Docket No. SPU-2021-0003

Environmental Law and Policy Center, Iowa Environmental Council, and Sierra Club (Environmental Organizations)

Response to MidAmerican's Initial Filing

Exhibit 1

A Clean Energy Future for MidAmerican and Iowa

A Clean Energy Future for MidAmerican and Iowa

Prepared for Sierra Club, Iowa Environmental Council, and the Environmental Law and Policy Center

December 15, 2021

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EXECUTIVE SUMMARY

Iowa has some of the best wind resources in the country, with 57 percent of the state's generation coming from wind in 2020.[1] Despite this abundant, clean, renewable, and cost-effective wind resource, utilities in the region continue to also rely heavily on costly and aging coal-burning generation resources and invest minimally in energy efficiency and demand-side management programs. MidAmerican Energy Company (MidAmerican or the Company) provides electricity to approximately 42 percent of the 1.7 million electric customers in the state of Iowa.[2] The Company has invested substantially in wind resources, but still relies heavily on coal, with nearly half of the Company's firm capacity coming from its coal resources.[3]

In May of this year (2021), the Iowa Utilities Board (the Board) opened a docket (Docket No. SPU-2021-0003) to review MidAmerican's "current generating fleet and how it meets the needs of MidAmerican's customers."[4] The review is to include potential retirement of its coal plants and provide a "least-cost analysis addressing options considered to meet its long-term resource needs."[5] This action resulted from an order issued by the Board in a prior docket (Docket No. EPB-2020-0156) deferring consideration of coal plant economics and resource planning issues to a future docket. Although the Company has designated most of its resource information and analysis as confidential (and it is therefore unavailable to the public or any intervenors), and presented no standard capacity expansion planning modeling, as we would expect in response to the Board's directive, this docket has at least provided a venue to review the Company's current resource mix and to ask the question, "*what is the least-cost portfolio to serve MidAmerican customers in Iowa over the next two decades?*"

It is in this context that Synapse conducted the analysis included in this report, prepared on behalf of Sierra Club, Iowa Environmental Council, and the Environmental Law and Policy Center. The purpose of our analysis is to (1) evaluate the cost to retire MidAmerican's coal fleet by 2030, and replace the energy and capacity with renewables, battery storage, and energy efficiency, and (2) determine whether retiring and replacing MidAmerican's coal fleet with clean energy is a lower-cost option for Iowa ratepayers than continuing to operate the plants through their currently planned retirement dates.

Using the EnCompass capacity expansion model, we found that retiring MidAmerican's coal fleet by 2030 and replacing it with a combination of renewables (2,060 MW of solar PV and 2,000 MW of wind), battery storage (740 MW), and energy efficiency (all together, the "clean energy scenario") would save MidAmerican ratepayers $1.2 billion over the next two decades compared to MidAmerican's current

[1] U.S. Energy Information Administration (EIA), *Iowa State Profile*, Available at https://www.eia.gov/state/?sid=IA.

[2] U.S. EIA Form 861 for 2020, Sales to Utility Customers. Available at https://www.eia.gov/electricity/data/eia861/.

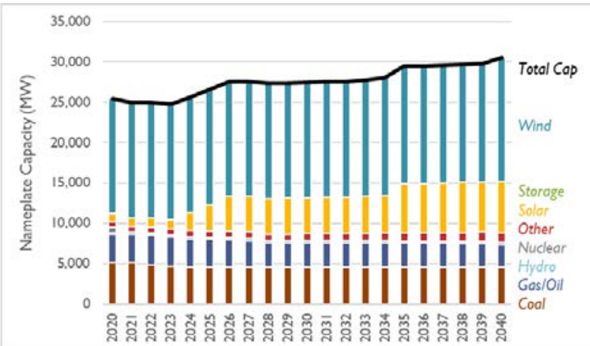
[3] U.S. EIA Form 923, U.S. EIA Form 860, FERC Form 1.

[4] Docket No. SPU-2021-0003, Order Opening Docket. May 13, 2021.

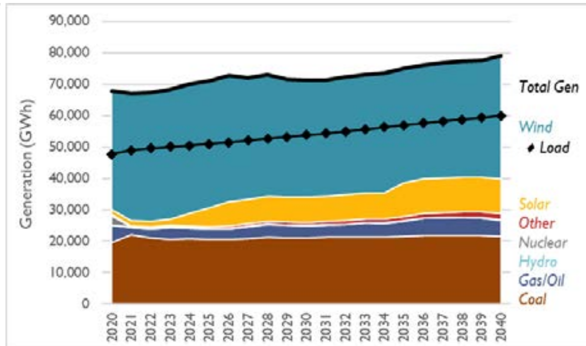
[5] Ibid.

plans to operate its coal fleet indefinitely ("business as usual scenario" or "BAU"). The generation and capacity results for the BAU and clean energy scenarios are shown in ES Figure 1 and ES Figure 2 below. ES Table 1, below, displays the Net Present Value Revenue Requirement (NPVRR) results.[6]

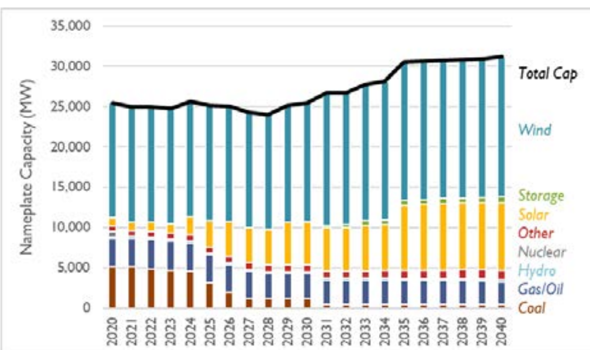
ES Figure 1a: Capacity mix for BAU Scenario



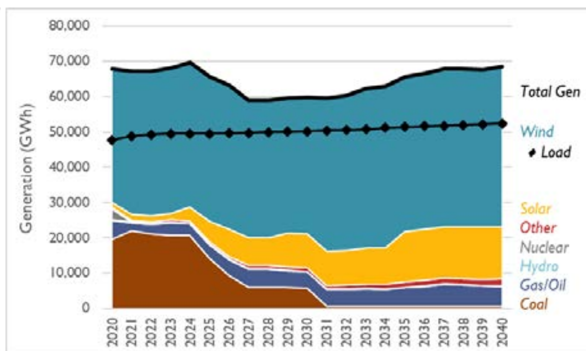
ES Figure 1b: Generation mix for BAU Scenario



ES Figure 2a: Capacity mix for 2030 Clean Energy Scenario



ES Figure 2b: Generation mix for 2030 Clean Energy Scenario



ES Table 1: Net present value of revenue requirement by scenario 2021–2040

Scenario	Total NPV ($Billion)	Delta From BAU Scenario ($Billion)
Business As Usual	12.7	-
2030 Retirements Clean Energy Scenario	11.6	1.2
Business As Usual – High Gas Price, CO_2 Tax Sensitivity	17.9	-
2030 Retirements Clean Energy Scenario - High Gas Price, CO_2 Tax Sensitivity	12.9	5.0

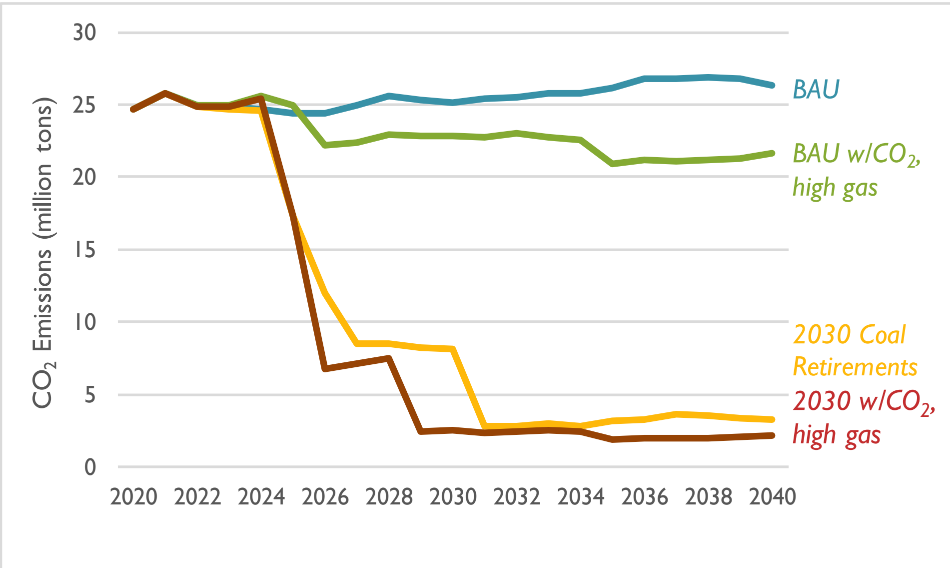
Source: Synapse analysis.

[6] Revenue requirement is defined as the total revenue that the Company must collect from its customers to cover its operating costs, interest paid on debt, and taxes, and to earn a reasonable return.

Our clean energy and BAU scenarios were both conservative because they did not account for the risks MidAmerican's customers face from potentially higher gas prices or the possibility of future carbon regulations. If such risks were to be realized, MidAmerican's customers could pay $5 billion more under MidAmerican's current plan to operate its coal plants indefinitely.

We also find that replacing the Company's coal fleet with clean energy resources will reduce carbon emissions by approximately 318 million tons over the next two decades. ES Figure 3 shows the CO_2 emissions associated with the BAU and the Clean Energy Scenario, along with the two High Gas Price, CO_2 tax sensitivities.

ES Figure 3: CO_2 emissions by scenario



Finally, we find that investing in energy efficiency and building renewable generation to displace energy from MidAmerican's existing fossil units will create local, high-quality jobs. Compared with investment in fossil fuels, renewables and energy efficiency create between two and three times as many jobs for the same quantity of spending.[7] Further, a substantial portion of MidAmerican's expenditures on fossil fuels does not benefit the Iowa economy, as the Company's fuels are sourced out of state and there are relatively few in-state jobs in these industries. Iowa has a strong supply chain for renewable energy resources and further investment by MidAmerican will strengthen this job sector.

Findings

1. MidAmerican has failed to provide a robust and transparent analysis of the economics of keeping its coal fleet online through each unit's scheduled retirement date, relative to retiring the plants and replacing them with clean energy resources.

[7] Garrett-Peltier, H., 2017. "Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model." *Economic Modelling*, *61*, pp.439-447.

2. MidAmerican's ratepayers will save approximately $1.2 billion over the next two decades if the Company retires the Neal, Louisa, Ottumwa, and Walter Scott coal plants by 2030 and replaces them with a combination of renewables (2,060 MW of solar PV and 2,000 MW of wind), battery storage (740 MW), and energy efficiency.
3. Replacing the Company's coal fleet with clean energy resources will reduce carbon emissions by 318 million tons over the next two decades.
4. Replacing the Company's coal fleet with clean energy resources will provide local, high-quality jobs.

Recommendations

1. The Board should require that MidAmerican publish public and transparent analysis on its future resource plans.

2. The Board should require that MidAmerican set retirement dates for each of its coal-fired power plants to retire between now and 2030 and develop a clear plan to replace the energy and capacity with renewables, battery storage, and energy efficiency.

1. MidAmerican currently relies on generation from its coal plants, and appears to intend to continue to do so for the next several decades.

1.1. Background

MidAmerican provides electricity to around 42 percent of the 1.7 million electric customers in the state of Iowa.[8] The region has some of the best wind resources in the country, with 57 percent of the state's generation coming from wind in 2020.[9] Despite this abundant wind resource, utilities in the region continue to also rely heavily on costly and aging coal generation resources. In addition, they invest minimally in energy efficiency and demand-side management programs.

This dynamic is a result of several policy and regulatory factors. While the federal production tax credits (PTC) enabled the significant build-out of wind in the region that we see today, other factors have inhibited progress toward cost-effective clean energy and best practice energy planning. Despite this progress on wind energy, utilities in Iowa are not required to file integrated resource plans (IRP), publish any other regular short- or long-range planning results, or make public any resource-planning modeling that they do conduct. The lack of an IRP requirement allows utilities to make resource planning decisions without transparency for the public or any significant oversight from the Board. Iowa also has a revenue-sharing mechanism, which has allowed MidAmerican to use excess revenue to pay down debt on its units without initiating a rate case. As a result, MidAmerican has not had a rate case since 2013 and likely will not have another one in the near future.[10] This also reduces public transparency and Board scrutiny over any of the Company's decisions.

Finally, in 2018 Iowa lawmakers passed a bill that reduces the amount of spending that the Board can require utilities to invest into energy efficiency programs.[11,12] Since that time, MidAmerican has

[8] U.S. EIA. Form 861 for 2020, Sales to Utility Customers. Available at https://www.eia.gov/electricity/data/eia861/.

[9] U.S. EIA. *Iowa State Profile*, Available at https://www.eia.gov/state/?sid=IA.

[10] See RPU-2018-0003, Transcript from Hearing Held Friday, October 12, 2018, at 67 (confirming no rate case anticipated by MidAmerican within ten years).

[11] Iowa Senate File 2311. Enacted 2018. *An Act Modifying Various Provisions Relating to Public Utilities, Providing for a Study of Electric Vehicle Infrastructure Support, and Including Effective Date Provisions*. Available at: https://www.legis.iowa.gov/docs/publications/LGE/87/SF2311.pdf.

[12] Uhlenhuth, Karen. 2021. "Since 2018 law, Iowa utilities are doing a lot less to help customers save energy." *Energy News Network.* Available at: https://energynews.us/2021/07/07/since-2018-law-iowa-utilities-are-doing-a-lot-less-to-help-customers-save-energy.

dramatically scaled back its energy efficiency initiatives intended to help customers rein in energy use and reduce costs.

In May of this year, the Board opened a docket (Docket No. SPU-2021-0003) to review "its current generating fleet and how it meets the needs of MidAmerican's customers," including potential retirement of MidAmerican's coal plants, and to provide a "least-cost analysis addressing options considered to meet its long-term resource needs."[13] This action resulted from an order issued by the Board in a prior docket (Docket No. EPB-2020-0156) deferring consideration of coal plant economics and resource planning issues to a future docket. Although the Company had designated most of its resource information and analysis as confidential (and it is therefore unavailable to the public or any intervenors), this docket has at least provided a venue to review the Company's current resource mix and ask the question, "*what is the least-cost portfolio to serve MidAmerican customers in Iowa over the next two decades?*" It is in this context that Synapse conducted the analysis included in this report.

Company profile

MidAmerican serves roughly 700,000 customers in the state of Iowa.[14] The Company operates within MISO Zone 3 and has historically been a net exporter of electricity.[15] During the period 2017–2019, approximately 28 percent of MidAmerican's total annual electricity sales (including generation and purchase) were to third-party electricity providers.[16] This suggests that the Company may be able to reduce its reliance on existing, uneconomic plants by reducing sales to third-party electricity providers, while still meeting the demand of its customers.

