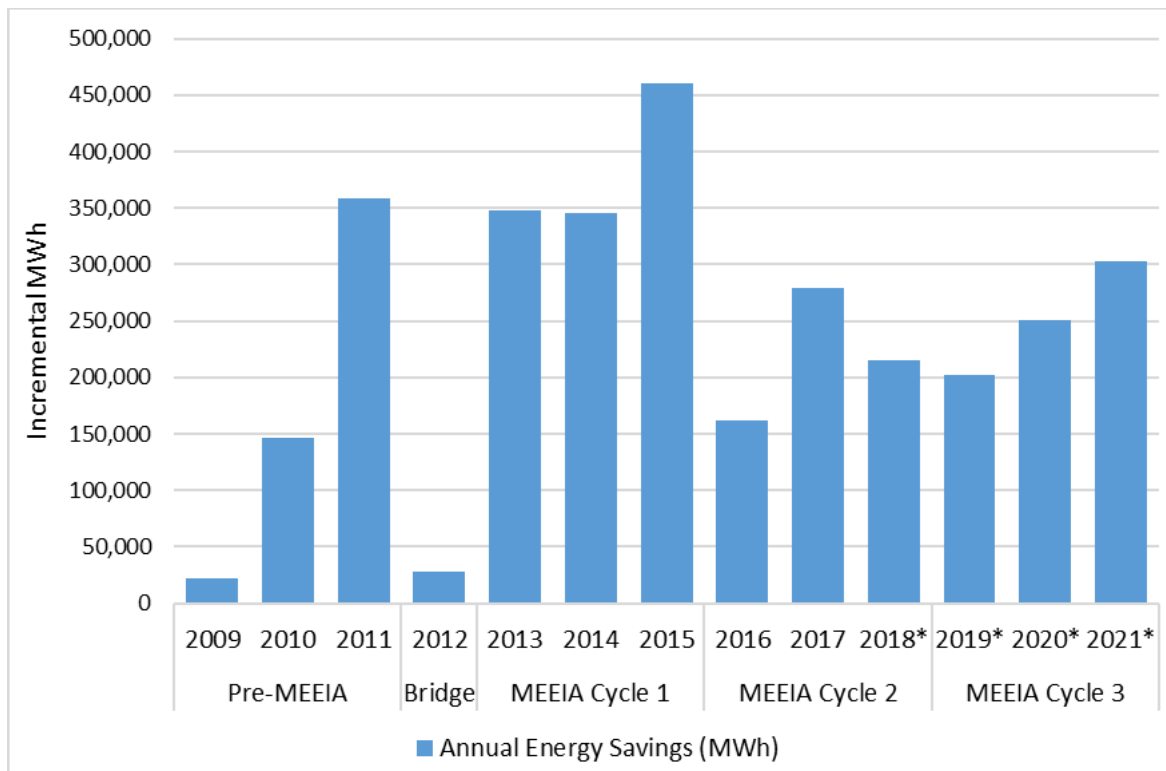
The Company also views the IRP Annual Update in its proper role as just that, an update on the nature of key variables and the conclusions that follow. Based on the conclusions drawn from the review and analysis discussed here, the Company believes that its preferred resource plan, as presented in its 2017 IRP filing, is still appropriate at this time. Should the Company's continued planning and consideration of relevant issues lead to a conclusion that its Preferred Resource Plan is no longer appropriate and should be replaced with a new Preferred Resource Plan, the Company will notify the Commission of its decision in accordance with 4 CSR 240-22.080(12).

2.3 Implementation of Current Preferred Resource Plan

Ameren Missouri adopted a new preferred resource plan with its 2017 IRP filing. In that filing, the Company indicated that its new Preferred Resource Plan includes the addition of 700 MW of new wind generation and 100 MW of new solar generation and implementation of energy efficiency and demand response programs, as well as continued pursuit of demand side management (DSM) programs throughout the entire planning horizon at the Realistic Achievable Potential level. The Company also indicated that the implementation of future programs will depend on policies that reflect timely cost recovery, proper alignment of incentives, and appropriate earnings opportunities, as required by the MEEIA. Also included in the filing was an updated implementation plan. Following is an item-by-item update on the status of the implementation steps listed in the Company's 2017 IRP filing.

Demand-Side Resources Implementation

MEEIA requires that utility incentives be aligned with helping customers use energy more efficiently by providing timely recovery of program costs, elimination of the throughput disincentive and timely earnings opportunities. Ameren Missouri has successfully implemented its second three-year cycle of approved MEEIA programs (third three-year cycle of programs when counting pre-MEEIA activities) which commenced on March 1, 2016. Figure 2.1 below provides a summary of the annual energy savings, with 2012 being a "bridge" year from the Company's pre-MEEIA programs to the MEEIA programs.

Figure 2.1 Historical Ameren Missouri Energy Efficiency Program Savings

*2018-2021 results are net-as-filed; evaluation results are not yet available

Ameren Missouri filed its application for its third MEEIA portfolio of demand-side programs on June 4, 2018. Ameren Missouri worked with stakeholders to reach agreement on a portfolio that includes a three-year term for residential and business efficiency and demand response programs, while integrating a six-year implementation for income-eligible offerings. Included was a cost recovery and earnings opportunity mechanism that addressed the stakeholders' concerns with the Company's initial proposal. A stipulation and agreement was filed on October 25, 2018. The Commission unanimously approved Ameren Missouri's MEEIA 2019-21 stipulation on December 5, 2018.

Table 2.1 below provides a summary of the annualized energy savings and peak reduction goals, as well as budgets, for residential, business and income qualified programs in the Company's approved MEEIA 2019-21 portfolio. It should be noted that the goals and budgets are re-aligned on calendar years, therefore 2019 reflects a 10-month program year.

Ameren Missouri

Table 2.1: MEEIA 2019-21 Implementation Plan (Annualized Savings)

	2019*	2020	2021	2022	2023	2024	Total
Estimated Program Net Savings MWh							
Low Income**	10,443	13,858	15,201	12,112	13,115	12,915	77,644
Residential ***	112,823	84,450	82,467	na	na	na	279,740
Business	78,696	152,847	205,044	na	na	na	436,587
TOTAL estimated net energy savings (MWh @ meter)	201,962	251,155	302,712	12,112	13,115	12,915	793,970
Estimated Program Net Savings MW							
Low Income **	2.4	3.4	4.1	4.2	4.7	4.7	23.4
Residential ***	57.4	45.8	47.9	na	na	na	151.1
Business	44.4	64.5	77.4	na	na	na	186.2
TOTAL estimated net demand savings (MW @ meter)	104.2	113.7	129.3	4.2	4.7	4.7	360.8
Estimated Program Costs (\$ millions)							
Low Income**	\$5.41	\$6.85	\$8.19	\$9.85	\$11.04	\$10.98	\$52.32
Residential ***	\$26.58	\$28.39	\$29.37	na	na	na	\$84.34
Business	\$18.15	\$31.58	\$40.93	na	na	na	\$90.66
TOTAL Program Costs (\$ millions)	\$50.14	\$66.83	\$78.48	\$9.85	\$11.04	\$10.98	\$227.31

* The MEEIA 2019-21 goals and budgets are re-aligned on calendar years, therefore 2019 is a 10 month program year.

** The MEEIA 2019-21 plan included Low Income programs for a 6 year period and all other programs for a 3 year period.

*** Due to a one year persistence for the Behavior Modification Program, this is only included once in the table above.

The above summary matches Appendix A from the MEEIA 2019-21 Plan with all costs allocated.

Renewables

Ameren Missouri solicited proposals from wind developers through a request for proposal process for wind projects in order to meet Missouri's Renewable Energy Standard (RES) requirements as laid out in the preferred resource plan. Ameren Missouri signed the first contract for an up to 400 MW project in Northeast Missouri in April 2018 and applied for a certificate of convenience and necessity (CCN) in that same month. The CCN was granted by the Commission in October 2018. The Company signed a contract and applied for a CCN in October 2018 for an up to 157 MW wind project in Northwest Missouri. The Commission granted the CCN in March 2019. Ameren Missouri continues negotiations for a third wind project located in either Missouri or surrounding states to complete the required wind build-out for RES compliance and expects to have all three projects on-line by the end of 2020.

The Company is evaluating options for the deployment of solar resources, including resource investments required by Senate Bill 564.

Meramec Energy Center

Ameren Missouri reaffirmed its decision to retire the Meramec Energy Center by the end of 2022 in the 2017 IRP and is taking the necessary steps for retirement including the

implementation of transmission system upgrades and required notifications to the Midcontinent Independent System Operator, Inc. (MISO).

Environmental

The Company continues to refine its estimates for environmental mitigation as part of its ongoing environmental compliance analysis. Dry fly ash systems and new wastewater treatment plants were completed at both the Labadie and Rush Island Energy Centers in 2018. Dry bottom ash projects were completed at Rush Island in 2018. Two remaining dry bottom ash systems at Labadie, on Units 1 & 2, are scheduled to be completed in 2019. Construction has started on dry ash handling and wastewater treatment systems at Sioux, with scheduled completion in 2020.

3. Planning Environment

3.1 Environmental Regulations

Ameren Missouri has reviewed its assumptions on the eventual requirements for pending environmental regulations. Table 3.1 summarizes the current and pending environmental regulations for which Ameren Missouri must implement mitigation measures, along with expectations for compliance requirements for certain potential regulations.

Ameren Missouri has made significant investments to comply with existing environmental regulations and maintain a sufficient compliance margin. Rules proposed or promulgated since the IRP filing in September of 2017 include revisions to the Clean Power Plan, final attainment designations for the national ambient air quality standards for ozone, revisions to the Coal Combustion Residual Rule and the proposal of Missouri regulations for the management of coal combustion residuals.

