Coal Plant Economics Assessment

MidAmerican Energy Company
February 2020

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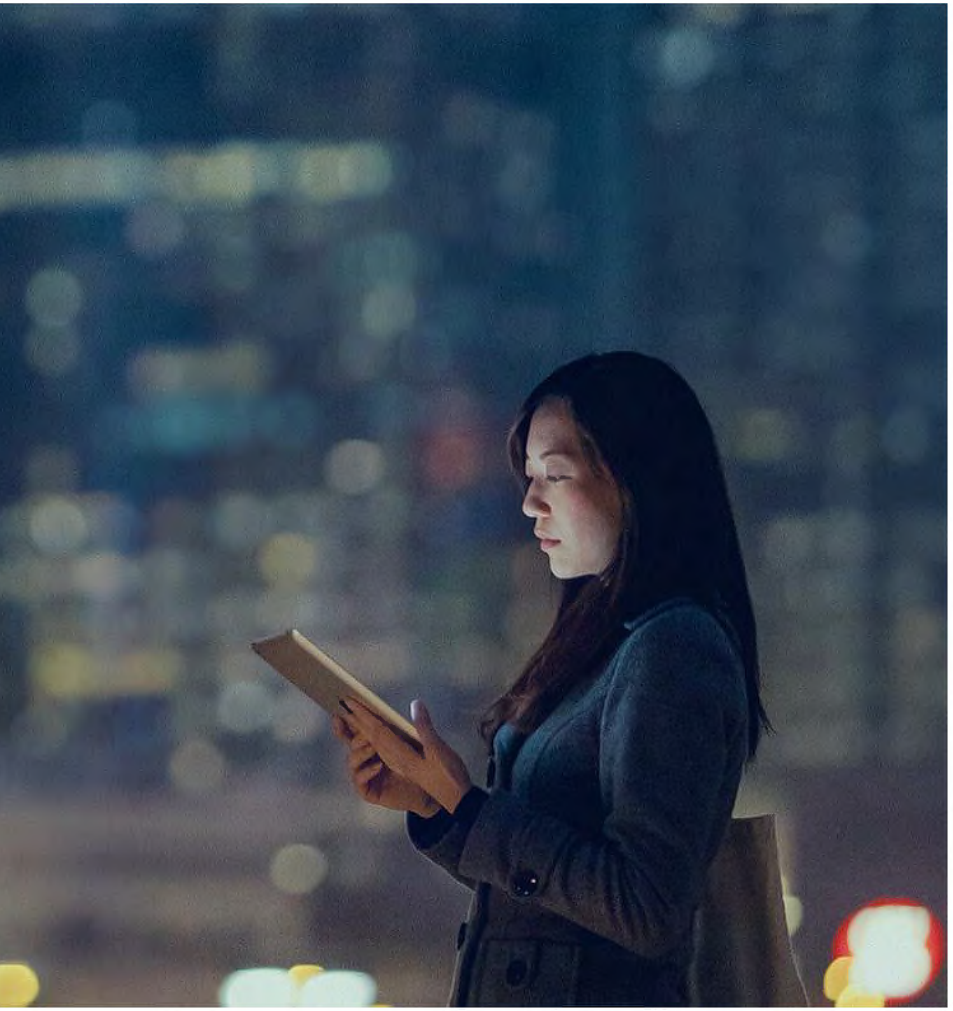

Introduction – MidAmerican Coal Plant Economics Study

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Siemens Energy Business Advisory performed an independent assessment of the economics of MidAmerican Energy Company's (MidAmerican or MEC) operating coal units.

- This independent analysis was performed in response to recent filings by intervenors in MidAmerican's Wind XII docket suggesting that these coal plants are not economic.
- MidAmerican provided some unit specific information for their owned units.
- Other forward looking assumptions for portfolio units and the broader market were based on Siemens Energy Business Advisory's latest assumptions.
- A range of future scenarios were considered to assess alternate future market outcomes around regulation, market prices and load.
- This report documents the approach and key findings of this assessment.