1.2. MidAmerican currently relies on its aging coal plants to supply energy and capacity to its ratepayers

MidAmerican relies on a combination of coal, gas, nuclear, and wind resources to provide electricity to its customers, as shown below in Table 1. In 2020, 21 percent of the Company's electricity generation came from coal and gas resources, 13 percent came from nuclear resources, and 66 percent came from wind. But nearly half of the Company's firm capacity[17] comes from its coal resources, with the other half coming from gas, wind, and nuclear resources.[18]

[13] Docket No. SPU-2021-0003, Order Opening Docket. May 13, 2021.

[14] U.S. EIA Form 861 for 2020, Sales to Utility Customers. Available at https://www.eia.gov/electricity/data/eia861/.

[15] FERC Form 1, 2020. Account 447 and Account 555.

[16] Estimate based on data reported by MidAmerican in U.S. EIA Form 861.

[17] Firm capacity is capacity the Company commits to have available during a specified period of time, generally during peak times.

[18] U.S. EIA Form 923, US EIA Form 860, FERC Form 1.

Table 1: MidAmerican's generation and capacity resources by type

Resource	Nameplate Capacity (MW)	Firm Capacity (MW)	Net Generation (GWh) 2020
Coal	2,961	2,961	5,810
Gas	1,678	1,678	676
Nuclear	505	505	3,927
Wind (PPA)	6,870	1,120	20,660
Hydro	36	-	8
Total	12,050	6,264	31,080

Source: EIA Form 923, FERC Form 1.

As shown in Table 2, all but one of the Company's coal units are over 35 years old, and MidAmerican has no stated plan to retire any of these units during the next decade. This means that by 2030, nearly 40 percent of the Company's firm capacity resources will be over 45 years old. These aging coal plants are costly to operate and maintain, and they emit significant quantities of CO_2 and other pollutants into the atmosphere.

Table 2: MidAmerican's Coal Fleet (MidAmerican ownership portion only)

Coal Units	Year Online	Capacity (MW)
Neal #3	1975	421
Neal #4	1979	282
Ottumwa	1981	419
Louisa	1983	715
Walter Scott #3	1978	574
Walter Scott #4	2007	550
Total		2,961

Source: FERC Form 1

Additionally, as discussed in depth in the next section, the Company has invested only minimally in energy efficiency and demand-side management programs.

1.3. MidAmerican's commitment to cost-effective energy efficiency has declined precipitously, to the detriment of its customers

Today, MidAmerican is investing minimally in demand-side management and energy efficiency measures. This was not always the case; the Company had strong energy efficiency program performance during the period of 2016 to 2018. During that time, MidAmerican achieved annual energy efficiency savings of about 1.5 percent of energy sales, compared to a 1 percent national average among large utilities in 2018 (the best-performing utilities achieved approximately 3 percent).[19]

From 2016 to 2018, MidAmerican spent between 3 and 4 percent of its annual revenues on energy efficiency, compared to approximately 9 percent of revenues for leading utilities. However, with the release of its *2019–2023 Energy Efficiency Plan*, the Company lowered its energy efficiency targets and spending to about half of its prior performance.[20] In 2019, the Company achieved meager energy efficiency savings of 0.76 percent of sales. Further, MidAmerican has failed to meet its energy efficiency program targets outlined in the low-ambition plan: for example, 2020 electric program spending was $9 million or 22 percent lower than planned and resulted in 21 percent lower energy savings than the target in its 2019–2023 Energy Efficiency Plan.[21] The 2019 result was worse, at $11 million lower than planned and 56 percent lower energy savings than targeted.[22]

The sharp decline in MidAmerican's energy efficiency resource development coincides with Senate File 2311, passed in 2018, which prohibits Iowa state regulators from requiring utilities to spend more than 2 percent of expected electric revenue. This law was modified in 2019 to prohibit utilities from exceeding this limitation even voluntarily. But the utility was not *required* to eliminate or limit energy efficiency and demand-side management as a resource and has done so only to the detriment of its customers. And MidAmerican is under-performing even this strict limit with its spending.

In contrast, Interstate Power and Light (IPL) recently conducted a voluntary resource planning effort in Iowa and included energy efficiency in a resource plan that was projected to save over $400 million. Investing in energy efficiency is more cost-effective than reliance on new generation: in 2019, it cost MidAmerican $18 to save 1 megawatt-hour (MWh) of electricity, as compared to between $20.07 to $23.89 to generate 1 MWh at MidAmerican's coal plants in 2020. By investing more in energy efficiency, MidAmerican can reduce costs for customers and reduce or avoid the need for infrastructure. Demand for electricity is expected to rise by about 29 percent between 2021 and 2040 under current energy efficiency investment plans.[23] If MidAmerican increased its investment in energy efficiency and actually used energy efficiency as an energy resource in planning, the Company could reduce this expected growth and reduce costs to customers substantially.

[19] U.S. Energy Information Administration Form 861 (years 2016, 2017, 2018).

[20] MidAmerican Energy Company. *Iowa Energy Efficiency Plan 2019-2023*. Filed with the Iowa Utilities Board on July 9, 2018, EEP-2018-0002 (pages 8-9).

[21] MidAmerican Energy Company. Energy Efficiency Plan Docket No. EEP-2018-0002. *2020 Annual Report to the Iowa Utilities Board*. April 28, 2021.

[22] MidAmerican Energy Company. Energy Efficiency Plan Docket No. EEP-2012-0002 & Docket No. EEP-2018-0002 *2019 Annual Report to the Iowa Utilities Board*. May 1, 2020.

[23] Purdue University, State Utility Forecasting Group. 2020. *2020 MISO Energy and Peak Demand Forecasting for System Planning*. Prepared for Midcontinent Independent System Operator, Inc.

1.4. MidAmerican appears to intend to continue its current reliance on its fossil fleet for energy and capacity for the next few decades

Although the Company has published no (public) formal resource planning document and provided no clear (public) analysis, based on the information available, it is likely that the Company plans to continue to rely on its fossil fleet for energy and capacity over the next decade and beyond.

As part of this current docket, the Company was required to file information and analysis showing how it planned to meet its future resource need. This analysis "should include consideration of fuel switching, generating unit retirement, modified dispatch, addition of new generation sources, wholesale market transactions, and the costs of alternative compliance options, as well as any economic development potential for those options."[24] But the information the Company has made available indicates that the Company has no plan to change its resource portfolio significantly over the next few decades. MidAmerican appears to plan on its resource mix a decade from now looking roughly the same as it does today, which means continued reliance on its coal fleet for nearly 30 percent of its generation.

2. RETIREMENT OF MIDAMERICAN'S EXISTING COAL PLANTS, AND REPLACEMENT WITH A COMBINATION OF ENERGY EFFICIENCY, RENEWABLE RESOURCES, AND BATTERY STORAGE RESOURCES WOULD SAVE RATEPAYERS APPROXIMATELY $1.2 BILLION THROUGH 2040.

For this analysis, Synapse used the EnCompass capacity optimization and dispatch model, developed by Anchor Power Solutions, to simulate resource choice impacts in MidAmerican's service territory as part of the larger MISO Zone 3 region between 2021 and 2040.[25] EnCompass is currently a best-in-class capacity expansion planning model and is used by utilities around the country. EnCompass is also well suited for capturing the value of renewable energy, and so is an appropriate tool for modeling resources in Iowa, which has significant renewable energy potential.

First, we modeled MidAmerican's current resource portfolio as part of the larger MISO footprint and relied on public data to project MISO's (and MidAmerican's) future resource mix. We compared the resulting net present value of revenue requirements for MISO Zone 3 for the Business as Usual Scenario to a Clean Energy Portfolio that retires all existing coal by 2030 and replaces the energy and capacity with a combination of renewables, battery storage, and energy efficiency. We also tested several high

[24] Docket No. SPU-2021-0003, Order Opening Docket. May 13, 2021.

[25] MISO Zone 3 covers the state of Iowa and a small portion of Minnesota and Illinois.

gas price and carbon tax sensitivities to evaluate what the optimal resource mix for the region looks like in the likely event that a federal carbon policy is implemented and gas prices increase.

The generation, capacity, emissions, and NPVRR results that we present in this report are for MISO Zone 3, but the NPVRR deltas we report represent savings for MidAmerican's system. We modeled MISO Zone 3 instead of only MidAmerican's system because the Company refused to provide its system load data, a critical model input. In the absence of this Company-level data, the most granular public load-data available was at the MISO zonal level. But the changes between scenarios – the retirement dates of MidAmerican's coal fleet, and the Company's energy efficiency investment – were isolated to MidAmerican's system; all other inputs and model settings were identical across scenarios. Therefore, the difference between NPVRRs we present (deltas) should roughly represent changes in the NPVRR for only MidAmerican's system. This means the cost savings identified should roughly represent savings that would accrue to just MidAmerican's system and ratepayers.

2.1. Modeled scenarios consider MidAmerican's planned reliance on fossil fuels, and a transition to renewables and clean energy

MidAmerican Business as Usual Scenario

For the MidAmerican BAU Scenario we assumed that MidAmerican would operate each of its coal plants beyond 2040. MidAmerican has not published a clear retirement schedule for any of its units, but Table 3 shows our best understanding of when the units might retire, as well as our retirement assumptions for our clean energy scenario. We assume that all coal units in the rest of MISO can retire economically at any point prior to their scheduled retirement dates. The model was not allowed to add any new gas resources anywhere in MISO, and we assumed baseline levels of energy efficiency equivalent to MidAmerican's current energy efficiency investment levels.

Table 3: Coal plant retirement dates by scenario

Coal Plant	Horizons Energy's National Database	Berkshire Hathaway Stakeholder meeting	2030 Coal Retirement Scenario
Neal North	12/31/2049	No later than 12/31/2049	12/31/2025
Neal South	12/31/2053		12/31/2025
Ottumwa	12/31/2055		12/31/2024
Louisa	12/31/2057		12/31/2026
Scott 3	12/31/2052		12/31/2024
Scott 4	12/31/2081		12/31/2030

Notes: At the Berkshire Shareholders meeting this past May, Greg Abel said that all units would be retired by 2049. There were no specifics as to when the units would be retired. Available at https://finance.yahoo.com/BRKlivestream/?guccounter=1 *(1:45 mark with a slide at 1:56).*

Clean Energy 2030 Scenario

For the clean energy scenario, we assumed that MidAmerican retired all its coal capacity by the end of 2030. The model was allowed to make economic retirement decisions for each coal unit, but the units were required to retire no later than the dates displayed in Table 3 above. The model therefore was allowed to select the optimal (least-cost) year in which to retire each coal unit. Coal in the rest of MISO was similarly allowed to retire economically at any point prior to each unit's scheduled retirement date. The model was not allowed to add any new gas resources anywhere in MISO, and we projected increased energy efficiency investment from current levels to meet regional average energy efficiency performance levels.

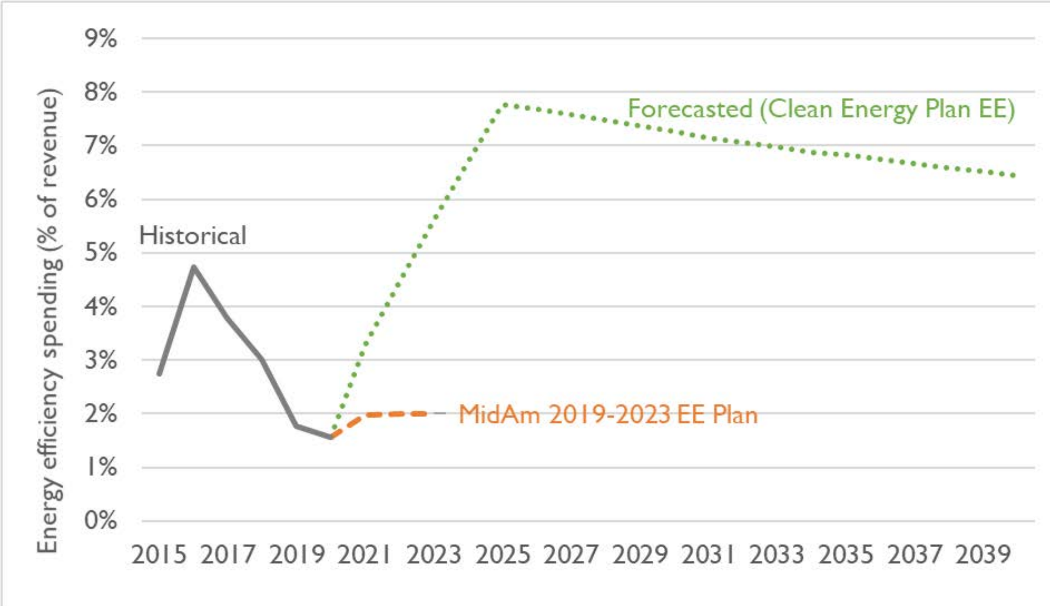
Energy efficiency and load forecasts

For energy efficiency, peer utilities in the Midwest have solid energy efficiency program performance. On average, the large Midwest utilities with robust programs achieved energy efficiency savings equal to 1.92 percent of sales in 2019, as compared to MidAmerican's 0.76 percent.[26] In the Clean Energy Scenarios outlined in this study, we include a plan for MidAmerican to ramp its annual energy efficiency program savings up to 1.92 percent of retail sales by Year 2025, equivalent to its peer utilities in the Midwest (we assume that the rest of Iowa remains at baseline planned levels). Achieving this level of savings will require increased investment, as illustrated in Figure 1. The level of spending would be a substantial increase, but it would be considerably lower investment than that of nationally leading utilities (approximately 9 percent of revenues).[27]

[26] According to data reported on U.S. EIA Form 861, which includes utilities with greater than 10,000 utility customers: Commonwealth Edison Co, Cedar Falls Utilities, Dayton Power & Light Co, Freeborn-Mower Coop Services, City of Holland, Otter Tail Power Co, Duke Energy Ohio Inc, DTE Electric Company, City of Traverse City - (MI), Northern States Power Co – Minnesota.

[27] This level of energy efficiency investment is above what is allowed under Iowa state law, but it represents one of the most economic resource options available to the utility.