Ameren Missouri

Table 3.1: Current & Pending Environmental Regulations

Regulatory Driver	Summary Requirements	Regulation Status	Compliance Timing
Cross-State Air Pollution Rule (CSAPR)	Reduction in NOx and SO2 allowances vs. CAIR; New allowances for trading program (state level caps)	EPA implemented Phase 1 starting on 1/1/2015. On September 7, 2016 EPA finalized an update effective December 27, 2016 to lower the seasonal NOx (May-Sept) allocations beginning with the 2017 ozone season.	Phase 1: 1/1/2015 Phase 2: 1/1/2017
Revisions to National Ambient Air Quality Standards (NAAQS)	Lower PM, NOx and SO2 limits; Expansion of non-attainment areas	SO2 final rule June, 2010; EPA issued a final designation of "unclassifiable" for area around Labadie; final designations for all areas 2016-2020.	SO2: 2017 - 2020
		Fine particulate (PM2.5) lowered 1/15/2013; Attainment designations 03/2015; State Implementation Plans 2018.	Missouri in attainment EPA will review standard in 2020
		Ozone standard lowered, final rule 12/2015; Attainment designations complete April 2018; St. Louis/Metro East area marginal nonattainment and size of area reduced.	EPA will review standard in 2020
Mercury and Air Toxics Standards (MATS)	Reduction in emissions of Mercury, HCl (proxy for acid gases) and particulate emissions (proxy for non-mercury metals)	Final rule effective April 16, 2012. Compliance required by April 16, 2015.	Rush Island and Sioux Energy Centers compliant on April 16, 2015; Labadie and Meramec (units 3 & 4) Energy Centers received MDNR approved 1-yr extensions and compliant on April 16, 2016.
Clean Air Visibility Rule (CAVR)/Regional Haze Rule	Application of Best Available Retrofit Technology (BART); Targets reduction in transported SO2 and NOx; status of CSAPR may require state to change approach.	Final rule issued by EPA in 1999; States submitted progress reports in 2013; CSAPR resolution may require changes to state rule.	EPA finalized a rule that will move the next deadline from July 31, 2018 to July 31, 2021.
Clean Water Act Section 316(a) Thermal Standards	Implementation through NPDES permit conditions	Evaluation covered by NPDES permits	2015 - 2020
Clean Water Act Section 316(b) Protection of Aquatic Life	Case-by-case determination of controls required to meet entrainment standards; national standard for impingement	Final rule from EPA effective October 2014	Study plans 2014; Studies 2015 - 2017; Compliance 2022 - 2024
Waters of The United States (WOTUS)	Protection of additional streams and tributaries	Final rule issued June 2015; the rule was challenged in several federal district courts. Case-by-case review of implementation while litigation continues. The EPA and Corps of Engineers proposed revisions to the definition on February 14, 2019; comment period closes April 15, 2019.	Final rule expected in 2019
Revisions to Steam Electric Effluent Limitations Guidelines (ELG)	Lower effluent emissions for existing parameters; Installation of wastewater treatment facilities; Implemented through NPDES permit conditions	EPA proposal April 19, 2013; final rule Sept 30, 2015; linked to CCR rule; revised rulemaking for steam electric power plant discharges effective January 4, 2016. The EPA has stayed compliance deadlines pending review of the final rule.	2018 - 2023
Coal Combustion Residuals (CCR)	Conversion to dry bottom ash and fly ash; Closure of existing ash ponds; Dry disposal in landfill	Final determination from EPA on haz/non-haz Dec 2014; final rule April 2015, effective October 19, 2015. Federal legislation (WINN Act) to revise rule signed December 16, 2016. Missouri state rule proposed 2/01/2019; comment period closed 3/28/2019.	2018 - 2023
Clean Air Act Regulation of Greenhouse Gases (GHG)/Affordable Clean Energy Rule (ACE)	New Source Performance Standard (NSPS) for new, modified, reconstructed units	New unit NSPS re-proposed Jan 2014; final rule effective 12/22/2015.	New unit NSPS applies 1/8/2014
		EPA proposed revisions to rule in December, 2018; comments closed 3/18/2019. EPA issued final rule for modified and reconstructed units effective 12/22/2015.	Modified/reconstructed applies 6/18/2014
	State emission limits for existing sources	Clean Power Plan final rule was stayed by Supreme Court 2/9/2016; EPA proposed repeal and replacement of CPP with ACE rule in 2018; DC Circuit Court holding case in abeyance pending EPA replacement of CPP rule.	CPP was not implemented due to Supreme Court stay ACE rule proposed in August 2018 Final ACE rule expected June 2019

Clean Air Act Regulation of Greenhouse Gases/Affordable Clean Energy Rule¹

In 2015, the EPA issued the Clean Power Plan, which would have established CO₂ emissions standards applicable to existing power plants. The United States Supreme Court stayed the rule in February 2016, and the Clean Power Plan was not implemented. The EPA has proposed to repeal and replace the Clean Power Plan. The U. S. EPA proposed the Affordable Clean Energy (ACE) rule in August 2018 as a replacement for the Clean Power Plan. The public comment period concluded in October 2018. The proposed rule would establish emission guidelines for states to follow in developing plans to limit CO₂ emissions from coal-fired electric generating units. The EPA proposes to define certain efficiency measures as the Best System of Emission Reduction (BSER). The EPA also proposed to update the New Source Review Permitting program to incentivize efficiency improvements at existing power plants. The EPA is expected to finalize the Affordable Clean Energy Rule in mid-2019.

The proposed ACE rule has several key components: 1) Defines BSER for greenhouse gas (GHG) emissions from existing power plants as on-site, heat-rate efficiency improvements; 2) provides states with a list of “candidate technologies” that can be used to establish standards of performance and be incorporated into their state plans; 3) updates EPA’s New Source Review permitting program to incentivize efficiency improvements at existing power plants; and 4) aligns Clean Air act section 111(d) general implementing regulations to give states adequate time and flexibility to develop their state plans.

The Clean Air Act sets a framework in section 111(d) under which EPA issues guidelines that determine BSER for existing sources, and the states develop plans to establish standards of performance for their existing sources. The states then submit those plans to EPA for approval. The proposal gives states the flexibility to design a plan that, in the state’s judgment, will work best under its particular circumstances. EPA also solicited comment on the range of state flexibility for state plans including the use of trading and averaging between sources.

EPA is proposing to provide states three years to develop state plans. The EPA would have 12 months to act on a complete state plan submittal. If states do not submit a plan or their submitted plan is not acceptable, EPA will have two years to develop a federal plan. A possible timeline based on a final rule in 2019 is for state plans to be due in 2022, EPA approval in 2023 and initial compliance no earlier than 2024.

¹ File No. EO-2019-0065 Paragraph 1.O (1)-(3)

Attainment Designations for the National Ambient Air Quality Standard (NAAQS) for Ozone

The air quality in the St. Louis area continues to improve. The EPA re-designated the St. Louis and Metro-East Illinois area to be in attainment with the 2008 eight-hour ozone standard. The EPA lowered the ambient standard for ozone from 75 ppb to 70 ppb in December 2015. EPA made final designations for about 85 percent of the country in November, 2017, however those designations did not include the St. Louis/Metro-East Illinois area. The EPA released final designations for the St. Louis/Metro-East Illinois area as well as the other remaining areas of the country on April 30, 2018. The final designation for the St. Louis area reduces the size of the nonattainment area by removing Jefferson County in Missouri and Monroe County in Illinois, as well as all but a small portion (Boles Township) of Franklin County in Missouri. The St. Louis/Metro-East Illinois ozone nonattainment area includes St. Louis City, St. Louis County and St. Charles County in Missouri and Madison and St. Clair counties in Illinois. The St. Louis area is designated as marginal which is the least severe category. Marginal areas have ozone design values from 71 ppb to 81 ppb. The St. Louis area has a design value of 72 ppb based on the last three years of monitoring data.

Coal Combustion Residuals

The federal Coal Combustion Residuals (CCR) rule was published April 17, 2015, and became effective October 19, 2015. It establishes national standards for the management of CCRs. The CCR rule is self-implementing, however in December 2016, Congress amended federal solid waste statutes to classify coal combustion residual units as "sanitary landfills" and authorized the states under the WIIN Act to develop programs that, following EPA approval, would act in lieu of the federal rule. Under the WIIN Act, each state may submit to EPA a permitting program or other system of approval to achieve compliance with the CCR rule or "other State criteria that [EPA] determines to be at least as protective as" that rule.² The amendments afford states flexibility in establishing a CCR management program, and state agencies are not required to adopt verbatim the federal CCR Rule. On February 1, 2019, the Missouri Department of Natural Resources (MDNR) proposed state rules to implement a CCR management program. The public comment period closed on March 28, 2019, and it is expected that the MDNR will finalize the state rules and submit the rules to EPA for review and approval in 2019.

While mitigation has been included in our analysis for current and certain potential future regulations, further changes in regulations are possible. The Company continues to monitor the potential for further changes in regulation that may impact resource planning

² Solid Waste Disposal Act ("SWDA") §4005 (d)(1)(B), 42 U.S.C. §6945(d)(1)(B)

Ameren Missouri

decisions. Table 3.2 below shows the capex and O&M assumptions for environmental mitigation.

Table 3.2: Environmental Mitigation Costs³

Facility	Environmental Mitigation	Regulation	In-Service Year	Cost (2019 & beyond, incl. AFUDC) \$ Million	Annual O&M \$ Million
Meramec	Ash Pond Closure	CCR	2022	39	0.3
	Activated Carbon	MATS	2016	-	0.2
	Groundwater Monitoring	CWA	2023	1	0.1
Meramec	Total Environmental			40	0.5
Labadie	Ash Pond Closure	CCR	2020	31	0.3
	Landfill Cells	CCR	2023	107	-
	Dry Ash Conversion	CCR	2019	35	-
	Waste Water Treatment Plant	ELG	2018	-	0.7
	Activated Carbon	MATS	2016	-	4.1
	Aquatic Life	CWA 316	2022	35	0.4
	Groundwater Monitoring	CWA	2021	1	0.1
Labadie	Total Environmental			209	5.5
Rush Island	Ash Pond Closure	CCR	2020	14	0.3
	Waste Water Treatment Plant	ELG	2018	-	0.4
	Activated Carbon	MATS	2014	-	1.2
	Fine Mesh Screens	CWA 316 (b)	2024	25	0.4
	Groundwater Monitoring	CWA	2023	0	0.1
Rush Island	Total Environmental			39	2.3
Sioux	Ash Pond Closure	CCR	2021	21	0.3
	Landfill Cells	CCR	2022	42	-
	Dry Ash Conversion	CCR	2020	64	-
	Waste Water Treatment Plant	ELG	2020	31	0.3
	Fine Mesh Screens	CWA 316 (b)	2023	16	0.2
	Activated Carbon	MATS	2014	-	0.1
	Groundwater Monitoring	CWA	2023	1	0.1
Sioux	Total Environmental			174	0.9
TOTAL	Total Environmental			462	9

3.2 Supply-Side Resource Review⁴

Ameren Missouri has analyzed cost and performance characteristics of a wide range of supply side resources in its 2017 IRP and has documented its analysis in Chapter 6 of its 2017 IRP filing. New supply side resources that were evaluated in the alternative resource plans in the 2017 IRP include the following;

³ File No. EO-2019-0065 Paragraph 1.S (1)-(9)

⁴ File No. EO-2019-0065 Paragraph 1.T

Ameren Missouri

- Gas Combined Cycle
- Gas Simple Cycle Combustion Turbine
- Wind
- Solar
- Pumped Hydroelectric Energy Storage
- Nuclear

Since the development of costs for supply side resources for the 2017 IRP, Ameren Missouri's expectations associated with owning these resources, with the exception of solar and wind, have not materially changed.

For solar and wind resource costs, Ameren Missouri solicited input from stakeholders and received Lazard's Levelized Cost of Energy Analysis version 12.0 and NREL 2018 Annual Technology Baseline (ATB) from Renew Missouri and Clean Grid Alliance, respectively. Ameren Missouri updated its cost and capacity factor expectations using these recommendations along with costs based on the four wind projects that it either has signed agreements with or is in negotiation for.

Table 3.3: 2017 IRP vs 2019 Annual IRP Update Wind and Solar Characteristics (2019 \$)

Resource Option	Project Cost with Owner's Cost, Excluding AFUDC (\$/kW)	First Year Fixed O&M Cost, (\$/kW)	First Year Variable O&M Cost, (\$/MWh)	Assumed Annual Capacity Factor (%)
Missouri Wind - 2017 IRP	\$1,973	\$28	\$0	40%
Wind - 2019 IRP Annual Update	\$1,594	\$16	\$0	41%
Solar - 2017 IRP	\$1,665	\$17	\$0	19%
Solar - 2019 IRP Annual Update	\$1,314	\$9	\$0	20%

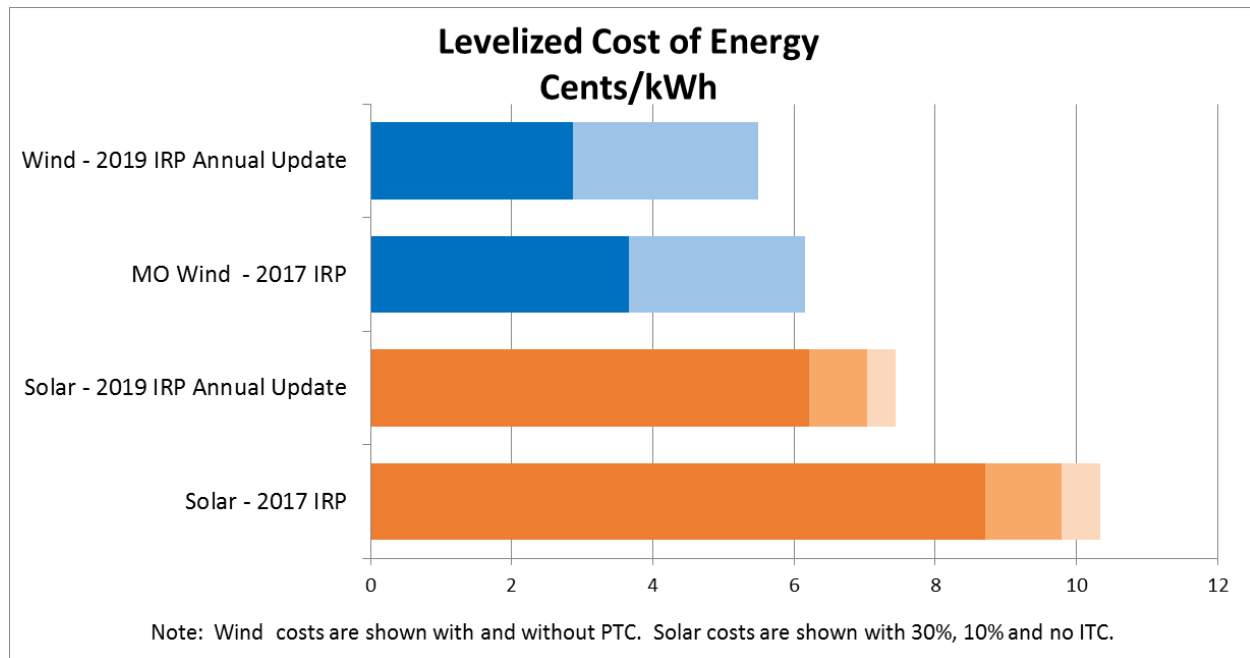
It should be noted that solar costs reported in this table are based on AC power rating; NREL solar cost data has been converted to a \$/kW AC rating using an inverter loading ratio of 1.3 as included in the 2018 ATB.⁵

⁵ <https://atb.nrel.gov/electricity/2018/index.html?t=su>

Ameren Missouri

The levelized cost of energy for wind and solar resources using the same financial assumptions as in the 2017 IRP are shown in the figure below. The estimates show the effects of cost declines from the 2017 IRP to 2019 IRP Annual Update. The figure also displays the reduction in costs when production cost credits (PTC) for wind, and investment tax credits (ITC) for solar are utilized.⁶

Figure 3.1: Levelized Cost of Energy



Because this is only an annual update and not a full IRP, Ameren Missouri has not performed a new screening analysis. A new supply side screening analysis will be performed as part of the development of Ameren Missouri's 2020 IRP. This will include both renewable and energy storage resources, which will be screened for inclusion in alternative plans, including any plans reflecting alternative retirement dates for existing coal-fired resources.⁷

Renewable Energy Offerings⁸

Senate Bill 564, among other things, allows the Commission to approve investments in small or pilot projects if the project is designed to advance the electrical corporation's knowledge of deploying certain technologies, including gaining operating efficiencies that result in customer savings and benefits.

⁶ File No. EO-2019-0065 Paragraph 1.K

⁷ File No. EO-2019-0065 Paragraph 1.R

⁸ File No. EO-2019-0065 Paragraph 1.E; File No. EO-2019-0065 Paragraph 1.M (1)-(2); File No. EO-2019-0065 Paragraph 1.N; File No. EO-2019-0065 Paragraph 1.Q

Ameren Missouri

Ameren Missouri filed its Smart Energy Plan with the Commission in February, 2019. The Smart Energy Plan includes a pilot portfolio to test microgrid technology, net metering inverters and other technologies to better understand future grid characteristics and needs and potential customer impacts. We plan to work with customers and universities to develop a test facility with a working microgrid and applicable technologies so we can evaluate the benefits associated with these devices and how they can best be integrated into the energy grid. Also included in the plan are investments in community solar and solar partnership projects along with other solar opportunities.

Ameren Missouri has initiated, and the Commission has approved, a number of programs that are designed to address the corporate social responsibility and/or renewable energy purchasing goals of commercial, industrial, institutional, and public-sector customers for increased access to renewable energy and distributed generation resources. For years, the Company has offered its Pure Power program – a voluntary program through which customers can obtain the benefits of renewable energy through the acquisition of the renewable energy credits associated with existing renewable generation. However, in response to increasing customer expectations for a more direct connection between their usage and energy generated by specific renewable generation facilities developed on their behalf, the Company has also initiated its Community Solar Program and its Renewable Choice Program.

The Community Solar Program is an option available to residential and small commercial customers to participate in the development of one megawatt of local solar resources and offset a part of their energy usage with generation from that resource. The Renewable Choice Program is a larger program, with up to 400 MW of wind capacity, designed for larger power users to choose to obtain access to renewable energy to offset some or all of their energy usage. The Renewable Choice Program was deliberately designed with municipal and other government entities' preferences for renewable energy in mind to enable the Company to accommodate goals or resolutions such as those adopted by the Board of Aldermen for the City of St. Louis. The program is only available to larger commercial and industrial customers that meet a demand qualification requirement, but it is available to all government entities regardless of the total demand of the electric account or accounts.