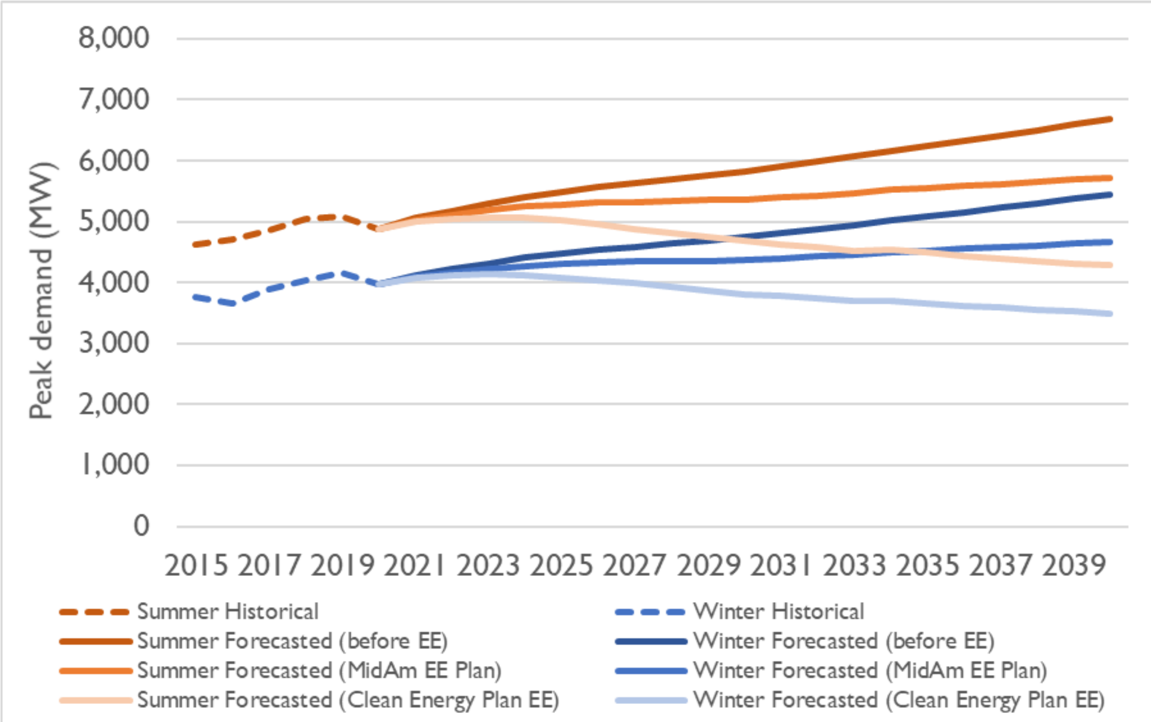
Figure 1: MidAmerican forecasted spending on energy efficiency



Source: EIA Form 861 for 2020; Purdue University, State Forecasting Group, 2020. 2020 MISO Energy and Peak Demand Forecasting for System Planning. Prepared for Midcontinent Independent System Operator.

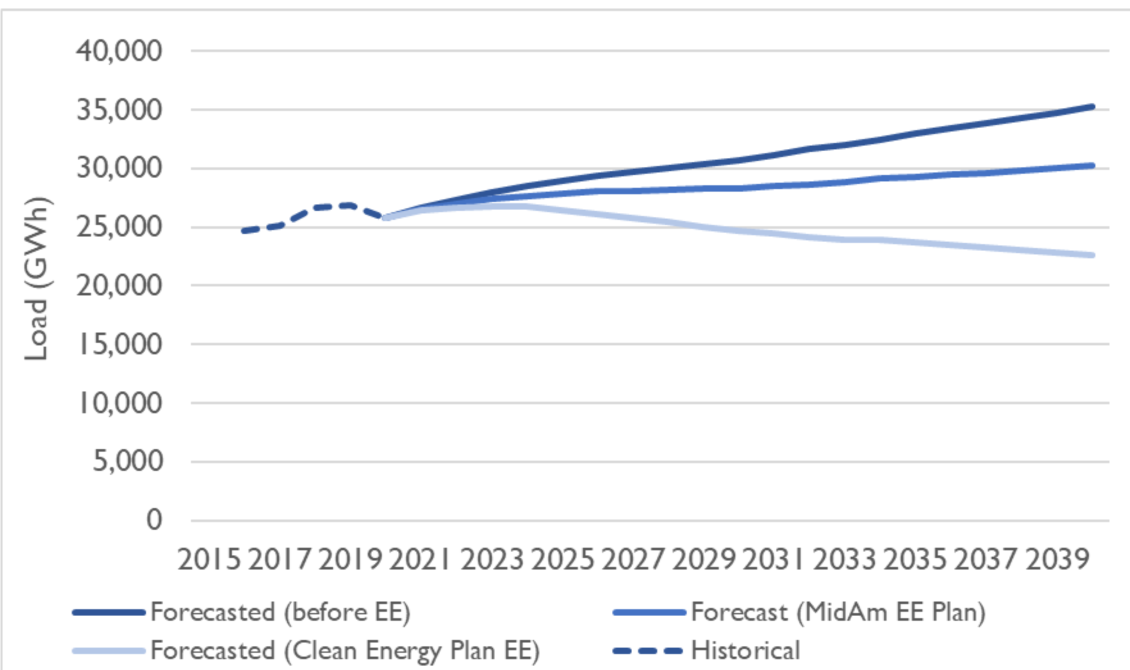
Under MidAmerican's current plan, the Company's system peak and net load will rise by about 17 percent by 2040. However, with a strong energy efficiency plan that is on par with other Midwest utilities, MidAmerican can reduce system peaks, which will lower overall costs as the utility transitions toward clean energy generating resources. Figure 2 and Figure 3 illustrate these effects.

Figure 2: MidAmerican forecasted peak load



Source: Purdue University, State Forecasting Group, 2020. 2020 MISO Energy and Peak Demand Forecasting for System Planning. Prepared for Midcontinent Independent System Operator.

Figure 3: MidAmerican forecasted net load

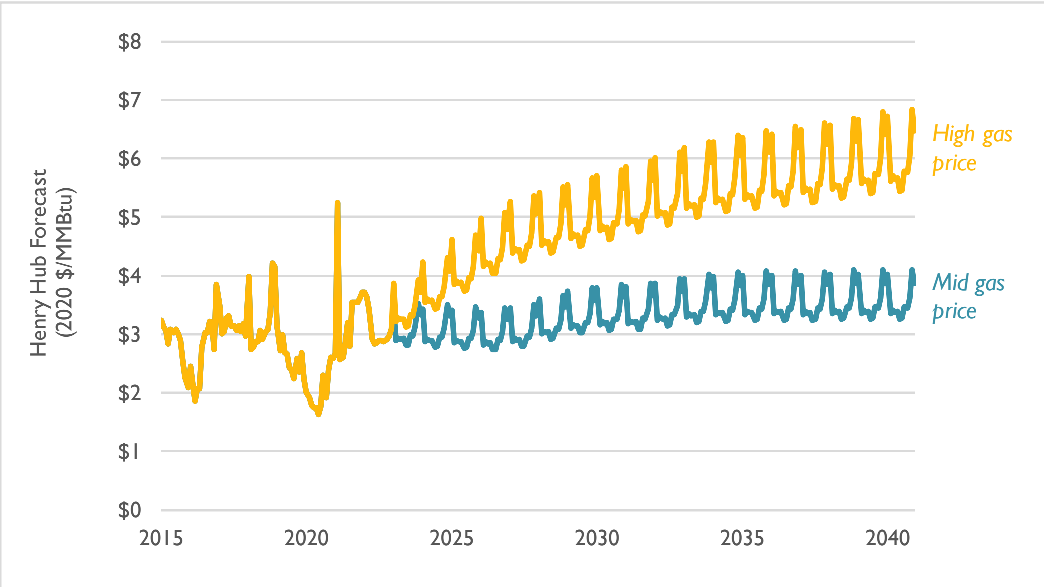


Source: Purdue University, State Forecasting Group, 2020. 2020 MISO Energy and Peak Demand Forecasting for System Planning. Prepared for Midcontinent Independent System Operator.

High Gas Price and Carbon Tax Sensitivity

To assess the potential financial impacts of a federal or statewide carbon tax and higher natural gas prices, we conducted a sensitivity analysis. Under the high gas price and CO_2 price sensitivity, Synapse used a gas price projection (shown in Figure 4) derived from EIA's 2021 Annual Energy Outlook (AEO) Henry Hub high gas price forecast (known as the Low oil and gas supply case) as opposed to the Mid case (known as the Reference case). Gas price volatility is already observable—as of August 2021, Henry Hub futures prices for January 2022 had risen above $5/MMBtu.[28]

Figure 4: **Natural gas price forecast comparison between High and Mid case**

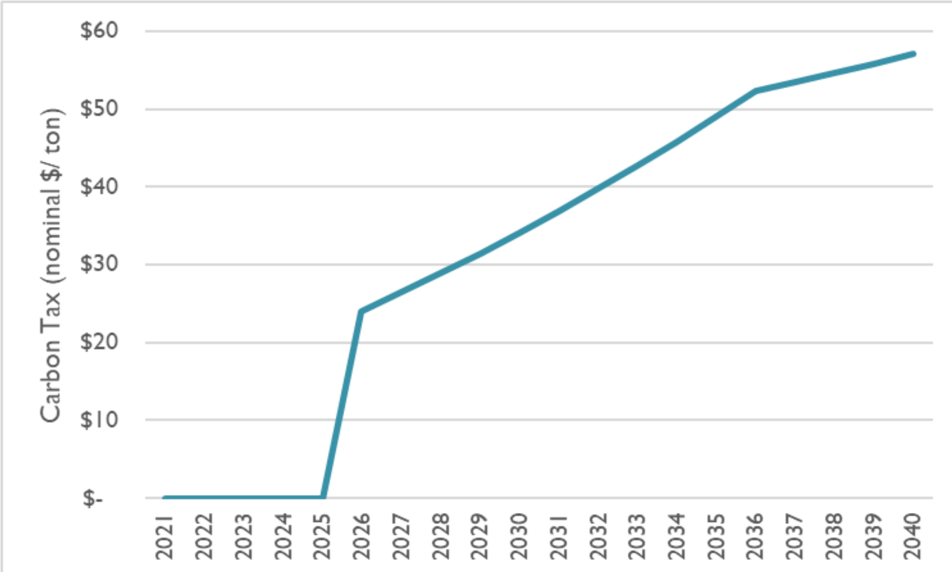


For the carbon tax, we surveyed the carbon tax assumptions used by utilities in the Midwestern region. Northern Indiana Public Service Company's (NIPSCO) tax forecast assumptions fell in the middle of the range we observed, so we used this as the basis for our modeled CO_2 tax.[29] To model this, we applied a $24.04 per short ton (nominal) carbon tax beginning in 2026 escalating up to $57.05 by 2040 (NIPSCO modeled a $20/ton tax in $2017 escalating to $35 a ton by 2036). Figure 5 shows our carbon tax forecast that we used in our sensitivities.

[28] CME Group, Henry Hub Natural Gas Futures – Settlements. Last updated October 21, 2021. Available at https://www.cmegroup.com/markets/energy/natural-gas/natural-gas.settlements.html.

[29] Northern Indiana Public Service Company LLC, *2018 Integrated Resource Plan*, October 2018. Available at https://www.nipsco.com/docs/librariesprovider11/rates-and-tariffs/irp/2018-nipsco-irp.pdf?sfvrsn=15has.

Figure 5: Carbon tax forecast



Source: Northern Indiana Public Service Company LLC, 2018 Integrated Resource Plan, October 2018. Available at https://www.nipsco.com/docs/librariesprovider11/rates-and-tariffs/irp/2018-nipsco-irp.pdf?sfvrsn=15has.

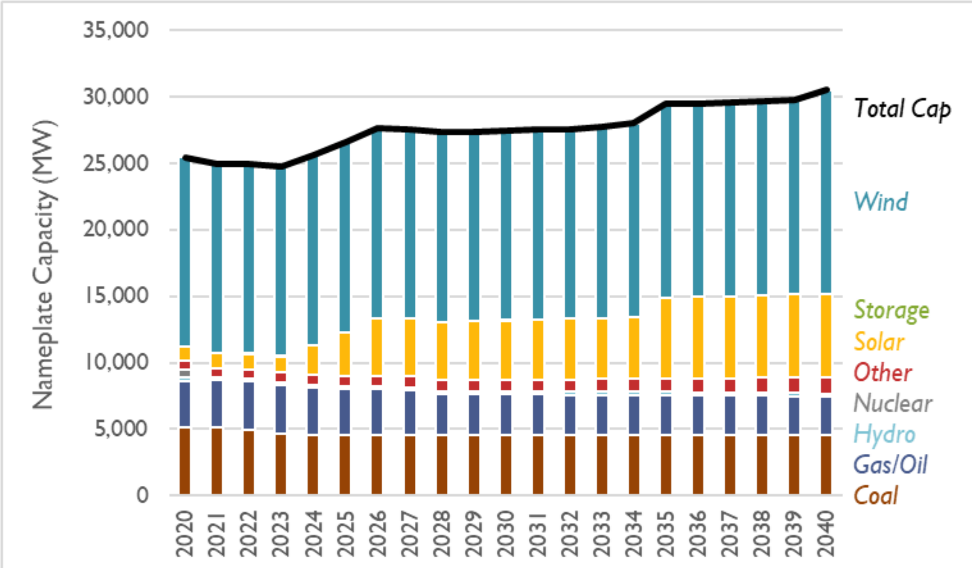
2.2. Retiring MidAmerican's coal fleet by 2030 and replacing it with renewables, battery storage, and increased energy efficiency investment would save ratepayers approximately $1.2 billion through 2040.

We find that retiring MidAmerican's six existing coal units over the next 10 years and replacing the energy and capacity with solar PV, wind, battery storage and energy efficiency would save MidAmerican ratepayers approximately $1.2 billion between now and 2040. Further, it would decrease CO_2 emissions by around 318 million tons.

Capacity results

Under the BAU scenario (shown in Figure 6), MidAmerican continues to operate all its coal plants through 2040. The model adds solar to serve additional load growth; but other than that, the Company and the resource mix for MISO Zone 3 looks very similar in 2040 to what it looks like today. The Company continues to rely on coal and gas resources to supply a significant portion of its firm capacity over the next two decades.

Figure 6: Nameplate capacity for MISO Zone 3 under MidAmerican BAU scenario

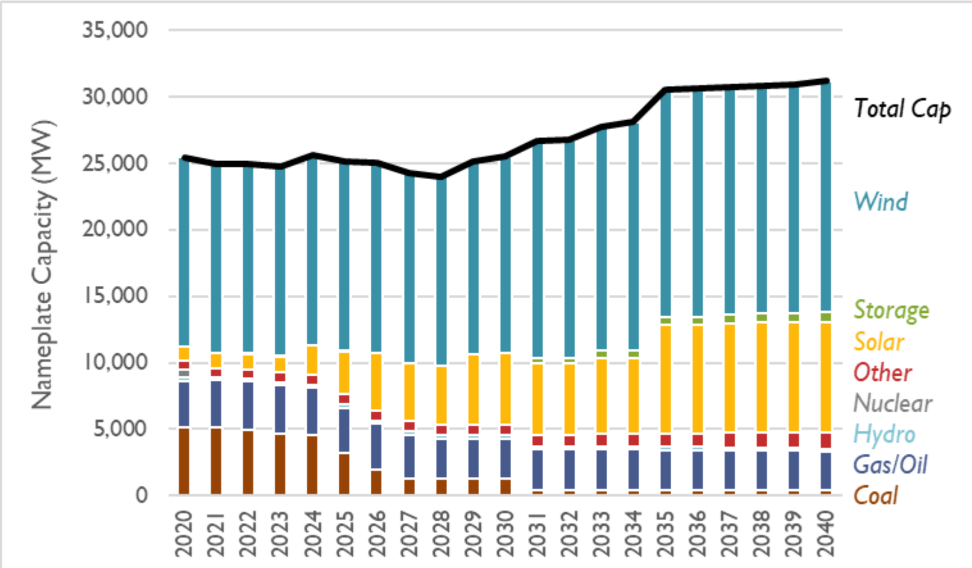


Under the Clean Energy 2030 Scenario (shown in Figure 7) the Company retires all coal by 2030.[30] The retirement years selected by the model are presented in Table 3 on page 6, above. The capacity is replaced with 2,060 MW of solar PV, 2,000 MW of wind, and 740 MW of battery storage. Demand is also lower than under the BAU due to increased investment in energy efficiency. The renewable builds in this scenario are roughly consistent with the quantity of renewables MISO currently has in its interconnection queue and expects to come online over the next decade.[31]

[30] The remaining coal in Figure 7 is for Muscatine Unit 9 which is located outside of MidAmerican's service territory in MISO Zone 3.