While both of these programs are limited in scale by the terms approved by the Commission, they both represent opportunities to meet growing customer demand for renewable energy options and to learn about customer interest in, and satisfaction with, the program structures. That information and continued assessment of customer preferences and needs create the potential to expand the existing programs in the future or develop new or related programs to further assist customers in meeting their renewable energy goals. The agreement that enabled the implementation of the Renewable Choice Program specifically contemplates that, once that program is fully subscribed, interested

Ameren Missouri

stakeholders will convene to determine whether and how additional renewable capacity should be developed in support of those goals.

Ameren Missouri is currently looking for ways to provide solar energy options to its low-income customers pursuant to the Joint Agreement signed by stakeholders resolving certain issues raised with our 2017 IRP. The Company participated in the Missouri NAACP Energy Justice Roundtable on October 30, 2018, to brainstorm with participants and explore options. The Company received input from NAACP representatives in the subsequent months regarding the potential elements of an effective low-income solar program. Ameren Missouri is working towards having a program proposal in the near future for its customers that reside in low-income communities.

On August 30, 2018, Ameren Missouri announced the donation of \$5 million over the next three years to provide energy assistance and new programs for our limited income customers to address immediate needs and help them keep bills lower over time. In 2018, approximately \$1 million was allocated to Ameren Missouri's energy assistance partners to provide immediate energy assistance to customers impacted by last summer's extreme temperatures. The remaining \$4 million will be administered by Ameren Missouri's community partners through 2020 for additional energy-assistance programs and long-term sustained energy improvements, such as weatherization support and equipment repair.

Senate Bill 564 also requires Ameren Missouri to invest \$14 million in utility-owned solar facilities through the end of 2023. Under this act, an electrical corporation's decision to invest in utility-owned solar facilities shall be deemed prudent, and permission from the Commission for construction of such facilities shall not be required. Ameren Missouri has not made a final decision on the specifics of how it will comply with this portion of the new law. The scope of implementation may include investment in some of the projects described above, specifically in our efforts to develop solar projects in low income areas of the Company's service territory.

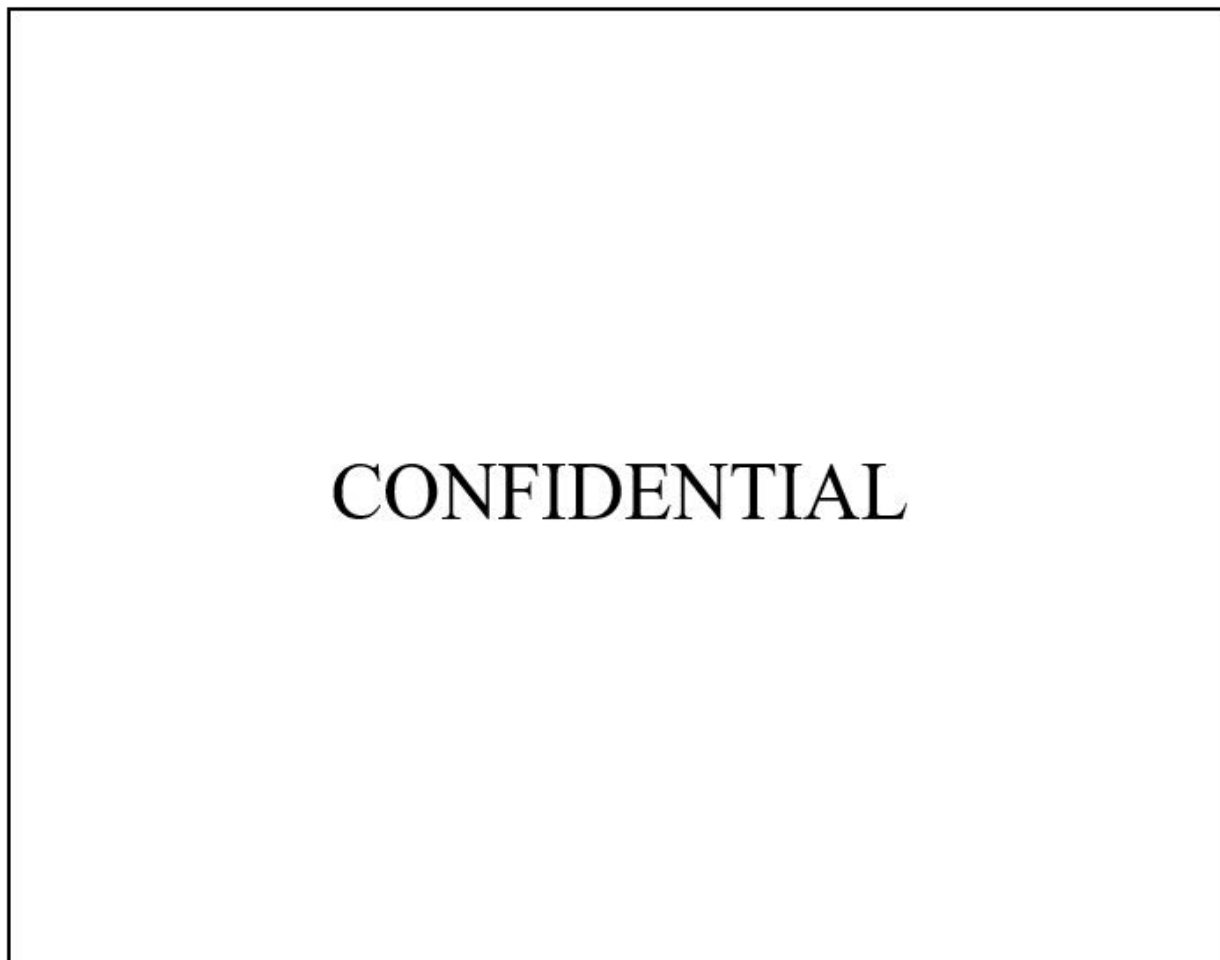
Existing Resources

A detailed analysis for Ameren Missouri's existing resources was included in the 2017 IRP along with evaluation of alternative resource plans that included early retirement of two of its coal-fired energy centers. Analysis of these alternative resource plans resulted in significant expected cost increases to customers. Figure 3.2 shows the total variable costs (fuel and non-fuel) for coal energy centers in the MISO market. With the exception of Meramec Energy Center, which is scheduled to retire by the end of 2022, all Ameren

Ameren Missouri

Missouri coal-fired energy centers are in the lowest-cost quartile of the coal-fired plants within the MISO footprint.⁹

Figure 3.2: MISO Coal Plant Variable Cost (Fuel and Non-Fuel)^{10}**



**

Securitization¹¹

As indicated in the MoPSC Order in File No. EO-2019-0065, some point to securitization as a potential tool for transitioning utility generation fleets from coal to renewable generation. While there are likely to be significant complexities when it is executed, the concept itself is relatively straightforward, and securitization has been used by utilities or proposed for the recovery of costs in the context of utility restructuring, retirement of coal and nuclear generation, investments in pollution controls, and disaster recovery due to

⁹ File No. EO-2019-0065 Paragraph 1.L

¹⁰ Source: FERC Form 1 via SNL (Major 500 – 514 for Individual Energy Centers)

¹¹ File No. EO-2019-0065 Paragraph 1.F

Ameren Missouri

major events such as storms and fires. For the specific application of securitization referenced in the MoPSC Order, the process includes the following steps:

- The utility determines that accelerated retirement of a coal-fired generator or generators is appropriate.
- The utility establishes a Special Purpose Entity (SPE) to issue bonds backed by a statutorily guaranteed revenue stream via a non-bypassable charge on utility customers' bills; the bonds thus carry the highest ratings from the rating agencies.
- The SPE issues the bonds and exchanges the net proceeds (after issuance costs) for the remaining balance of the utility coal assets being retired.
- The principal and interest payments on the bonds are serviced by the guaranteed customer revenue stream via a trust.
- The utility uses the proceeds received from the SPE to invest in renewable generation assets.

As is evident, the employment of securitization in this context is dependent on the adoption of appropriate and workable legislation, followed by several key decisions on the part of the utility. First, the utility must determine that it is appropriate to accelerate the retirement of coal-fired assets. As with any resource planning decision, a decision to accelerate the retirement of coal generation includes consideration of long-term economics, customer rate impacts, emission reduction goals, and other objectives as well as risks including those associated with reliability, system operations, financing, and regulation. Such considerations were accounted for in the Company's 2014 decision to accelerate the retirement of its Meramec Energy Center and the depreciation of its associated plant investment.

Second, the utility must determine that it is appropriate to expand its investment into renewable generation beyond its existing plans in conjunction with the aforementioned accelerated coal retirement. Such a decision necessarily includes consideration of those factors mentioned above in the discussion of coal retirement decisions. It may also include consideration of compliance with renewable portfolio standards, such as Missouri's RES, programs offering customers the option of meeting their energy needs with renewable energy, such as Ameren Missouri's Renewable Choice Program, or other planning and policy drivers.

Third, the utility must determine that the use of the securitization approach outlined above is an appropriate step for executing on the first two decisions. By its nature, securitization is a complex undertaking that involves coordination among the utility seeking to execute the strategy, rating agencies who establish the ratings for the bonds, and the MoPSC, which reviews and approves the securitization plans. Because implementing securitization is complex, it is extremely important that the decisions regarding coal retirement, renewable investment, and the securitization strategy are meticulously

Ameren Missouri

planned. It may also involve some degree of pre-approval for utility actions undertaken to execute the plan. The utility must also consider other alternatives for achieving its objectives with respect to potential accelerated coal retirements and additional investments in renewable generation. Such alternatives may include accelerating the retirement date of coal units and increasing the annual depreciation expense as a result, traditional financing, and tax equity financing. Ameren Missouri continues to execute its acquisition of renewable generation pursuant to its preferred resource plan using a traditional financing approach.

At this time, Ameren Missouri has not yet made decisions with regard to accelerating the retirement of coal generation beyond its Meramec Energy Center nor any additional investments in renewable generation associated with such accelerated retirements. While no such decisions have yet been made, the availability of securitization as a potential tool for accelerated coal retirements and renewable investments could provide another viable option and additional planning flexibility for utilities when considering such decisions. The potential value of this option and flexibility depends in large part on the specific provisions of the necessary statutory authority that would have to be carefully crafted through the legislative process. Ameren Missouri is open to further discussion and exploration of this idea to determine its value and viability.

3.3 Transmission and Distribution Review¹²

Ameren Missouri continues to maintain and replace aging infrastructure to serve its customers. The Company has filed its Smart Energy Plan that includes investments to transform its system to a stronger and smarter grid to meet its customers' rising expectations for greater reliability, security and control over their energy usage. Ameren Missouri will be implementing over 2,000 Smart Energy Plan projects to provide customers with improved safety, security, reliability and resiliency, while also committing to keeping rates stable and predictable. Some examples of these projects are:

- Automating the electric distribution system to help isolate problems and restore service more quickly following storms and other power interruptions by deploying switching devices and accompanying communications technologies to build self-healing power lines, which are designed to significantly reduce the length of outages.
- Hardening the electric distribution system to better withstand severe weather. This includes 12,000 new utility poles for storm hardening, many fortified with composite materials and stronger equipment.

¹² File No. EO-2019-0065 Paragraph 1.G

Ameren Missouri

- Employing smart grid technologies (e.g., relaying, monitoring, fault information, communications) as we upgrade existing substations and construct new ones.
- Developing a communications network to monitor and enable analytics from connected grid devices. To enable the grid of the future, the system requires a smarter, stronger and more secure communications network with far greater bandwidth. Our plan is to develop a wireless footprint statewide, starting with the St. Louis metropolitan area.

Smart Meter Program¹³

The Smart Meter Program (SMP) is part of Ameren Missouri's Smart Energy Plan and is being implemented to modernize Ameren Missouri's metering system. Ameren Missouri was one of the first utilities in the country to install Automated Meter Reading (AMR) technology across its system more than 20 years ago to help maintain customer affordability. While AMR has provided benefits to our customers, it doesn't allow for two-way information flow and can't provide real-time information to our customers. The SMP includes replacing all electric meters, gas modules, and the associated communication network in the Missouri service territory over approximately seven years beginning in 2019:

- 1.2 million electric advanced metering infrastructure (AMI) meters (residential and commercial/industrial) with remote connect/disconnect (RCD) capability for residential meters.
- 130,000 gas AMI modules (residential and commercial/industrial, not including new gas meters, only the communication module of the meters).
- RF mesh network, enabling two-way communication.
- Modifying the existing Meter Data Management System and Head End System to accept Ameren Missouri data.
- Upgrading the Dorsett Meter Shop to facilitate the receipt and testing of AMI meters.
- Creation of an Ameren Missouri Network Lab and Integrated Operations Center.

This project is estimated to cost a total of \$392.4 million in capital investment based on a 100% deployment assumption by December 2025.

The project cost estimate includes 15 months to design and build out the digital (information technology) system, followed by five and a half years for electric meter, gas module, and network purchase and deployment. As a provision within the Smart Energy Plan (SEP), this project is subject to a yearly expenditure cap of 6% of Ameren Missouri's total capital spend which dictates the length of the deployment. Network deployment will

¹³ File No. EO-2019-0065 Paragraph 1.D

Ameren Missouri

begin in early 2020, electric meter deployment will begin in mid-2020, and gas module deployment will begin in 2024.

Table 3.4: SMP Capital Investment (\$Million)

Prior Costs	2019	2020	2021	2022	2023	2024	2025
\$6	\$49	\$48	\$62	\$57	\$51	\$60	\$59

The SMP team has identified and categorized the AMI benefits into 2 categories:

- **Operational Benefits** – \$309 Million reduction in operations and maintenance (O&M) costs. Examples of these cost reductions are the elimination of AMR meter read fees paid to our AMR vendor and elimination of fees paid to contractors to manually disconnect and reconnect customers.
- **Customer Benefits** – These benefits may still have a small impact on O&M costs, but mainly are a customer benefit or improved functionality.

Customer Benefits:

Lower Overall Cost of Service:

Reduction in truck rolls for numerous activities (Service Extenders, Reprogramming, and Testing).

This will allow for additional focus on other customer priorities.

Will allow for efficient deployment of line assets during storms and outage events

AMI technology will detect anomalous energy patterns, reducing non-technical usage, avoiding unneeded energy costs and increase revenue

Improved Billing:

Reduction in estimated billing

Increased Meter accuracy

Outage Management:

Will allow Ameren MO to obtain outage information quickly and send out notification when power has been restored

Increased Customer Functionality (Future Development):

Increased Rate Options such as TOU

Peak Time Rewards (Demand Response)

Convenience Pay (Pre-Pay)

Manage Energy Use:

Empowers customers to manage energy usage through alerts or viewing the web

Enables customers to analyze how their living habits, home improvements, and the weather impact their bill

Energy Efficiency:

Improved web functionality provides energy-saving recommendations

Ameren Missouri

Allows customers to build a tailored energy savings plan and track progress

Enhanced Services:

Allows customers to take advantage of targeted promotions based on their customer profile

Faster reconnect response time

Ameren Missouri SMP implementation can be adapted to meet customer expectations for new energy products and services such as demand response, additional time of use tariffs, and improvements to the intelligent storm response systems. Additionally, customers will see improved usage insights and outage communications. The financial analysis for the Smart Meter Program is provided in Appendix A.

Ameren Missouri had analyzed conservation voltage reduction (CVR) in its 217 IRP. In that filing, Ameren Missouri indicated that smart meters that can communicate voltage levels along the distribution circuit need to be in place for CVR. With the SMP implementation, a CVR program that saves energy may be possible in the near future.¹⁴

Transmission Costs¹⁵

Ameren Missouri updated its cost expectations for transmission upgrades needed for Meramec Energy Center retirement to \$92 Million (nominal \$). Ameren Missouri's expectations on transmission interconnection costs for new supply-side resources as well as the transmission system upgrade costs that might be incurred following retirement of its existing coal-fired energy centers, with the exception of Meramec Energy Center transmission upgrade costs have not materially changed since the 2017 IRP. These costs can be found in Chapter 7 of the 2017 IRP filing.

3.4 Demand-Side Resource Review

Ameren Missouri began offering energy efficiency programs to its customers in 2009, and has implemented the largest portfolio of utility energy efficiency programs in Missouri with its MEEIA Cycle 1 & 2 energy efficiency portfolios in 2013-2018. Ameren Missouri's third cycle of MEEIA energy efficiency programs was approved by the Commission on December 5, 2018, and Ameren Missouri began implementation in March 2019.

Ameren Missouri has conducted a comprehensive DSM potential study with the assistance of a nationally recognized independent contractor to estimate demand-side resource potential that was used in its 2017 IRP and that informs the MEEIA Cycle 3

¹⁴ File No. EO-2019-0065 Paragraph 1.H

¹⁵ File No. EO-2019-0065 Paragraph 1.C

Ameren Missouri

energy and demand savings and cost estimates. The comprehensive DSM potential study, which was included in the 2017 IRP filing, reviewed and considered the impact of foreseeable emerging energy efficiency and demand response technologies throughout the planning period.¹⁶ In its 2017 IRP, Ameren Missouri evaluated alternative resource plans without any further deployment of DSM resources after MEEIA Cycle 2; these included add at least 1,800 MW of new supply-side resources to meet the load and reserve margin requirements.¹⁷

Ameren Missouri has initiated development of its 2019 DSM Market Potential Study that will inform its next triennial IRP filing. The 2019 Market Potential Study will also consider the impact of emerging energy efficiency and demand response technologies, and it will also ensure we capture data needed to evaluate what would be required in a DSM program to address customers' needs that might otherwise "opt out" of participation in MEEIA. Sources utilized to identify primary drivers for a customer to opt out will include Ameren Missouri customers that are currently opted out or have indicated plans to opt out. Results of the evaluation will be applied to existing DSM Programs and potential future programs to identify the effect on program costs, program cost effectiveness, associated charges to customer classes, and ability to achieve estimated savings targets.¹⁸

Electric Vehicle Charging Infrastructure¹⁹

Electric vehicle (EV) charging infrastructure, in and of itself, is by definition not a resource that can be used by the Company to meet its customers' energy or capacity needs. To that end, charging infrastructure cannot itself be screened as a resource. The very existence and availability of charging can, however, encourage EV adoption by customers. Those EVs represent a flexible load that may have the potential to become a valuable resource in time. Because EVs consume energy from batteries, the timing of the charging of batteries can be managed. Rate options and/or demand response programs can, therefore, be designed to take advantage of this flexible load resource. The first step in building this resource is to encourage the adoption of EVs, so that there is load to be managed. The Company has analyzed the ability of charging infrastructure to be a cost-effective means to encourage EV adoption in the context of its proposed Charge Ahead program (File No. ET-2018-0132) and has proposed a third party incentive approach to developing this infrastructure to encourage this beneficial load. The Company's current plans regarding EV infrastructure, as discussed in section 3.6 of this report, are focused

¹⁶ File No. EO-2019-0065 Paragraph 1.U

¹⁷ File No. EO-2019-0065 Paragraph 1.G

¹⁸ File No. EO-2019-0065 Paragraph 1.I

¹⁹ File No. EO-2019-0065 Paragraph 1.P

Ameren Missouri

on this approach, rather than the ownership model that is enabled by the Court of Appeals, Western District's decision in KCP&L v. PSC, No. WD80911 (Aug. 7, 2018).