[31] 2021 OMS-MISO Survey Results, July 2021 RASC. Available at https://cdn.misoenergy.org/20210707%20RASC%20Supplemental%202021%20OMS-MISO%20Survey%20Results566176.pdf.

Figure 7: Nameplate capacity for MISO Zone 3 under Clean Energy 2030 Scenario



Generation results

In the MidAmerican BAU scenario, coal and wind generation remain relatively constant between 2020 and 2040. Load in MISO Zone 3 is projected to grow by 26 percent, or by 12 thousand GWhs, during that period. The increased load is met largely by new solar and gas generation, which together make up 21 percent of generation in 2040, up from just 10 percent in 2020. The Company remains a large net exporter of generation to MISO throughout the time period, though imports increase by about one thousand GWhs between 2020 and the late 2030s. Figure 8 and Table 4 show the generation results for MISO Zone 3 in the MidAmerican BAU scenario and Figure 9 shows the export results.

Figure 8: Generation mix for MISO Zone 3, BAU Scenario

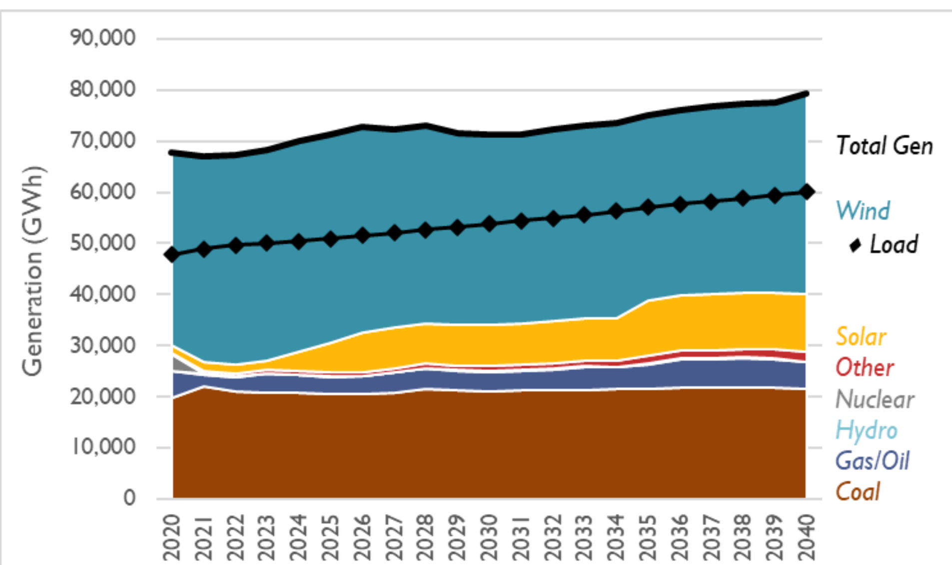
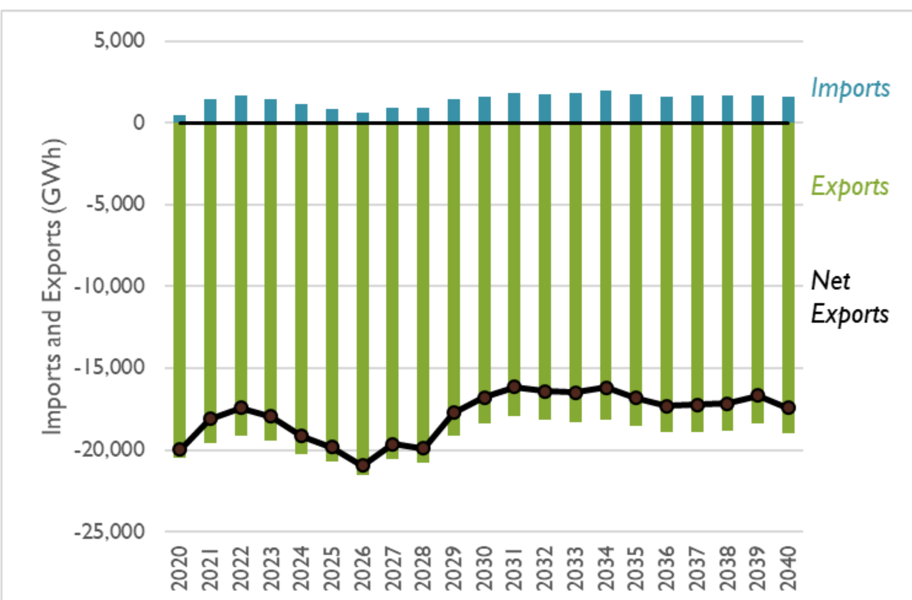


Table 4: Generation mix for MISO Zone 3, BAU Scenario

Generation Mix for MISO Zone 3, BAU Scenario – GWh									
Year	Wind	Solar	Nuclear	Hydro	Gas/Oil	Coal	Other	Total Generation	Load
2020	37,647	1,510	3,147	53	5,378	19,654	406	67,794	47,752
2021	40,413	1,762	0	139	2,278	22,086	439	67,116	48,930
2022	40,844	1,842	0	140	2,762	21,135	513	67,235	49,626
2023	41,179	1,908	0	142	3,726	20,739	613	68,308	50,077
2024	41,101	3,881	0	140	3,414	20,785	636	69,958	50,474
2025	40,627	5,832	0	137	3,361	20,554	677	71,187	50,986
2026	40,258	7,813	0	139	3,400	20,516	742	72,867	51,496
2027	38,694	7,863	0	140	3,863	20,850	787	72,196	52,061
2028	38,714	7,923	0	140	4,072	21,425	827	73,100	52,682
2029	37,520	7,972	0	138	3,833	21,228	889	71,580	53,243
2030	37,223	8,049	0	137	3,834	21,062	962	71,267	53,812
2031	36,896	8,093	0	136	3,843	21,316	1,040	71,324	54,404
2032	37,448	8,189	0	138	4,092	21,264	1,098	72,228	54,989
2033	37,587	8,215	0	138	4,463	21,384	1,177	72,963	55,573
2034	38,132	8,278	0	138	4,264	21,465	1,248	73,525	56,364
2035	36,265	10,792	0	138	4,853	21,556	1,386	74,990	57,054
2036	36,337	10,906	0	139	5,426	21,891	1,483	76,183	57,678
2037	36,766	10,935	0	140	5,558	21,823	1,587	76,807	58,205
2038	36,922	11,068	0	139	5,665	21,898	1,677	77,369	58,784
2039	37,211	11,139	0	140	5,544	21,824	1,803	77,661	59,398
2040	39,225	11,189	0	139	5,211	21,533	1,909	79,205	60,055

Figure 9. Imports and exports for MISO Zone 3, MidAmerican BAU Scenario



The Clean Energy 2030 Scenario nearly eliminates coal generation in MISO Zone 3 after 2030, replacing it with a combination of wind, solar, gas, and storage (Muscatine 9 and Archer Daniels Midland Cedar Rapids stay online). By 2031, wind and solar account for a combined 89 percent of total generation. Over the remaining 10 years, new solar generation slightly replaces wind. Relative to the MidAmerican BAU scenario, load growth is muted, increasing by just 10 percent between 2020 and 2040 thanks to improved energy efficiency performance. Exports decrease as the Company retires its coal plants, especially after 2030. Figure 10 and Table 5 show the generation results for MISO Zone 3 for the 2030 Clean Energy Scenario and Figure 11 shows export results.

Figure 10: Generation mix for MISO Zone 3, Clean Energy 2030 scenario

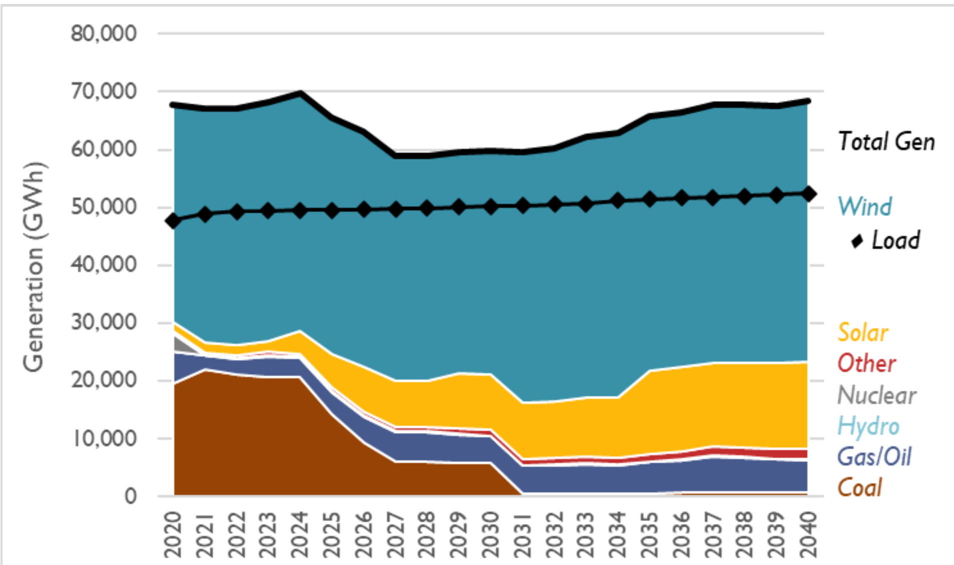
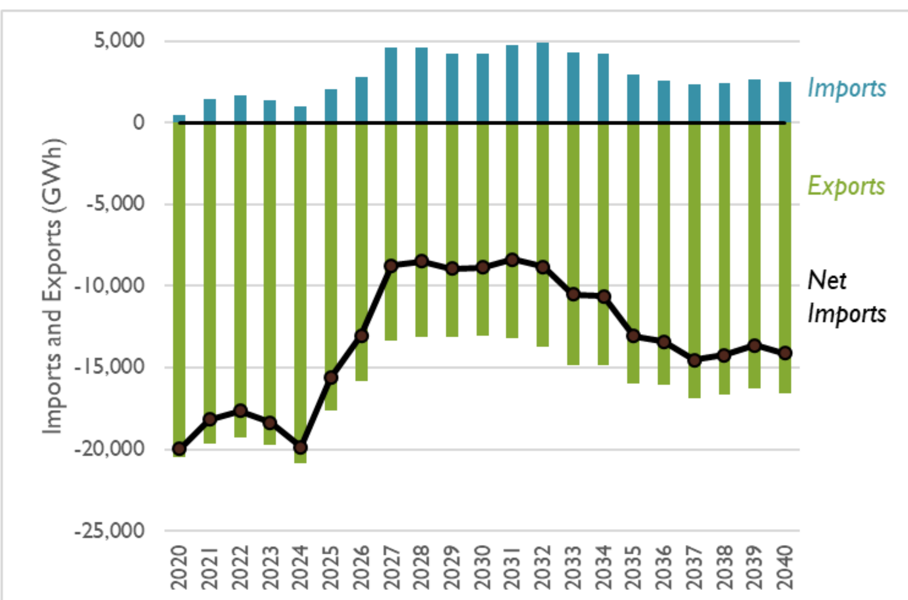


Table 5: Generation mix for MISO Zone 3, Clean Energy 2030 Scenario

Generation Mix for MISO Zone 3, Clean Energy 2030 Scenario - GWh									
Year	Wind	Solar	Nuclear	Hydro	Gas/Oil	Coal	Other	Total Generation	Load
2020	37,647	1,510	3,147	53	5,378	19,654	406	67,794	47,752
2021	40,403	1,762	0	139	2,266	22,076	438	67,084	48,821
2022	40,825	1,842	0	140	2,723	21,105	513	67,147	49,315
2023	41,149	1,908	0	142	3,644	20,666	612	68,121	49,462
2024	41,048	3,881	0	140	3,279	20,706	634	69,688	49,506
2025	40,840	5,832	0	140	3,855	14,208	678	65,554	49,561
2026	40,565	7,813	0	140	4,478	9,326	746	63,068	49,618
2027	38,943	7,879	0	141	5,239	5,969	792	58,963	49,735
2028	38,864	7,940	0	141	5,176	5,980	845	58,947	49,914
2029	38,259	9,557	0	140	4,823	5,916	907	59,601	50,040
2030	38,577	9,629	0	140	4,539	5,878	995	59,758	50,180
2031	43,424	9,677	0	138	4,763	549	1,050	59,600	50,348
2032	43,845	9,758	0	139	4,813	579	1,126	60,260	50,513
2033	45,064	10,225	0	139	5,060	589	1,179	62,257	50,681
2034	45,877	10,284	0	139	4,783	584	1,275	62,943	51,169
2035	43,879	14,388	0	139	5,340	611	1,357	65,713	51,447
2036	44,051	14,461	0	138	5,651	628	1,511	66,440	51,663
2037	44,609	14,503	0	139	6,264	664	1,607	67,787	51,786
2038	44,586	14,633	0	138	6,072	659	1,676	67,765	51,964
2039	44,459	14,744	0	139	5,749	654	1,765	67,509	52,180
2040	45,150	14,902	0	138	5,681	635	1,906	68,412	52,442

Figure 11. Imports and exports for MISO Zone 3, Clean Energy 2030 scenario



High gas price and carbon tax sensitivity

In the high gas price and CO_2 tax sensitivity, we see lower emissions in MISO Zone 3 in both the BAU and 2030 Clean Energy Scenarios relative to their respective scenarios without high gas prices and a CO_2 tax. However, the decrease is more significant in the BAU scenario than in the Clean Energy Scenario. The NPVRR of each scenario increases, but the cost savings from the 2030 Clean Energy Scenario jumps significantly from around $1.2 billion to around $5 billion over the next two decades (relative to the BAU scenario with high gas prices and a CO_2 tax).

Delta between scenarios

In the Clean Energy 2030 Scenario, an additional 2,060 MW of solar PV is added to the electric system in MISO Zone 3 (incremental to anything already planned) over the next two decades relative to the BAU Scenario. This solar shows up as both utility-owned and as power purchase agreement (PPA) resources. This means that the model chooses to build new utility-owned solar PV to fill a capacity need (based on the capital cost of the resource); it adds PPA resources to meet an energy need (based on the levelized cost of energy, LCOE, of the resource). The model also adds an incremental 740 MW of battery storage and 2,000 MW of Wind PPAs to Iowa's system. These incremental solar, wind, and battery storage resources (along with the incremental energy efficiency investment) will essentially replace the energy and capacity from MidAmerican's retired coal fleet. Table 6 and Table 7 show the results of all capacity additions and coal plant retirements for the BAU and the Clean Energy 2030 Scenario respectively and Table 8 shows the incremental addition for the Clean Energy 2030 Scenario relative to the BAU.

Table 6: Coal retirements and new cumulative nameplate capacity additions in MISO Zone 3 for BAU (MW)

Year	Coal	Gas/Oil	Solar	Solar PPA	Storage	Wind	Wind PPA	Gas/Oil
	Retirements	Unplanned Additions						Planned Addition
2020	0	0	0	0	0	0	0	0
2021	213	0	0	0	0	0	0	18
2022	252	0	0	0	0	0	0	213
2023	68	0	0	0	0	0	0	0
2024	0	0	0	1,000	0	0	0	0
2025	40	0	0	2,000	0	0	0	0
2026	0	0	0	3,000	0	0	0	0
2027	0	0	0	3,000	0	0	0	0
2028	0	0	0	3,000	0	0	0	0
2029	0	0	0	3,000	0	0	0	0
2030	0	0	0	3,000	0	0	0	0
2031	0	0	0	3,000	0	0	0	0
2032	0	0	0	3,000	0	0	0	0
2033	0	0	0	3,000	0	0	100	0
2034	0	0	0	3,000	0	0	300	0
2035	0	0	1,420	3,000	0	0	300	0
2036	0	0	1,420	3,000	0	0	300	0
2037	0	0	1,420	3,000	0	0	300	0
2038	0	0	1,420	3,000	0	0	300	0
2039	0	0	1,420	3,000	0	0	400	0
2040	0	0	1,420	3,000	0	0	1,100	0

Table 7: Coal retirements and new cumulative nameplate capacity additions in MISO Zone 3 for Clean Energy 2030 Scenario (MW)

Year	Coal	Gas/Oil	Solar	Solar PPA	Storage	Wind	Wind PPA	Gas/Oil
	Retirements	Unplanned Additions						Planned Addition
2020	0	0	0	0	0	0	0	0
2021	213	0	0	0	0	0	0	18
2022	252	0	0	0	0	0	0	213
2023	68	0	0	0	0	0	0	0
2024	1,434	0	0	1,000	0	0	0	0
2025	1,184	0	0	2,000	0	0	0	0
2026	746	0	0	3,000	0	0	0	0
2027	0	0	0	3,000	0	0	0	0
2028	0	0	0	3,000	0	0	0	0
2029	0	0	0	3,840	0	0	200	0
2030	814	0	0	3,840	0	0	500	0
2031	0	0	0	3,840	360	0	2,100	0
2032	0	0	0	3,840	360	0	2,100	0
2033	0	0	0	4,080	580	0	2,600	0
2034	0	0	0	4,080	580	0	2,900	0
2035	0	0	2,400	4,080	580	0	2,900	0
2036	0	0	2,400	4,080	580	0	2,900	0
2037	0	0	2,400	4,080	660	0	2,900	0
2038	0	0	2,400	4,080	660	0	2,900	0
2039	0	0	2,400	4,080	660	0	2,900	0
2040	0	0	2,400	4,080	740	0	3,100	0

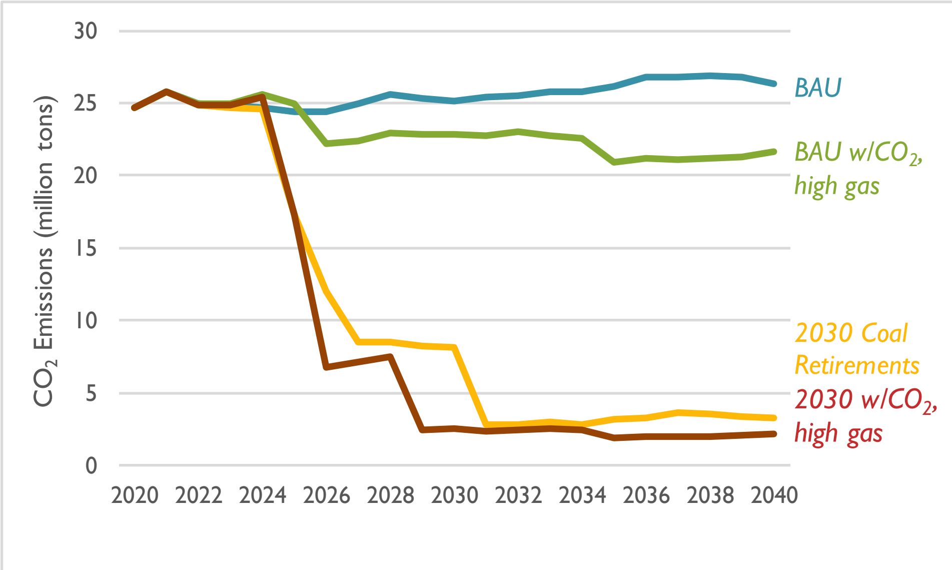
Table 8: Delta in cumulative nameplate capacity additions and coal retirements for MISO Zone 3 in Clean Energy 2030 Scenario relative to BAU (MW)

Year	Coal Retirements	Gas/Oil	Solar	Solar PPA	Storage	Wind	Wind PPA	Gas/Oil Planned Addition
		Unplanned Additions						
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0
2025	1,434	0	0	0	0	0	0	0
2026	1,144	0	0	0	0	0	0	0
2027	746	0	0	0	0	0	0	0
2028	0	0	0	0	0	0	0	0
2029	0	0	0	840	0	0	200	0
2030	0	0	0	840	0	0	500	0
2031	814	0	0	840	360	0	2,100	0
2032	0	0	0	840	360	0	2,100	0
2033	0	0	0	1,080	580	0	2,500	0
2034	0	0	0	1,080	580	0	2,600	0
2035	0	0	980	1,080	580	0	2,600	0
2036	0	0	980	1,080	580	0	2,600	0
2037	0	0	980	1,080	660	0	2,600	0
2038	0	0	980	1,080	660	0	2,600	0
2039	0	0	980	1,080	660	0	2,500	0
2040	0	0	980	1,080	740	0	2,000	0

Carbon dioxide emissions results

We observe very different emissions trajectories between the two scenarios, as shown in Figure 12. Under the BAU, MidAmerican and MISO Zone 3 will continue to emit CO_2 from its existing coal and fossil plants, with emissions gradually rising by the end of the 2030s. In the Clean Energy Scenario, the Company's and Zone 3's emissions drop as its coal plants are retired. We find that replacing the Company's coal fleet with clean energy resources will reduce carbon emissions by approximately 318 million tons over the next two decades.

Figure 12: CO_2 emissions by scenario for Iowa



Revenue requirement results

The results of our modeling show that the Clean Energy 2030 Scenario saves MidAmerican ratepayers just under $1.2 billion in net present value terms as shown in Table 9 below. When the high gas price and CO_2 tax sensitivity is introduced, the savings relative to the BAU from the Clean Energy Scenario increase to around $5.0 billion over the next two decades.

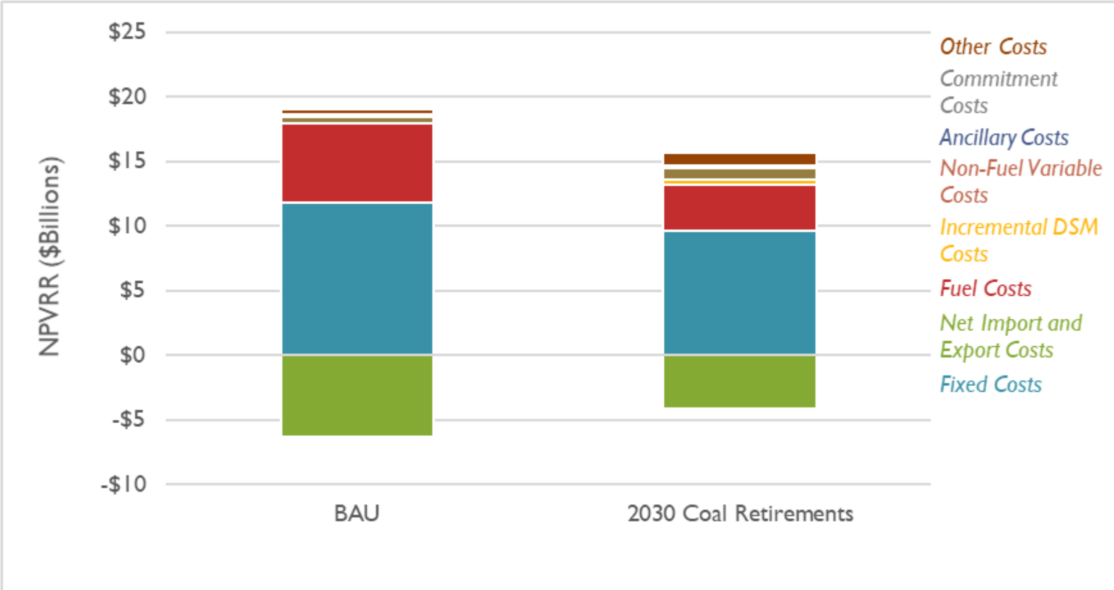
Table 9: Net present value of revenue requirement for MISO Zone 3 by scenario

Scenario	Total NPV for MISO Zone 3 ($Billion)	MidAmerican NPV Delta From BAU Scenario ($Billion)
Business As Usual	12.7	
2030 Retirements Clean Energy Scenario	11.6	1.2
Business As Usual – High Gas Price, CO_2 Tax Sensitivity	17.9	
2030 Retirements Clean Energy Scenario – High Gas Price, CO_2 Tax Sensitivity	12.9	5.0

Figure 13 and Table 10 shows the costs incurred for each scenario broken down by category. We did not include depreciation or book value costs for existing units, as those should not vary significantly across scenarios.[32] Fuel costs, import and export costs, and fixed costs account for the majority of the NPVRR associated with each scenario.

[32] Rate impacts from early retirements will vary depending on whether undepreciated plant balances can be securitized or put into a regulatory asset.

Figure 13: NPVRR by scenario and cost category for MISO Zone 3



Notes: Capital costs are included only for resources endogenously added by EnCompass. Non-fuel variable costs include production tax credits. Net import and export revenues include costs and revenues from purchases, sales, and contracts.

The Clean Energy 2030 Scenario had lower net import/export revenues and higher non-fuel variable costs, other costs for MISO Zone 3, demand-side management (DSM) costs, ancillary service costs, and commitment costs than the BAU Scenario. But the fuel savings, lower fixed costs, and lower capital costs required to maintain the unit (which are sizable for aging coal plants) combined to net nearly $1.2 billion NPVRR savings for the Clean Energy 2030 Scenario relative to the BAU for the state of Iowa.

Table 10: NPVRR of BAU and cost delta for Clean Energy Scenario by cost for MISO Zone 3

Scenario	BAU *Total* ($Millions)	Clean Energy 2030 *Delta* ($Millions)
Fuel Costs	$6,101	($2,502)
Non-Fuel Variable Costs	$481	$349
Net Import/Export Costs	($6,299)	$2,186
Other Costs	$434	$567
Ancillary Costs	$44	$57
Commitment Costs	$139	$13
Incremental DSM Cost	$0	$414
Fixed Costs	$11,843	($2,243)
Total	**$12,742**	**($1,158)**

Note: Other Costs include book depreciation, property taxes, allowed return, insurance costs, and program costs.

3. RETIRING MIDAMERICAN'S COAL FLEET WOULD STRENGTHEN THE LOCAL ECONOMY AND PROVIDE HIGH QUALITY JOBS

Meeting the energy load of MidAmerican customers with renewable energy and energy efficiency is an opportunity to strengthen the Iowa economy

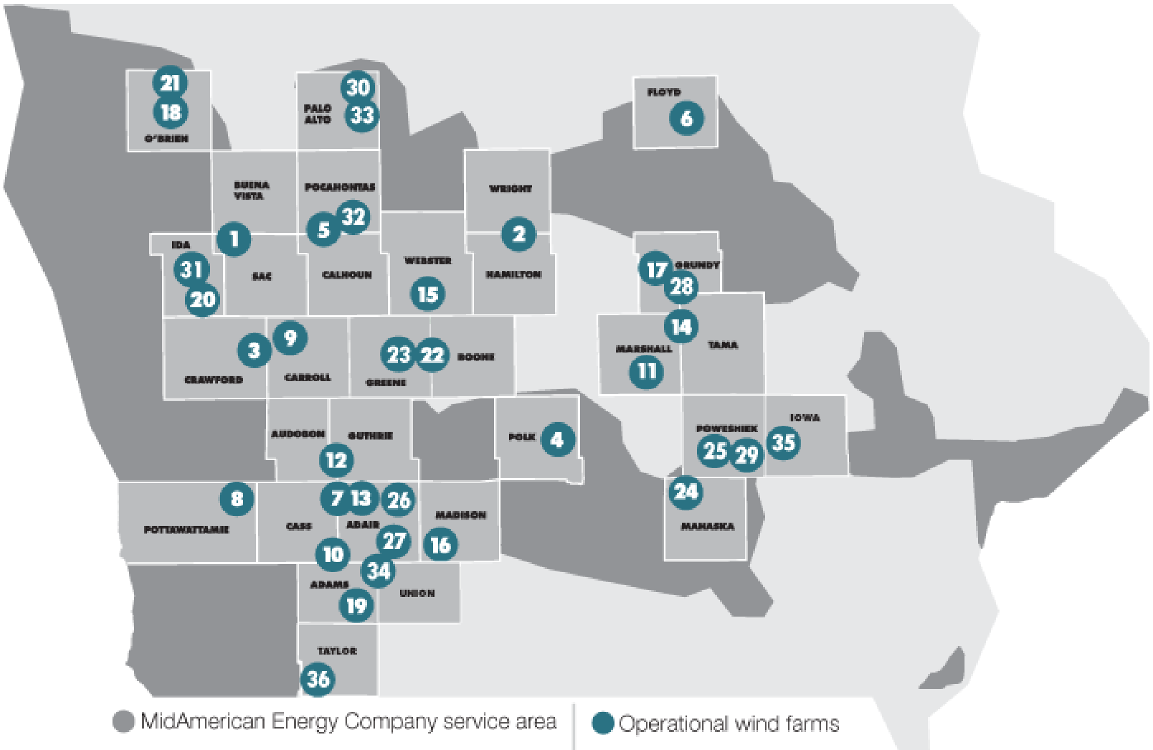
Renewable energy and energy efficiency are key sectors within the Iowa economy. Recent analysis by the Environmental Law & Policy Center identified 113 companies in Iowa's clean energy industry supply chain.[33] In 2019, wind and solar businesses employed over 9,000 and 800 Iowa workers, respectively; energy efficiency businesses provided another 21,000 jobs.[34] The strong in-state supply chain for renewable energy resources in Iowa provides a unique opportunity for MidAmerican to bolster the state economy while transitioning to 100 percent renewable energy. Notably, MidAmerican's existing wind resources provide positive local impacts in communities throughout the state, as shown in Figure 14. MidAmerican has identified a range of benefits to the Iowa economy associated with its $13 billion in existing wind energy investments.[35] The benefits include construction and permanent job creation, long-term economic benefits to rural areas, payments to landowners, and property tax payments.

[33] Falck, S., J. Mandelbaum, L. Reynolds, L. Stephens. 2021. *Iowa Clean Energy Supply Chain Businesses: Good for Jobs, Good for Economic Growth, and Good for Our Environment*. Environmental Law & Policy Center. Available at: https://elpc.org/resources/iowa-clean-energy-supply-chain-report/.