As EV load grows on the system, as mentioned above, that load has the potential to be a valuable resource. In the Company's 2016 Market Potential Study, rates to shift EV charging to off-peak were screened as a measure and were determined not to be cost effective. However, metering, communications, smart charging, and other technologies are evolving rapidly and the Company continues to monitor these developments. The Company will continue to screen EV-related rate and DR options in the context of that evolution in its 2019 Market Potential Study.

Distributed Energy Resource Potential²⁰

The continued advancement of distributed energy resources (DER) is driving additional focus on a broad range of distributed resources. These include energy efficiency (EE), demand response (DR), energy storage, and distributed generation (DG) such as solar photovoltaic, wind, and combined heat and power (CHP). Ameren Missouri has performed potential studies covering EE, DR, DG, and CHP specifically and will continue to evaluate these types of DERs in future potential studies. Please refer to Chapter 8 – Demand-Side Resources and associated appendices in the Company's 2017 IRP filing for full details of our potential assessments for these resources. Ameren Missouri has also included in its IRP supply-side screening evaluations consideration of utility-owned DG resources, such as solar photovoltaic, reciprocating engine, and battery storage technologies. These and possibly other DG technologies will continue to be evaluated as part of future IRP analyses. Finally, Ameren Missouri has included estimates for penetration of customer-owned solar generation as part of its IRP load forecasting analysis, with three different levels of penetration corresponding to our base, high and low load forecasts. We will continue to evaluate the potential deployment of DERs as part of our ongoing IRP analysis.

Ameren Missouri maintains a database of customer-owned generation in conjunction with net-metering agreements and makes an annual filing with the Commission that summarizes the number of net-metered customers, capacity and energy received by Ameren Missouri in accordance with 4 CSR 240-20.065 (10)(A). Utility-owned resources are listed in our supply-side analysis chapter of the 2017 IRP.

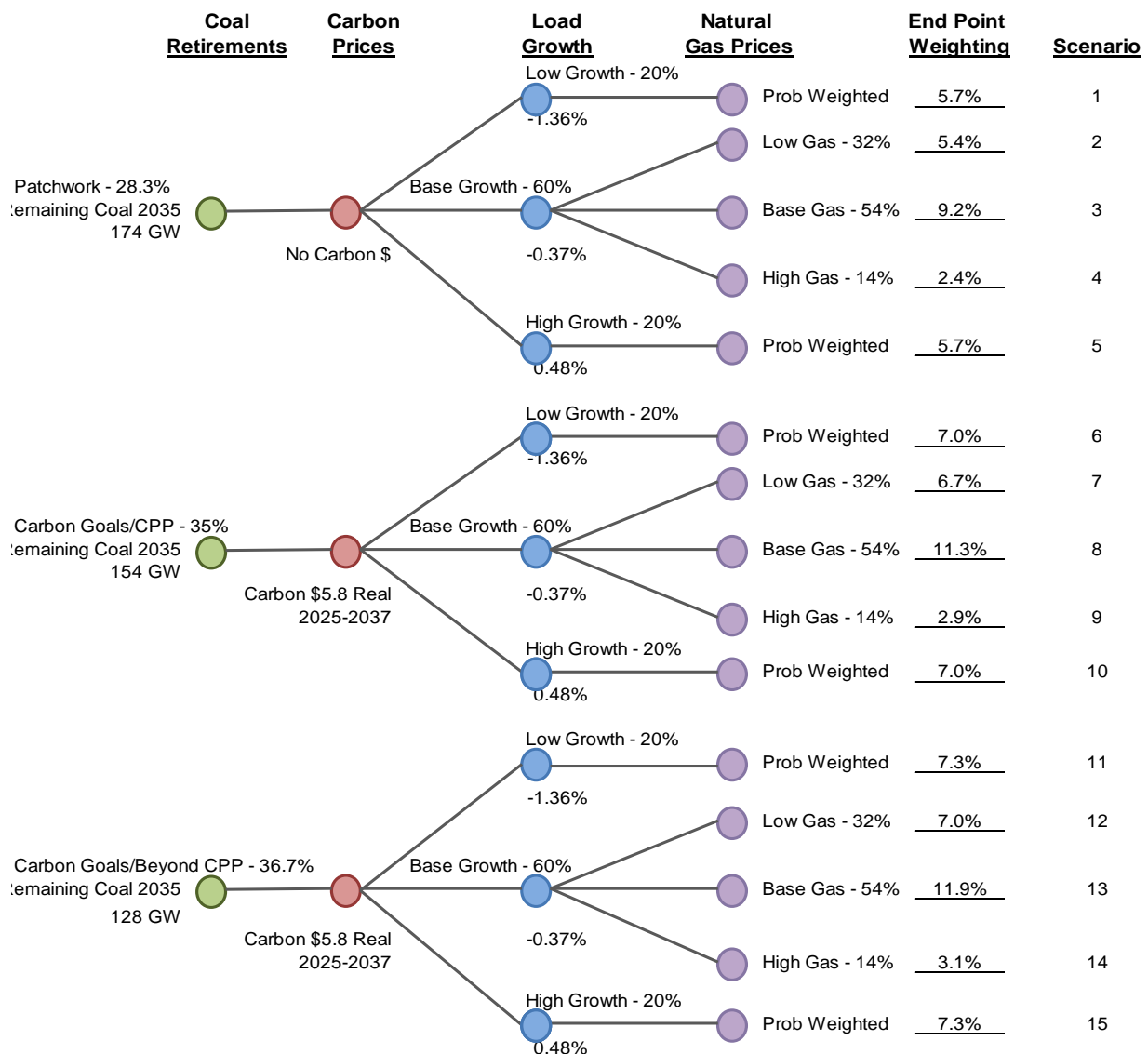
²⁰ File No. EO-2019-0065 Paragraph 1.A (1)-(3)

3.5 Uncertain Factors

3.5.1 Price Scenarios

Ameren Missouri has reviewed its assumptions for load growth, coal retirements, carbon prices, and natural gas prices, which are the major drivers of power prices. As discussed in more detail in this section, Ameren Missouri has determined that its current expectations for these driver variables are within the ranges established in the 2017 IRP. As a result, it is not necessary to update our power price scenarios. Each unique combination of uncertain factors is probability weighted and allows for analysis over a wide range of potential future conditions. Figure 3.3 shows the scenario tree from the 2017 IRP.

Figure 3.3: Scenario Tree



Coal Retirements

As specified in the 2017 IRP, a range of coal retirements was assumed to reflect a variety of factors that can significantly affect power prices over the 20-year planning period. The range of retirements is intended to capture the effects of market pressures on existing coal resources. This includes increasing investment in renewable generation resources, greater investment in efficient gas-fired generation and potential future environmental regulations. The current expectations for coal plant retirements have not materially changed from our assumptions in the 2017 IRP.

As of January 2019 the most current Annual Energy Outlook (AEO) includes a reference case that reflects an expected 101 GW of coal retirements. This reference case generally assumed only current laws and regulations are in place throughout the study period and does not make additional assumptions that may accelerate this retirement expectation. All of our cases include a higher level of coal retirements than this reference case assumption. The pressures that accelerate coal retirements are considered to be greater than those that are currently reflected in regulations. To highlight this effect of changing expectations, one of the cases reflected in the AEO for 2019 is characterized as a "High Oil and Gas Resources and Technology case," which represents a future with lower gas prices. These effects are due to advancing technology and productivity gains associated with higher oil production. In this case coal retirements increased from 101 GWs in the reference case to 129 GWs.

Figure 3.4 shows the assumptions used in the 2017 IRP and continues to reflect our planning assumptions.

Figure 3.4: Coal Retirement Assumptions

2017 IRP Assumptions	
Remaining Coal	Carbon Prices
Low - 28.3% Remaining Coal 2035 174 GW 127 GW Retired from 2016 Levels	No Carbon \$
Base - 35% Remaining Coal 2035 154 GW 150 GW Retired from 2016 Levels	Carbon \$5.8 Real 2025-2037
High 36.7% Remaining Coal 2035 128 GW 178 GW Retired from 2016 Levels	Carbon \$5.8 Real 2025-2037

Carbon Dioxide Emission Prices

In addition to coal plant retirements, the above figure shows the carbon price expectations assumed in the 2017 IRP. We used a CO₂ emissions price as one of the factors that would affect CO₂ emissions in two of three cases but would not be the only, or even the main driver of reduced CO₂ emissions in each case.

This perspective is also in alignment with the 2019 AEO. As the two charts from the 2019 AEO below illustrate, even in the reference case, carbon intensity is expected to decline in the electric power industry based on the reduced usage of coal resources and an increasing reliance on renewable and natural gas generation. This expectation is in alignment with all of our cases, even with a zero or a small CO₂ value. All three of our coal retirement scenarios assume greater levels of coal retirements than the 2019 AEO reference case and therefore each will provide a lower level of carbon intensity than is reflected below.