[34] *Ibid.*

[35] MidAmerican Energy Company. 2021. *Wind Energy*. Available at: https://www.midamericanenergy.com/wind-energy.

Figure 14. MidAmerican service area



Source: MidAmerican Energy Company. 2021. Wind Energy. Available at: https://www.midamericanenergy.com/wind-energy.

Transitioning MidAmerican's energy supply to incorporate more renewable energy and ramp up energy efficiency, as in the Clean Energy 2030 Scenario, can boost the Iowa economy. The Iowa Economic Development Authority notes that companies such as Google, Facebook, and Microsoft are locating energy-intensive facilities in Iowa because Iowa generates more wind electricity than any other state.[36] A long-term commitment by MidAmerican would ensure sustained local opportunities in the energy sector that would support new and existing businesses in the region. Efforts by local leaders and the State of Iowa (e.g., through Future Ready Iowa[37]) to develop and train a robust energy workforce will continue to supply qualified professionals to operate MidAmerican's efficiency programs and maintain its renewable energy supply resources.

[36] Iowa Economic Development Authority. 2021. *Renewable Energy: #1 in Wind Energy*. Available at: https://www.iowaeda.com/renewable-energy/.

[37] See, for example, wind energy careers pathways identified through *Future Ready Iowa*: Council for Experiential Learning. 2017. *Opportunities in Energy: Iowa Career Pathways*. Available at: https://www.futurereadyiowa.gov/sites/fri/files/basic_page_files/Opportunities%20in%20Energy%20-%20Iowa%20Career%20Pathways%20%282017%29.PDF.

Investment in renewable energy delivers more local benefits than continued reliance on fossil fuels

Investments in energy efficiency, solar power, wind power, and batteries can strengthen local and state economies while saving ratepayers money. Together, there are 2.7 million U.S. jobs dedicated to these energy resources.[38] Over half of those jobs are in the construction sector,[39] which support the economies where these energy resources are installed. Additionally, energy efficiency investments save ratepayers money by reducing utility bills, which can create new jobs when the savings are re-spent in the economy.[40]

Transitioning away from fossil-fuel-based electricity generation can create a net increase in jobs associated with low-carbon energy supply and energy efficiency. Compared with investment in fossil fuels, renewables and energy efficiency create between two and three times as many jobs for the same quantity of spending.[41] A substantial portion of MidAmerican's expenditures on fossil fuels do not benefit the Iowa economy, as the Company's fuels are sourced out of state and there are relatively few in-state jobs in these industries. MidAmerican's 2021 fuel receipts indicate that its fleet of coal plants purchased coal exclusively from three coal mines in Wyoming (Black Thunder, Antelope Coal Mine, and North Antelope Rochelle Mine).[42] The oil and gas mining and extraction jobs sector employ only 970 workers in Iowa, representing 0.046 percent of all in-state jobs in 2019, or half the national average for this sector.[43] Iowa has a strong supply chain for renewable energy resources. Further investment by MidAmerican will bolster this job sector. Reduced spending on coal and gas generation will result in job loss in those sectors. However, this should be considered alongside the increase in renewable and energy efficiency jobs to understand the overall net impact. Thoughtful consideration should be given to how to transition any workers who lose jobs.

[38] National Association of State Energy Officials and Energy Futures Initiative. 2020. *The 2020 U.S. Energy & Employment Report*. Available at: https://www.usenergyjobs.org.

[39] *Ibid.*

[40] See, for example: Camp, E., J. Hall, P. Knight, C. Odom. 2020. *Investing in Public Infrastructure in Massachusetts: Impacts of Investment in Clean Energy, Water, and Transportation*. Synapse Energy Economics for Labor Network for Sustainability.

[41] Garrett-Peltier, H. 2017. "Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model." *Economic Modelling*, *61*, pp.439-447.

[42] U.S. Energy Information Administration, Form 923 (year 2021).

[43] Bureau of Economic Analysis. 2019. Regional Data, Total Full-Time and Part-Time Employment by NAICS Industry. Available at: https://www.bea.gov/data/employment/employment-by-state.

4. CONCLUSION

Based on our analysis, we find that MidAmerican ratepayers will be significantly better off if the Company retires its coal units over the next 10 years and replaces the energy and capacity with a combination of solar PV, wind, battery storage, and increased investment in energy efficiency. Specifically, we find that replacing the Company's coal fleet with clean energy resources will reduce carbon emissions by around 318 million tons over the next two decades, will save ratepayers nearly $1.2 billion over the next decade, and will create local, high-quality jobs.

Findings

1. MidAmerican has failed to provide a robust and transparent analysis of the economics of keeping its coal fleet online through each unit's scheduled retirement date (relative to retiring the plants when going-forward economics so indicate) and replacing them with clean energy resources.
2. MidAmerican's ratepayers will save $1.2 billion over the next two decades if the Company retires the Neal, Louisa, and Ottumwa, and Walter Scott coal plants by 2030 and replaces them with a combination of renewables (2,060 MW of solar PV and 2,000 MW of wind), battery storage (740 MW), and energy efficiency.
3. Replacing the Company's coal fleet with clean energy resources will reduce carbon emissions by 318 million tons over the next two decades.
4. Replacing the Company's coal fleet with clean energy resources will provide local, high-quality jobs.

Recommendations

1. The Board should require that MidAmerican publish public and transparent analysis on its future resource plans.
2. The Board should require that MidAmerican set retirement dates for each of its coal-fired power plants to retire between now and 2030 and develop a clear plan to replace the energy and capacity with renewables, battery storage, and energy efficiency.

Appendix A. RESOURCE PLAN METHODOLOGY AND INPUTS

Modeling approach

Synapse engaged in a rigorous modeling exercise to evaluate the economics of Mid-American's coal plants in Iowa by modeling the future changes in capacity, generation, wholesale market prices, and electric-sector CO_2 emissions for a BAU case and several Synapse-designed scenarios. We evaluated the economics of retiring MidAmerican's coal fleet between now and 2030 and replacing it with renewables, battery storage, energy efficiency, and market imports. The model is assessed at a zonal level within MISO, with MISO South aggregated into a single region, and with and energy flows in and out of PJM.

- **Business-as-Usual Scenario:** This scenario analyzes a "most likely" future in which MidAmerican continues to operate all its existing coal plants through at least 2040. All existing and planned unit additions and retirements are retained for the MISO North and Central regions. Load forecasts and baseline energy efficiency assumptions were developed based on Purdue University's *2021 MISO Energy and Peak Demand Forecasting for System Planning* report.

- **Clean Energy 2030 Scenario:** These scenarios analyze an alternative future in which MidAmerican's Iowa coal plants retire by 2030 and are replaced with a combination of renewable generation and battery storage. In addition, these scenarios assume that MidAmerican's energy efficiency and demand response programs perform at a level consistent with the average performance achieved by MidAmerican's regional peers.

Modeling structure

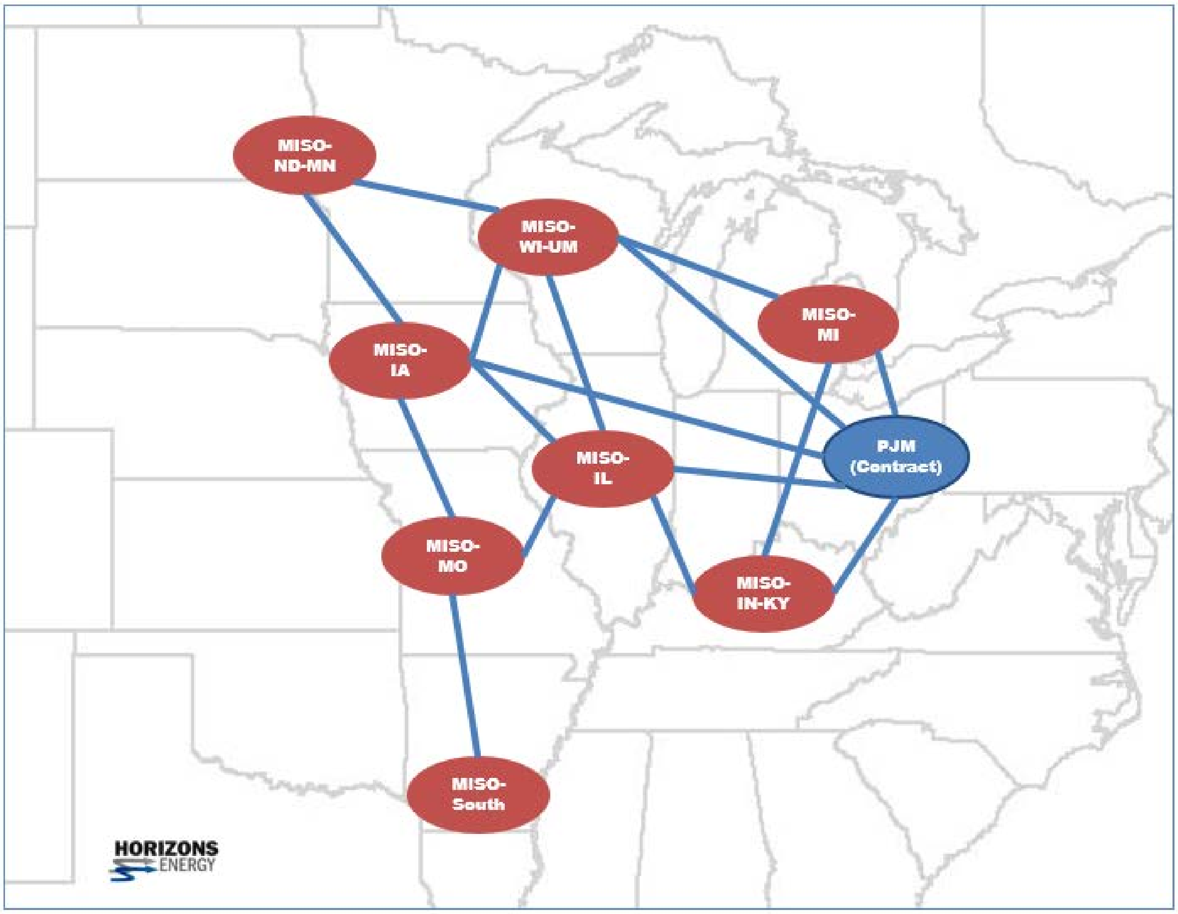
Synapse used the EnCompass model developed by Anchor Power Solutions. EnCompass is a single, fully integrated power system platform that provides an enterprise solution for utility-scale generation planning and operations analysis. Synapse populated the model with the MISO portion of the EnCompass National Database, created by Horizons Energy. Horizons Energy benchmarked its comprehensive dataset across the 21 North American Electric Reliability Corporation (NERC) assessment areas. The EnCompass model combined with the National Database provides a solid and defensible modeling foundation and a detailed and benchmarked unit-level dataset.

Topology

EnCompass, like other production-cost and capacity-expansion models, represents load and generation by mapping regional projections for system demand and specific generating units to aggregated geographic regions. These load and generation areas are then linked by transmission paths to create an aggregated balancing area.

MidAmerican's Iowa coal units are located in MISO Load Zone 3. We modeled detailed load zones within the northern and central parts of the MISO balancing area, with the southern load zones aggregated into a single region to simplify the topology.[44] Additionally, we model external contract regions to represent the PJM balancing areas.[45] Figure A-1 shows these modeled areas and the links between them.

Figure A-1: Modeled topology



<u>Modeling timescale</u>

In EnCompass, we explicitly modeled 20 years from 2021 through 2040. Each year is modeled in EnCompass' mixed capacity-expansion production-cost construct. In this construct, EnCompass determines the optimal least-cost capacity build-out over a one year time horizon and approximates unit commitment over the course of each year.

[44] MISO's southern load zones include MISO AR, MISO LA-TX, and MISO MS.

[45] Southern Power Pool, Electric Reliability Council of Texas, and Independent Electricity System Operator also connect with MISO, but they were not modeled in order to simplify the topology.

In addition to creating an optimal projection of system operation at the annual level, it is important to analyze operation at the sub-annual level. This second perspective allows for modelers to assess constraints or issues that may only arise at certain times of the year, including month-to-month fuel consumption, or hourly emissions of criteria pollutants. EnCompass allows for a wide variety of temporal resolutions—for this project Synapse uses the default, which is to model one on-peak and one off-peak day within each month, for each year, at a 24-hour resolution.

Reliability

EnCompass allows users to define generating units based on those units' ability to participate in various ancillary services markets including Regulation, Spinning Reserves, and Non-Spinning Reserves. The model allows users to specify these abilities for each unit, at varying levels of granularity. EnCompass allows units to contribute to contingency and reserves requirements, and it considers applicable costs when determining bids.

Load and demand-side forecast inputs

Primary inputs include the load forecast for peak demand (MW) and annual energy (GWh) throughout the MISO region from 2020–2040. The load forecast for the MISO region includes the impacts of energy efficiency programs, building codes and standards, distributed energy resources, and behind-the-meter solar PV. The other regional loads are based off the National Database. Likewise, annual peak demand forecasts (shown in Table A-1) use values provided by the National Database.

Table A-1: MISO baseline annual peak forecast

Year	Annual Peak Demand by Load Zone - MW										
	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10	MISO
2020	18,027	12,588	9,712	9,538	8,114	16,677	21,394	7,786	20,850	4,637	128,705
2021	18,150	12,674	9,778	9,604	8,170	16,791	21,541	7,839	20,993	4,669	129,587
2022	18,172	12,690	9,790	9,616	8,180	16,812	21,567	7,849	21,019	4,675	129,746
2023	18,196	12,706	9,803	9,628	8,191	16,834	21,596	7,859	21,047	4,681	129,917
2024	18,216	12,720	9,814	9,639	8,200	16,852	21,619	7,868	21,070	4,686	130,059
2025	18,243	12,739	9,828	9,653	8,212	16,877	21,651	7,879	21,101	4,693	130,250
2026	18,245	12,740	9,829	9,654	8,213	16,879	21,654	7,880	21,103	4,693	130,266
2027	18,294	12,774	9,856	9,680	8,235	16,924	21,711	7,901	21,159	4,706	130,612
2028	18,345	12,810	9,883	9,707	8,258	16,971	21,772	7,923	21,219	4,719	130,978
2029	18,389	12,841	9,907	9,730	8,277	17,012	21,824	7,942	21,269	4,730	131,290
2030	18,424	12,865	9,926	9,749	8,294	17,045	21,866	7,957	21,311	4,739	131,545
2031	18,461	12,891	9,946	9,768	8,310	17,079	21,910	7,973	21,353	4,749	131,809
2032	18,498	12,917	9,966	9,788	8,327	17,113	21,954	7,989	21,396	4,758	132,072
2033	18,535	12,943	9,986	9,807	8,343	17,147	21,998	8,005	21,439	4,768	132,336
2034	18,572	12,969	10,006	9,827	8,360	17,181	22,042	8,021	21,481	4,777	132,599
2035	18,609	12,994	10,025	9,846	8,377	17,215	22,085	8,037	21,524	4,787	132,863
2036	18,646	13,020	10,045	9,866	8,393	17,250	22,129	8,053	21,567	4,796	133,126
2037	18,683	13,046	10,065	9,886	8,410	17,284	22,173	8,069	21,609	4,806	133,389
2038	18,720	13,072	10,085	9,905	8,426	17,318	22,217	8,085	21,652	4,815	133,653
2039	18,756	13,097	10,105	9,925	8,443	17,352	22,261	8,101	21,695	4,825	133,916
2040	18,793	13,123	10,125	9,944	8,460	17,386	22,304	8,117	21,737	4,834	134,180

Sales

Our baseline load forecast was developed based on Purdue University's *2021 MISO Energy and Peak Demand Forecasting for System Planning* report. We apply the forecast to Zone 3's load shape developed by Horizons Energy based on the NERC 2019 Long Term Reliability Assessment, extrapolated out beyond 2029. Purdue University's 2021 MISO report did not include a separate energy efficiency forecast, therefore we relied on Purdue's 2020 MISO report for our baseline energy efficiency forecast.

Our forecast for MISO's load (shown below in Table A-2) includes the impacts of very minimal energy efficiency programs. Therefore, for the BAU scenario, we assumed that the MISO Zone 3 achieved baseline levels of EE equivalent to Mid American's current EE investment levels. For the Clean Energy 2030 scenario, we developed a more aggressive energy efficiency forecast that assumed that MidAmerican's energy efficiency and demand response programs ramp up to perform at a level consistent with the average performance achieved by MidAmerican's regional peers.

Table A-2: MISO baseline load forecast

Year	Annual Energy by Load Zone – GWh										
	LRZ1	LRZ2	LRZ3	LRZ4	LRZ5	LRZ6	LRZ7	LRZ8	LRZ9	LRZ10	MISO
2020	89,374	60,143	47,752	47,996	36,243	86,859	92,083	36,667	108,560	20,614	626,291
2021	89,270	61,883	48,930	48,477	36,126	90,247	93,696	38,264	110,729	21,524	639,146
2022	89,559	62,925	49,626	49,245	36,195	92,603	94,530	39,164	112,687	22,305	648,839
2023	89,651	63,388	50,077	49,476	36,203	93,114	94,949	39,528	114,203	22,257	652,846
2024	89,945	63,832	50,474	49,730	36,281	94,455	95,133	39,976	115,232	22,623	657,681
2025	90,194	64,346	50,986	50,012	36,441	95,620	95,601	40,428	116,669	22,991	663,288
2026	90,732	64,899	51,496	50,311	36,799	96,868	95,961	40,873	118,126	23,335	669,400
2027	91,474	65,466	52,061	50,625	37,186	98,255	96,353	41,349	119,547	23,664	675,980
2028	91,961	66,044	52,682	50,904	37,426	99,530	96,747	41,817	120,595	24,004	681,710
2029	92,283	66,623	53,243	51,196	37,612	100,840	97,058	42,270	121,594	24,368	687,087
2030	92,596	67,227	53,812	51,519	37,790	102,238	97,436	42,726	122,627	24,758	692,729
2031	92,842	67,820	54,404	51,828	37,889	103,588	97,891	43,182	123,702	25,150	698,296
2032	92,823	68,389	54,989	52,112	37,948	104,985	98,310	43,669	124,712	25,547	703,484
2033	92,919	69,002	55,573	52,425	38,079	106,475	98,861	44,190	125,866	25,890	709,280
2034	93,201	69,599	56,364	52,759	38,237	107,954	99,391	44,712	127,274	26,208	715,699
2035	93,731	70,178	57,054	53,077	38,265	109,493	99,901	45,267	128,610	26,540	722,116
2036	93,889	70,722	57,678	53,373	38,212	110,944	100,366	45,783	129,804	26,846	727,617
2037	94,231	71,265	58,205	53,658	38,247	112,404	100,839	46,306	131,051	27,153	733,359
2038	94,662	71,803	58,784	53,946	38,334	113,932	101,306	46,852	132,417	27,459	739,495
2039	95,182	72,355	59,398	54,231	38,410	115,454	101,763	47,395	133,811	27,782	745,781
2040	95,962	73,001	60,055	54,540	38,474	117,178	102,459	48,028	135,287	28,116	753,100

Resource inputs

Existing resources

Table A-3 below summarizes MISO’s existing resources as of 2020. Currently, MISO has approximately 210 GW of capacity. Nearly 75 percent of MISO’s capacity is met by combined cycle gas plants, steam (oil or gas) plants, coal plants, or other gas plants. Hydroelectric, nuclear, renewables, and distributed generation together make up about 25 percent of the regional transmission organization’s current capacity.

Table A-3: Summary of MISO's existing capacity by resource type and MISO Region

Resource Type	MISO Region Existing Resources (MW)			Share of Total %
	MISO-IA	Other Zones	Total	
Combined Cycle	1,788	35,019	36,806	17%
Coal	6,792	67,914	74,706	35%
Internal Combustion (Gas/Oil)	425	1,391	1,816	1%
Gas Combustion Turbine	1,647	18,032	19,679	9%
Steam (Gas/Oil)	1,488	24,173	25,661	12%
Onshore Wind	14,319	14,009	28,328	13%
Solar	608	2,492	3,100	1%
Hydro	234	2,347	2,580	1%
Other Renewable	5	1,224	1,229	1%
Distributed Generation	171	57	228	0%
Storage	15	2,494	2,509	1%
Nuclear	601	13,415	14,017	7%
Other	5	49	54	0%
Total	**28,098**	**182,615**	**210,713**	**100%**

Source: Horizon's Energy's National Database.

Our analysis incorporated sustaining capital expenditures for coal plants operating within MISO Zone 3. We estimated these cost streams using the Sargent and Lundy capital expenditure formula developed for the U.S. Energy Information Administration for use in its Annual Energy Outlook Report.[46] The formula is shown below. It estimates annual capital expenditures based on the plant's age and whether they plant has flue gas desulfurization (FGD) equipment installed.

$$CAPEX\ (2017\ \$/KW - yr) = 16.53 + (0.126 \times age\ in\ years) + (5.68 \times FGD)$$

<u>Known unit additions and retirements</u>

The EnCompass National Database includes known unit additions and known unit retirements scheduled to occur in MISO by 2040. These are resources which are scheduled to be either completed or retired in future years. Within MISO, there are no known unit additions scheduled to occur after 2023, but between 2020 and 2023 known additions will add 10.6 GW of capacity in MISO. Table A-4 summarizes known additions by commission date and resource type.

[46] Sargent & Lundy Consulting. *Generating Unit Annual Cost and Life Extension Costs Analysis, Prepared for U.S. Energy Information Administration*. May 2018. Available at https://www.eia.gov/analysis/studies/powerplants/generationcost/pdf/full_report.pdf.

Table A-4: Summary of known unit additions in MISO by scheduled commission date and resource type

Year	2020	2021	2022	2023	Total
Combined Cycle	1,700	1,224	1,146	-	4,070
Coal	-	-	-	-	-
Internal Combustion (Gas/Oil)	23	27	-	-	51
Gas Combustion Turbine	458	182	-	88	729
Steam (Gas/Oil)	84	-	213	-	296
Onshore Wind	4,990	141	-	-	5,131
Solar	1,002	731	-	-	1,733
Hydro	62	-	-	-	62
Other Renewable	2	-	-	-	2
Distributed Generation	-	-	-	-	-
Storage	5	-	-	-	5
Nuclear	-	-	-	-	-
Other	-	-	-	-	-
Total	**8,326**	**2,306**	**1,359**	**88**	**10,632**

Source: Horizon's Energy's National Database.

The scheduled retirements account for 56.5 GW of capacity including combined cycle, coal, other gas/oil resources, hydroelectric, nuclear, non-hydroelectric renewables, and storage generators. Table A-5 below shows the retirement timeline. Synapse adjusted the retirement dates for the Dolet Hills, Joppa, and Muscatine coal plants to reflect accelerated retirement timelines announced after the most recent EnCompass update.

Table A-5: Summary of MISO's expected capacity retirement by resource type

Year	Retirements by Resource Type (MW)							
	Coal	Other Gas/Oil	Nuclear	CC	Non-Hydro Renewable	Hydro	Storage	Total
2020	2,391	434	601	87	2	5	-	3,521
2021	1,281	342	-	75	-	1	-	1,700
2022	6,706	480	804	-	-	35	-	8,026
2023	5,639	1,241	-	-	16	-	1	6,896
2024	550	663	-	-	11	3	-	1,227
2025	195	1,218	-	28	6	11	-	1,458
2026	622	1,669	1,065	-	28	-	-	3,384
2027	-	710	-	87	21	-	-	819
2028	3,110	230	-	-	21	-	-	3,361
2029	635	572	-	-	63	-	-	1,270
2030	3,192	93	1,213	240	-	6	-	4,743
2031	610	1,260	-	13	2	-	21	1,905
2032	972	25	455	-	50	86	1	1,588
2033	-	761	1,121	-	41	-	19	1,942
2034	1,219	524	1,352	-	6	-	5	3,107
2035	1,260	741	-	-	41	7	5	2,054
2036	1,186	146	-	247	26	9	-	1,614
2037	120	7	-	42	43	6	-	218
2038	127	26	985	282	3	149	-	1,571
2039	1,331	77	-	264	2	4	-	1,678
2040	3,875	305	-	242	5	34	-	4,462
Total	35,020	11,526	7,596	1,607	387	357	52	56,545

Notes: Other Gas/Oil includes steam, gas combustion and internal combustion plants. Non-Hydro Renewable includes onshore wind, solar, distributed generation, and other renewables (geothermal, biofuel, landfill).

Source: Horizon's Energy's National Database.

Renewables and storage

Renewable parameters were a central input for this modeling exercise. These parameters include available capacity (in MW), resource characteristics (e.g., annual average capacity factors, capacity credits, and output profiles), and costs (including up-front costs, tax incentives, and fixed and variable operating costs).

<u>Renewable and storage performance and cost</u>

We used cost and performance data from public sources for both existing and new renewable resources. This list currently includes:

- *National Renewable Energy Lab (NREL) Annual Technology Baseline (ATB), August 2021* for both the non-PPA and PPA costs of utility-scale solar, utility-scale wind, and distributed solar PV.[47] Capital expenditure assumptions for utility-scale solar and wind resources from NREL ATB are shown below in Figure A-2 and the $/MWh energy cost used for Solar and Wind PPAs are shown in Figure A-3 below;

Figure A-2: Capital expenditures for non-PPA wind and solar resources

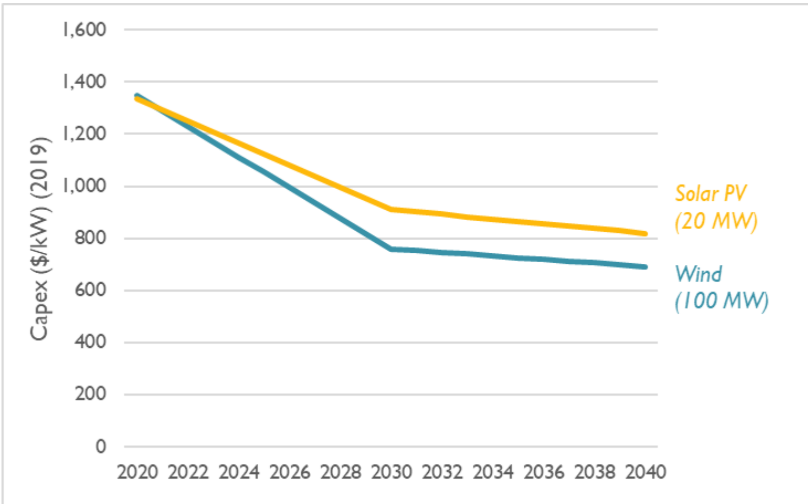
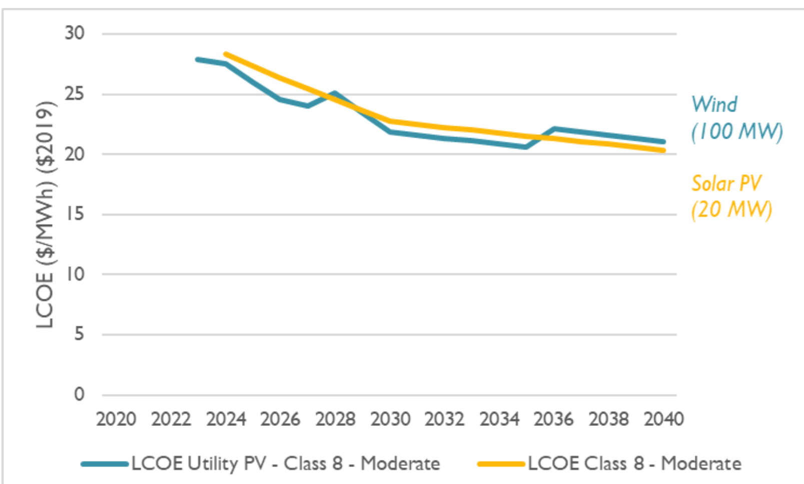


Figure A-3: LCOE for PPA wind and solar resources



- The firm capacity values included in EnCompass (presented below in Table A-6 below);

[47] National Renewable Energy Laboratory, Annual Technology Baseline, Errata. Available at https://atb.nrel.gov/electricity/2021/errata.

Table A-6: ELCC firm capacity assumptions

Resource	Firm Capacity (%)
Wind	16.9
Solar	50
Storage	100

- Regional wind shapes included in EnCompass; and
- Hourly solar profile included in EnCompass.

Generic additions

New renewable power plants and battery resources

New additions of renewable power plants and battery storage resources are largely driven by cost, with the model optimizing new builds by constructing the lowest-cost resources. We allowed EnCompass to construct utility-scale solar, onshore wind, solar PPAs, wind PPAs, and lithium-ion battery storage resources (4-hour). The solar and wind PPA resources represent a resource modeled with no capital cost and the entire project cost levelized and expressed as an energy charge. This was done so the model could add new solar and wind to satisfy energy needs even if the system does not need any new capacity. These resources do not actually need to be PPAs—they can be owned by the utility.

We did not allow the model to build any new generic gas resources, only gas plants that are explicitly planned.