Figure 3.5: U.S. Electricity Fuel Mix and Carbon Intensity

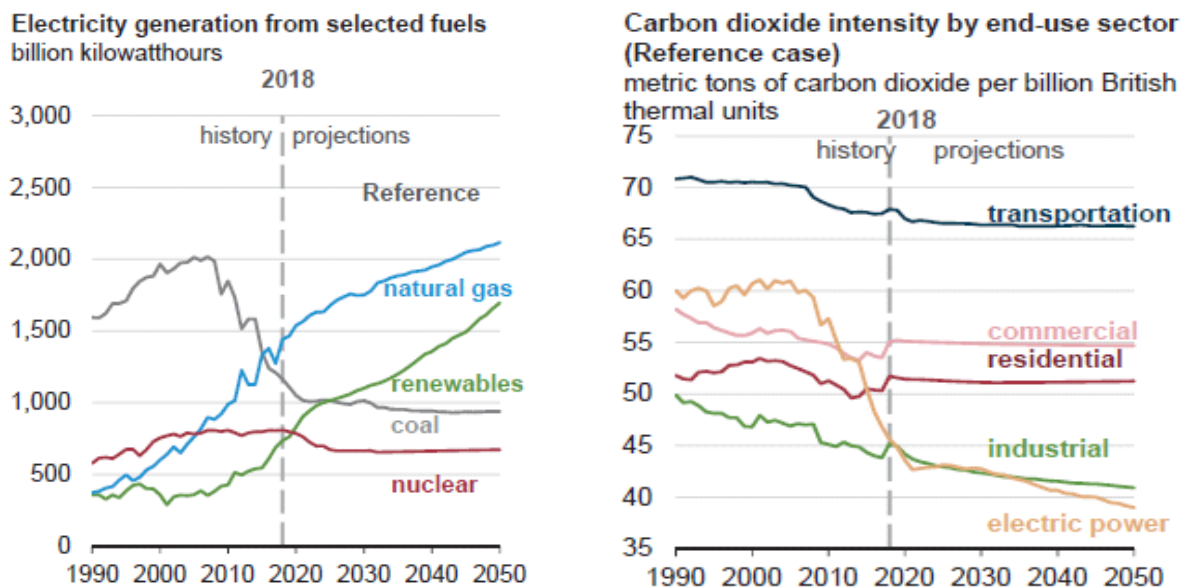


Table 3.5: CO₂ Price Assumptions

	2016 \$/Ton Real			Nominal		
	Low Case	Mid Case	High Case	Low Case	Mid Case	High Case
2025	\$0.00	\$3.11	\$3.11	\$0.00	\$3.71	\$3.71
2026	\$0.00	\$3.42	\$3.42	\$0.00	\$4.17	\$4.17
2027	\$0.00	\$3.77	\$3.77	\$0.00	\$4.68	\$4.68
2028	\$0.00	\$4.15	\$4.15	\$0.00	\$5.26	\$5.26
2029	\$0.00	\$4.57	\$4.57	\$0.00	\$5.91	\$5.91
2030	\$0.00	\$5.03	\$5.03	\$0.00	\$6.64	\$6.64
2031	\$0.00	\$5.54	\$5.54	\$0.00	\$7.46	\$7.46
2032	\$0.00	\$6.11	\$6.11	\$0.00	\$8.39	\$8.39
2033	\$0.00	\$6.73	\$6.73	\$0.00	\$9.43	\$9.43
2034	\$0.00	\$7.42	\$7.42	\$0.00	\$10.60	\$10.60
2035	\$0.00	\$8.18	\$8.18	\$0.00	\$11.91	\$11.91
2036	\$0.00	\$9.01	\$9.01	\$0.00	\$13.39	\$13.39
2037	\$0.00	\$9.93	\$9.93	\$0.00	\$15.05	\$15.05

It should be noted that the price assumptions shown represent an explicit price on CO₂ emissions, not necessarily an estimated cost to comply with CO₂ emission regulations. While these prices may factor into the cost of compliance, the cost to comply is necessarily a function of the form of the regulation and the compliance options available.

Natural Gas Prices

Supply – According to 2019 AEO, natural gas production from shale gas and tight oil plays as a share of total US natural gas production continues to grow, both in share and absolute volume because of the sheer size of the associated resources. Associated natural gas production from tight oil production in the Permian Basin grows strongly as does the oil co-production from Eagle Ford and Haynesville regions. The continued development of the Marcellus and Utica shale plays in the east are also robust. Technological advancements and improvements in industry practices continue to lower production costs and increase volume of natural gas recovery per well. These advancements have a significant cumulative effect in play that extend over wide areas and that have large undeveloped resources. Our expectations for natural gas supply in the 2017 IRP remain consistent with the current view from AEO 2019.

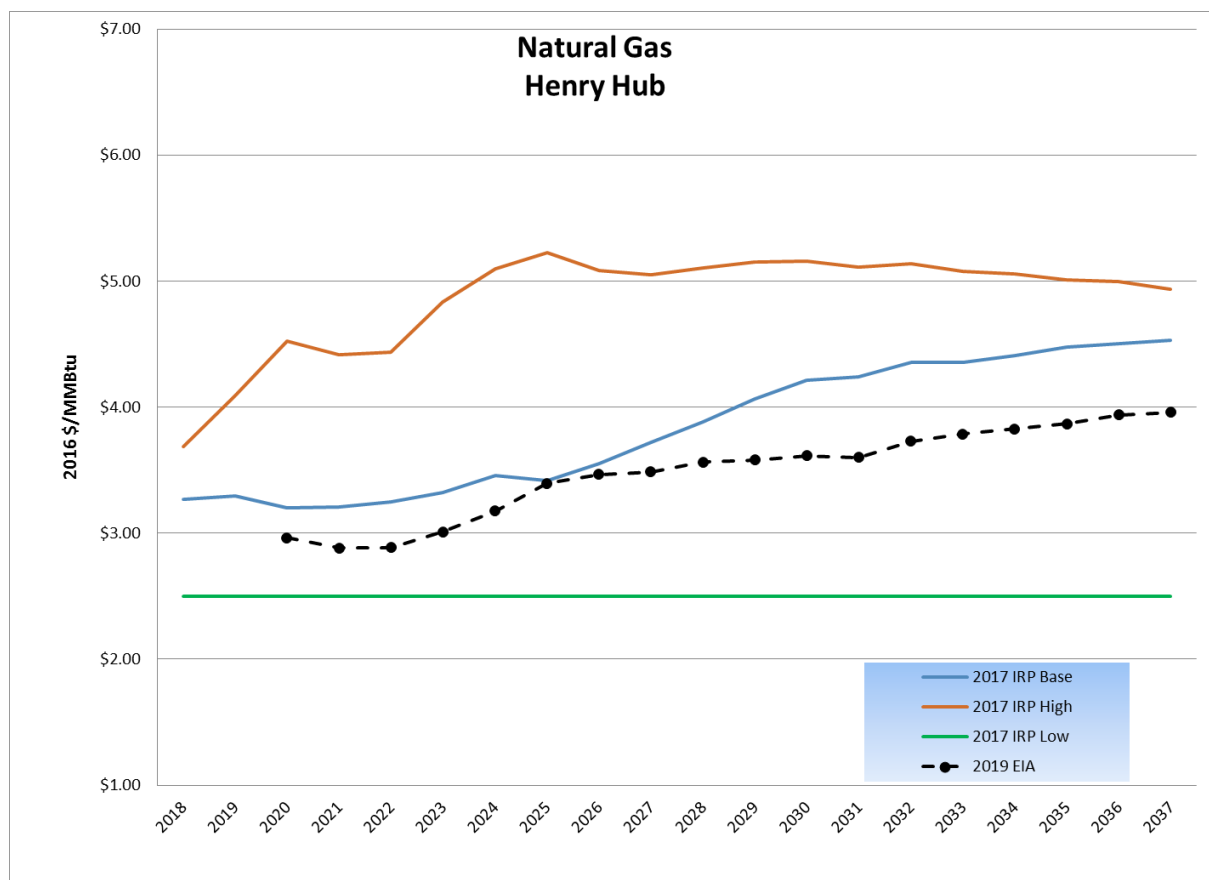
Demand – In reviewing the drivers of demand, we continue to see several drivers shaping it long term. The drivers are energy efficiency programs, coal to gas switching, industrial growth and LNG exports. Upward pressure on demand will result from expanded coal to gas switching, industrial growth and global exports of LNG with only efficiency having a moderating impact. The 2019 AEO includes an expectation that the United States will

Ameren Missouri

remain a net natural gas exporter in all cases due to the robust supply and increasing productivity advances to access this resource.

Infrastructure – The expectations for infrastructure remain consistent with the 2017 IRP. The developments in large gas production in the Marcellus and Utica shale reserves in the Northeast continue to create a dramatic shift in flow. These changes in the interstate pipeline system will occur as the supply pool from the Northeast grows. Natural gas will be directed toward the growing demand from: the petro-chemical industry in the Southeast, gas-fired generation throughout the Midwest and East, and LNG exports in the Gulf Coast.

Figure 3.6: Natural Gas Price Forecasts



Price – Current expectations are for prices to trend closer to the low end of our IRP range. However, as we move forward in time demand from LNG exports, coal-to-gas switching and increased industrial demand could drive higher prices in later years. As demonstrated in Figure 3.6, EIA’s 2019 Annual Energy Outlook reflects future gas prices that are well within the range used in the 2017 IRP.

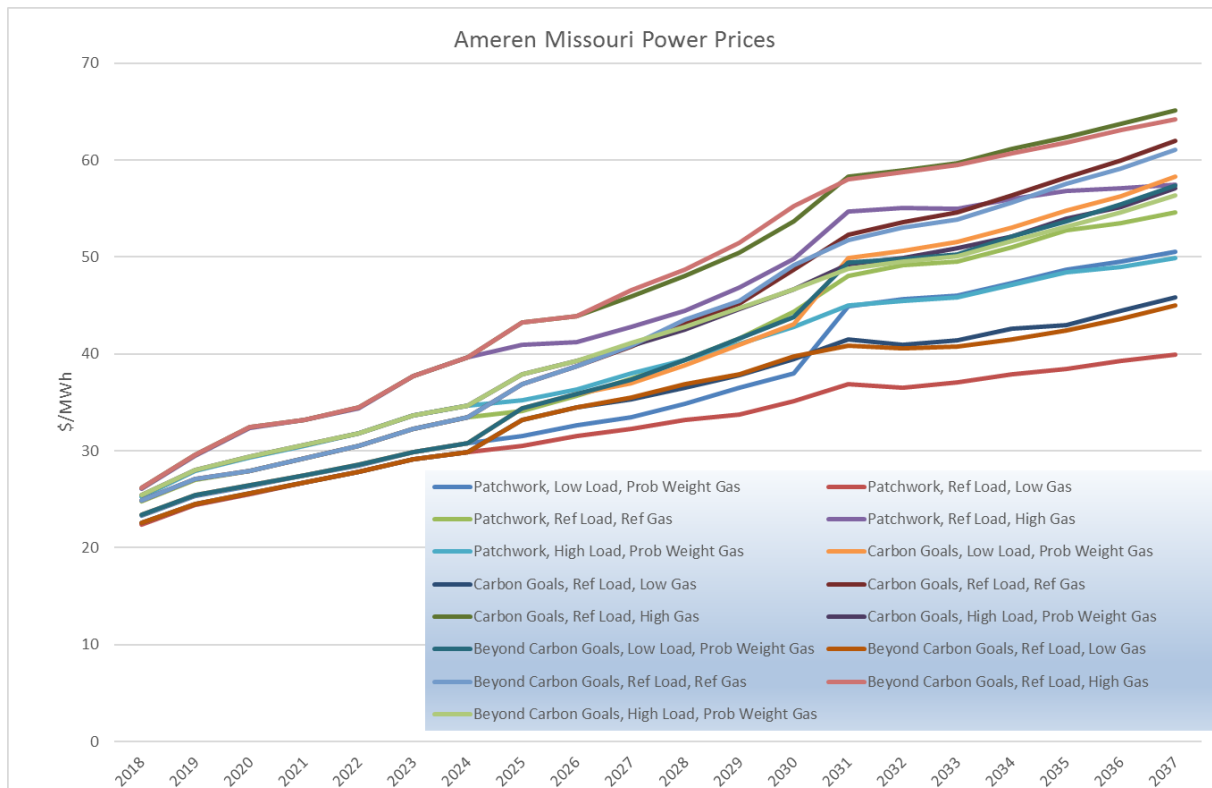
Load Growth

In the probability tree in Figure 3.3, load growth has 3 different value levels – one features a 0.48% compound annual growth rate (CAGR) over the IRP 20-year timeframe, with a 20% subjective probability; the other is -0.37% CAGR over the IRP 20-year timeframe, with a 60% subjective probability; and the last level features -1.36% CAGR with a 20% subjective probability. We continue to use these three levels to represent the distribution of potential load growth based on a review of assumptions with our internal subject matter experts. Our load growth assumptions for Ameren Missouri’s service territory continue to fall within this range.

3.5.2 Scenario Modeling

Because current assumptions for each of the three scenario variables described in section 3.3.1 are within the ranges defined in our 2017 IRP, no updated scenario modeling is warranted at this time. The power price forecasts for the scenarios modeled for the 2017 IRP are presented in Figure 3.7 below.

Figure 3.7: Market Price Scenarios



3.5.3 Independent Uncertain Factors

Ameren Missouri reviewed a broad range of uncertain factors, including foreseeable emerging energy efficiency, storage and distributed generation technologies in its 2017 IRP²¹ and identified two independent uncertain factors to be critical as a result of the sensitivity analysis conducted and presented in the 2017 IRP: DSM costs and coal prices. The Company reviewed its expectations and previous value ranges for these critical uncertain factors and determined the % deviations for the low-base-high values from the expected values of each uncertain factor are still valid.

3.5.4 Coal Price Forecasts

The 2017 IRP long-term coal price assumptions included a review of the drivers that most affect the coal industry and more specifically those affecting Powder River Basin (PRB) coal. The overall assumptions about US coal supply have not materially changed.

Ameren Missouri continues to maintain an expectation that long-term demand for PRB coal will be negatively affected by lower energy prices and coal-fired power plant retirements. Additionally, how environmental regulations, transportation costs and even producer solvency will influence the coal markets are continually under review.

The factors reviewed that affect PRB production costs remain the same and are:

- Strip ratios (overburden vs. coal seam) are expected to increase.
- Government regulations continue to increase reclamation costs including coal producers potentially having to insure payment of future reclamation costs (“self-insurance” will be more limited in the future).
- Severance taxes and coal lease fees.
- Cost of materials, supplies and capital equipment such as diesel fuel, explosives & haul trucks.
- Haul distances from coal pit to load-out are expected to increase.
- Eventual interference with the railroad mainline.

The cost of mining PRB coal has recently declined and stabilized as producers have reduced operations and focused on more cost-effective reserves to meet the declining demand base. However, long-term production costs are projected to rise as strip ratios increase. Strip ratios are forecasted to increase by 25% over the next 20 years based on current supply and demand fundamentals. Mining companies have reduced cash costs

²¹ File No. EO-2019-0065 Paragraph 1.A (1)-(3)

Ameren Missouri

over the past few years but long-run costs will increase in real terms due to the increasing strip ratios as production moves westward.

Coal prices may vary from the forecast due to the drivers mentioned above but are not limited to those drivers alone. Examples of other drivers that may impact coal prices are new mining, generation or environmental technology, changes in the electric grid and load loss/growth.

Our plan to meet emission compliance standards is to continue utilizing environmental controls and burn predominantly ultra-low sulfur coal (typically considered 0.55 lb. SO₂/MMBtu or less) remains consistent with assumptions made in the 2017 IRP. Ameren Missouri expects long-term production/supply of ultra-low sulfur PRB coal to be 200-350 million tons per year.

3.6 Energy and Peak Forecasting²²

Ameren Missouri has reviewed its key drivers for long-term load expectations and has concluded that current expectations are materially unchanged.

In its 2017 IRP, Ameren Missouri has evaluated the impact of distributed generation and electric vehicles at low-base-high levels of penetration. The analysis can be found in Chapter 3 of the 2017 IRP. Ameren Missouri will be providing \$28 Million in solar rebates to customers that install solar systems between 2019 and 2023 as included in Senate Bill 564 and Ameren Missouri Smart Energy Plan. Solar rebates accelerate customer-owned solar installations in the first few years but are not expected to materially change the total installation expectations through the planning horizon.

The Company's current and planned EV-related initiatives focus on the Charge Ahead – EV proposal that was partially approved by the Commission in February, 2019 (File No. ET-2018-0132). The Corridor Subprogram was approved and allows Ameren Missouri to provide incentives to stimulate the private sector to develop, own, and operate approximately 11 DC-fast charging islands in the Company's service territory. This innovative program is designed to jump start the free market in order to leverage private investment in a manner that develops infrastructure that meets EV-owning customers' changing service needs and helps encourage broader EV adoption by customers. The other localized charging station incentives proposed by Ameren were not approved and the Commission has ordered the MoPSC Staff to open a working docket (File No. EW-2019-0229) to further evaluate various options for development of localized EV charging stations.

²² File No. EO-2019-0065 Paragraph 1.B; File No. EO-2019-0065 Paragraph 1.J

Ameren Missouri

In addition, Ameren Missouri has a commitment that is memorialized in the Stipulation and Agreement in File No. ER-2016-0179 to propose amendments to its existing residential time-of-use rate that, among other objectives, are designed to promote additional off-peak charging of EVs.

The EV landscape is rapidly evolving, and Ameren Missouri continues to monitor emerging technologies, trends, and developments in other jurisdictions. Through these activities, Ameren Missouri will consider on an ongoing basis new beneficial ways to support its customers' adoption and use of EVs. Ameren Missouri is very cognizant of the Court of Appeals Western District decision regarding utility ownership of EV charging equipment and the options that provides to meet customer needs going forward, but has no current plans to change the incentive-based approach to EV charging development proposed in the Charge Ahead proceeding.

4. Compliance References

File No. EO-2019-0065 Paragraph 1.A (1)-(3)	22, 29
File No. EO-2019-0065 Paragraph 1.B	30
File No. EO-2019-0065 Paragraph 1.C	20
File No. EO-2019-0065 Paragraph 1.D	18
File No. EO-2019-0065 Paragraph 1.E	12
File No. EO-2019-0065 Paragraph 1.F	15
File No. EO-2019-0065 Paragraph 1.G	17, 21
File No. EO-2019-0065 Paragraph 1.H	20
File No. EO-2019-0065 Paragraph 1.I	21
File No. EO-2019-0065 Paragraph 1.J	30
File No. EO-2019-0065 Paragraph 1.K	12
File No. EO-2019-0065 Paragraph 1.L	15
File No. EO-2019-0065 Paragraph 1.M (1)-(2)	12
File No. EO-2019-0065 Paragraph 1.N	12
File No. EO-2019-0065 Paragraph 1.O (1)-(3)	8
File No. EO-2019-0065 Paragraph 1.P	21
File No. EO-2019-0065 Paragraph 1.Q	12
File No. EO-2019-0065 Paragraph 1.R	12
File No. EO-2019-0065 Paragraph 1.S (1)-(9)	10
File No. EO-2019-0065 Paragraph 1.T	10
File No. EO-2019-0065 Paragraph 1.U	21

Appendix A
SMP Financial Analysis¹

THIS APPENDIX IS
CONFIDENTIAL IN
ITS ENTIRETY

¹ EO-2019-0065 Paragraph 1.D