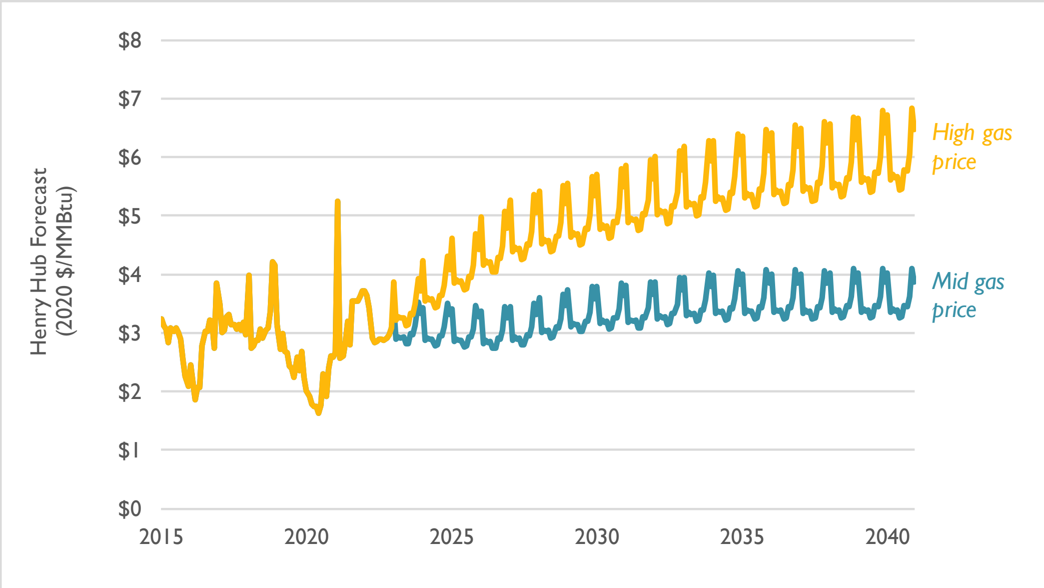
Natural gas prices

To calculate a BAU natural gas price, we relied on a combination of historical data reported by the EIA, NYMEX futures, and AEO forecasts. Prior to July 2021, the forecast relied on observed Henry Hub gas prices reported by the EIA to calculate annual averages. For the near term (2021 through 2022), the forecast used NYMEX futures for Henry Hub natural gas prices, before switching to the 2021 AEO reference case forecast for the long term (2026 through 2040). Between these two periods, a linear interpolation was used to stitch the two forecasts together. We calculated trends in average monthly prices from the historical data reported by the EIA and from near-term NYMEX futures and applied those to this longer-term natural gas price to develop long-term monthly trends. From here we calculated an annual price.

In addition to the BAU natural gas price, we created a high gas price scenario using the Low oil and gas supply case as opposed to the Reference case gas price projection from EIA’s 2021 Annual Energy Outlook (AEO) Henry Hub forecast.

Figure A-4 below shows the proposed BAU and High monthly natural gas price forecasts.

Figure A-4: Monthly natural gas price forecast



Appendix B. Generation and Capacity Results for Additional Modeled Scenarios

Figure B-1: Nameplate capacity for MISO Zone 3 for BAU High Gas Price, CO_2 Tax Sensitivity

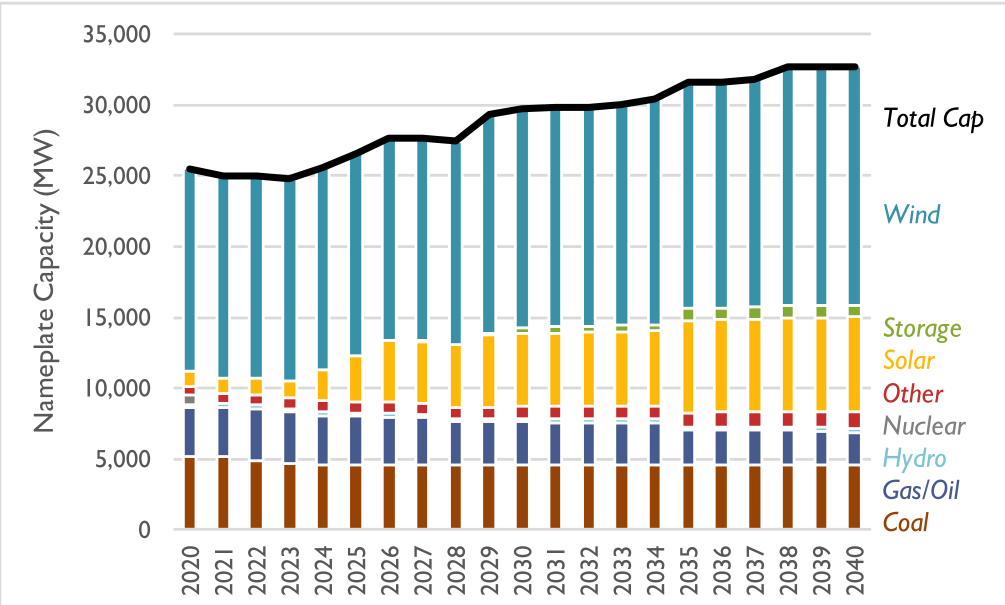


Figure B-2: Generation for MISO Zone 3 for BAU High Gas Price, CO_2 Tax Sensitivity

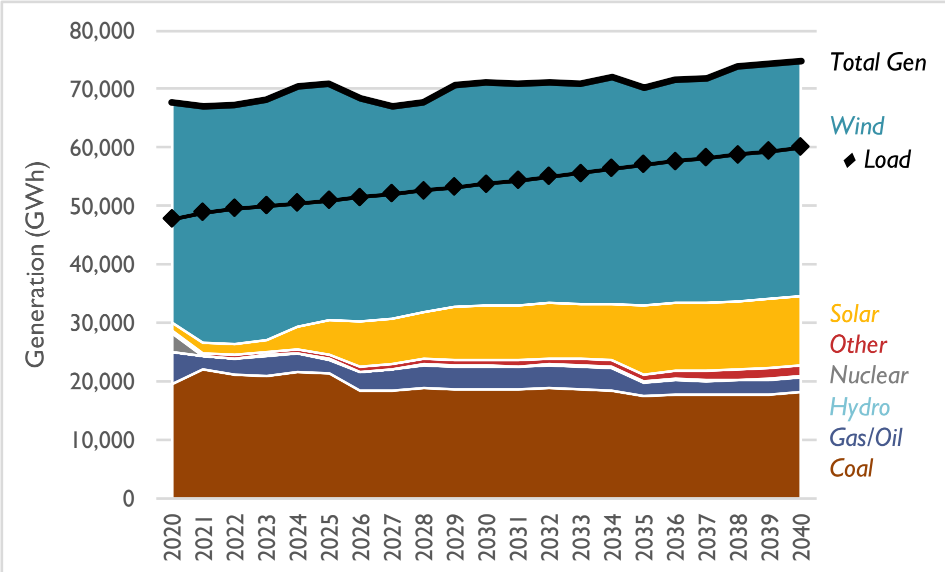


Table B-1. Generation for MISO Zone 3 for BAU High Gas Price, CO_2 Tax Sensitivity

Year	Generation Mix for MISO Zone 3, BAU High Gas Price, CO_2 Tax Sensitivity - GWh								
	Wind	Solar	Nuclear	Hydro	Gas/Oil	Coal	Other	Total Generation	Load
2020	37,647	1,510	3,147	53	5,378	19,654	406	67,794	47,752
2021	40,413	1,762	0	139	2,278	22,086	439	67,116	48,930
2022	40,844	1,842	0	140	2,762	21,135	513	67,235	49,626
2023	41,177	1,908	0	140	3,319	21,065	616	68,226	50,077
2024	41,094	3,881	0	137	3,036	21,744	641	70,532	50,474
2025	40,406	5,832	0	136	2,407	21,415	678	70,873	50,986
2026	38,166	7,813	0	143	3,093	18,492	749	68,456	51,496
2027	36,321	7,846	0	142	3,476	18,546	809	67,139	52,061
2028	35,941	7,910	0	143	4,035	18,837	862	67,728	52,682
2029	37,768	9,151	0	142	3,950	18,719	913	70,642	53,243
2030	38,124	9,278	0	144	3,833	18,780	981	71,139	53,812
2031	37,938	9,304	0	142	3,782	18,694	1,056	70,916	54,404
2032	37,812	9,409	0	141	3,855	18,929	1,098	71,243	54,989
2033	37,606	9,432	0	143	3,872	18,743	1,189	70,983	55,573
2034	38,662	9,503	0	143	3,868	18,514	1,252	71,943	56,364
2035	37,294	11,617	0	141	2,222	17,631	1,322	70,227	57,054
2036	37,985	11,695	0	141	2,506	17,809	1,447	71,582	57,678
2037	38,210	11,741	0	140	2,357	17,783	1,512	71,743	58,205
2038	39,984	11,774	0	138	2,444	17,826	1,618	73,784	58,784
2039	40,130	11,841	0	138	2,468	17,910	1,768	74,255	59,398
2040	40,084	11,967	0	141	2,632	18,172	1,829	74,826	60,055

Figure B-3: Nameplate capacity for MISO Zone 3 for Clean Energy 2030 Retirement, High Gas Price, CO_2 Tax Sensitivity

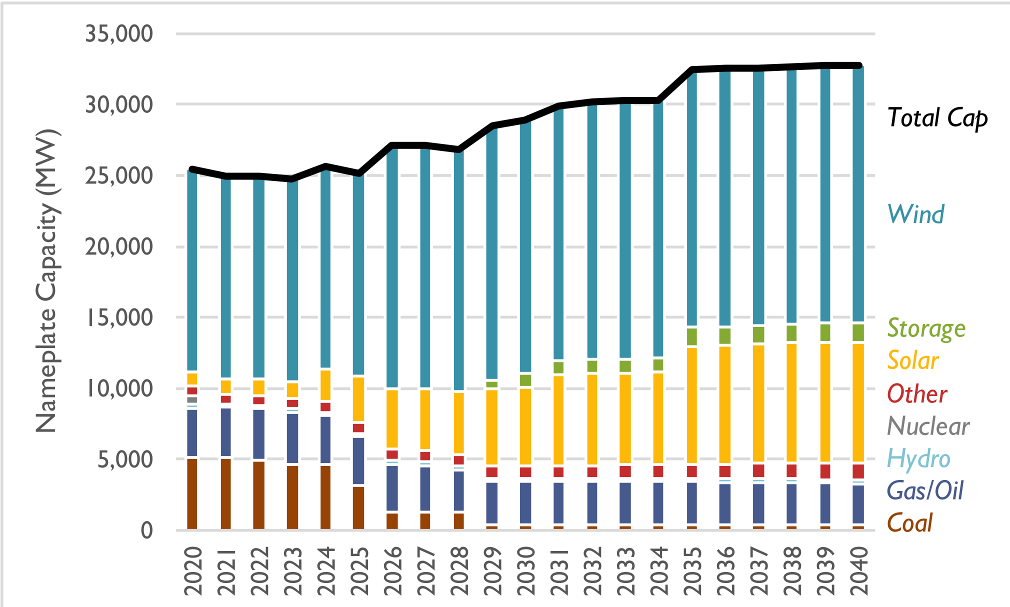


Figure B-4: Generation for MISO Zone 3 for Clean Energy 2030 Retirement, High Gas Price, CO_2 Tax Sensitivity

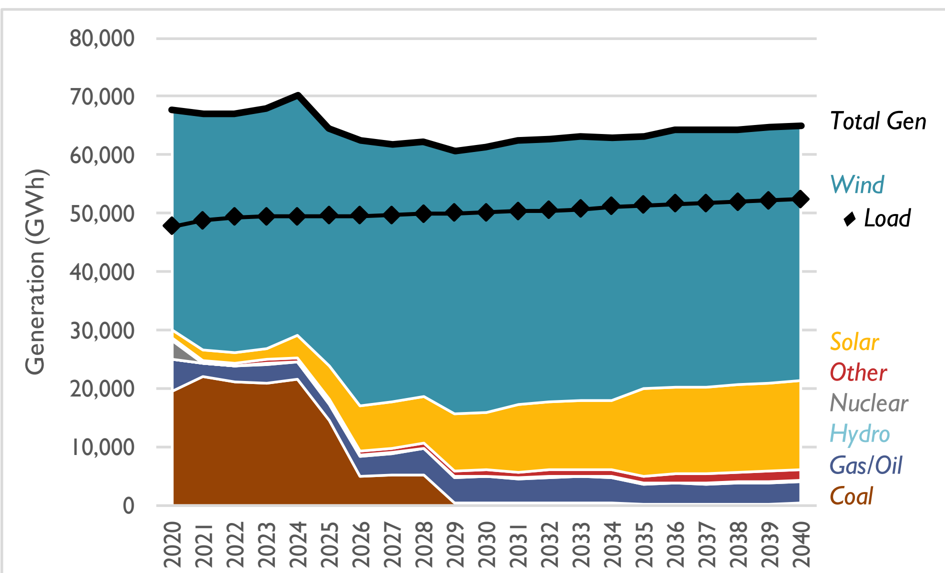


Table B-2. Generation for MISO Zone 3 for Clean Energy 2030 Retirement, High Gas Price, CO_2 Tax Sensitivity

Year	Generation Mix for MISO Zone 3, Clean Energy 2030 Retirement, High Gas Price, CO_2 Tax Sensitivity - GWh								
	Wind	Solar	Nuclear	Hydro	Gas/Oil	Coal	Other	Total Generation	Load
2020	37,647	1,510	3,147	53	5,378	19,654	406	67,794	47,752
2021	40,403	1,762	0	139	2,266	22,076	438	67,084	48,821
2022	40,825	1,842	0	140	2,723	21,105	513	67,147	49,315
2023	41,147	1,908	0	139	3,236	21,008	616	68,054	49,462
2024	41,040	3,881	0	137	2,926	21,651	635	70,270	49,506
2025	40,571	5,832	0	136	2,693	14,658	683	64,573	49,561
2026	45,192	7,805	0	143	3,419	5,094	753	62,406	49,618
2027	44,179	7,802	0	141	3,732	5,242	819	61,915	49,735
2028	43,685	7,864	0	144	4,422	5,325	865	62,305	49,914
2029	44,903	9,822	0	143	4,449	405	911	60,633	50,040
2030	45,274	9,918	0	144	4,599	414	966	61,315	50,180
2031	45,118	11,548	0	142	4,203	426	1,024	62,461	50,348
2032	45,088	11,655	0	140	4,439	410	1,097	62,830	50,513
2033	45,125	11,672	0	143	4,531	420	1,201	63,092	50,681
2034	44,993	11,756	0	143	4,452	408	1,272	63,024	51,169
2035	43,112	14,913	0	140	3,315	371	1,323	63,174	51,447
2036	43,833	14,945	0	140	3,484	388	1,456	64,247	51,663
2037	43,882	14,965	0	139	3,411	378	1,509	64,284	51,786
2038	43,419	15,066	0	139	3,566	382	1,632	64,205	51,964
2039	43,771	15,158	0	137	3,615	389	1,738	64,809	52,180
2040	43,574	15,289	0	141	3,818	402	1,825	65,049	52,442

Appendix C. EXCERPT OF BOARD ORDER IN DOCKET NO, SPU-2021-0003

IT IS THEREFORE ORDERED:

1. Docket No. SPU-2021-0003 is opened to review MidAmerican Energy Company's long-term resource plans.

2. MidAmerican Energy Company shall file within 60 days of the date of this order the following information:

    a. Any current documents that provide details about its long-term resource requirements;

    b. An overview of its current generating fleet and how it meets the needs of MidAmerican's customers;

    c. A least-cost analysis addressing options considered to meet its long-term resource needs, including the potential effects on reliability and economic development potential; and

    d. An analysis of the issues identified in Docket No. EPB-2020-0156 that have been deferred to this docket. The analysis should include consideration of fuel switching, generating unit retirement, modified dispatch, addition of new generation sources, wholesale market transactions, and the costs of alternative compliance options, as well as any economic development potential for those options.

3. Comments, additional information, or responses to the information filed by MidAmerican Energy Company shall be filed within 90 days of the date of this order.

4. The Utilities Board is proposing to take official notice of the filings in Docket No. EPB-2020-0156. Any objections to the taking of official notice shall be filed within 10 days of the date of this order.