Average Utilization of MEC Coal Fleet by Scenario

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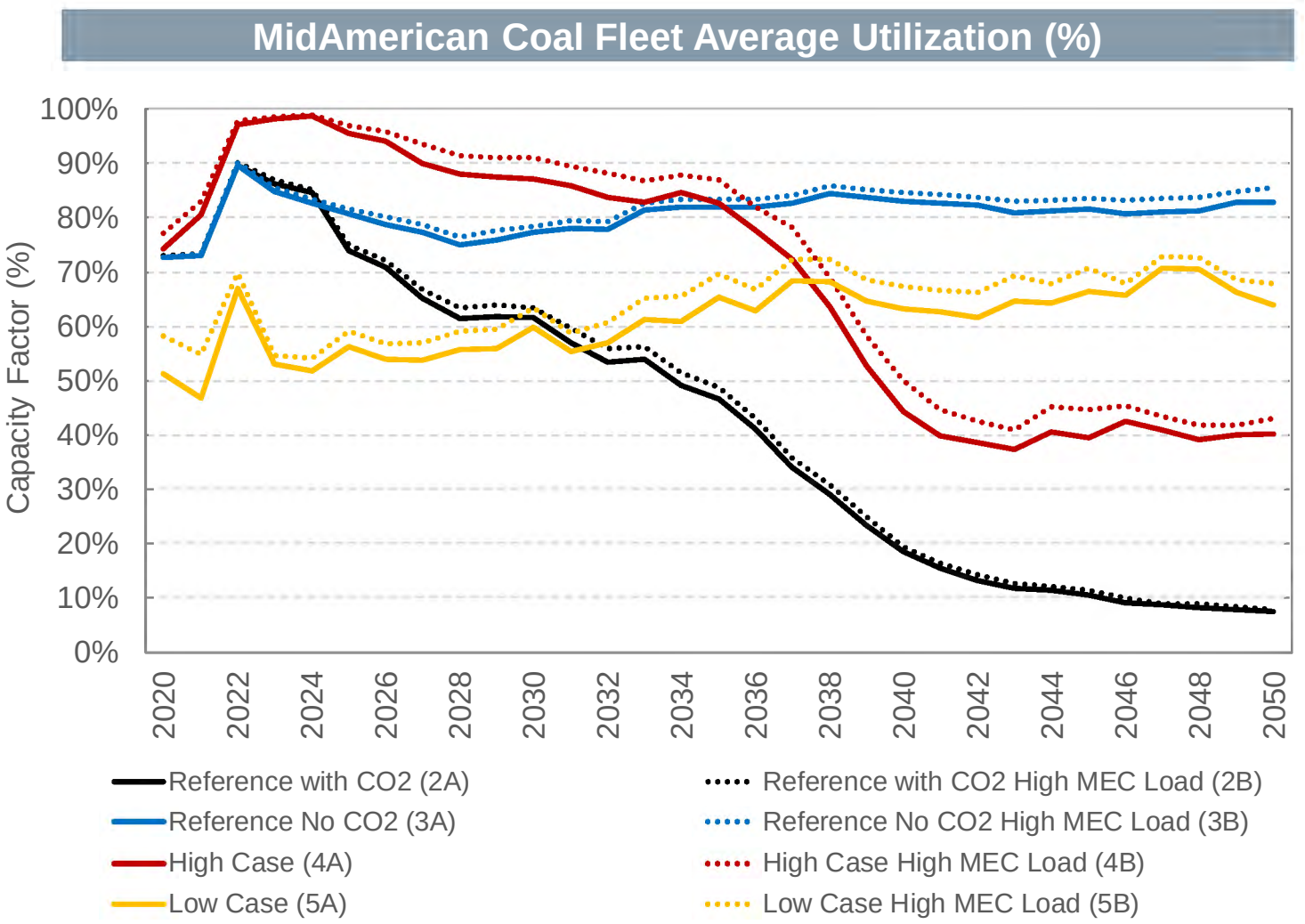

- The utilization of the MEC units varies notably under the four market scenarios considered.
- The presence of a price on carbon in the Reference w/ CO2 Case and High Case drives down utilization as the carbon price increases in the 2030s and beyond.
- In the High Case, higher power prices delay and limit this decline in dispatch.
- In absence of a carbon price, the MEC unit dispatch remains fairly constant.
- Lower power prices in the Low Case supports lower overall utilization relative to the Reference Case No CO2.

Economic Retirement Assessment by Scenario

(Base MidAmerican load and carbon applied as a tax in relevant scenarios)

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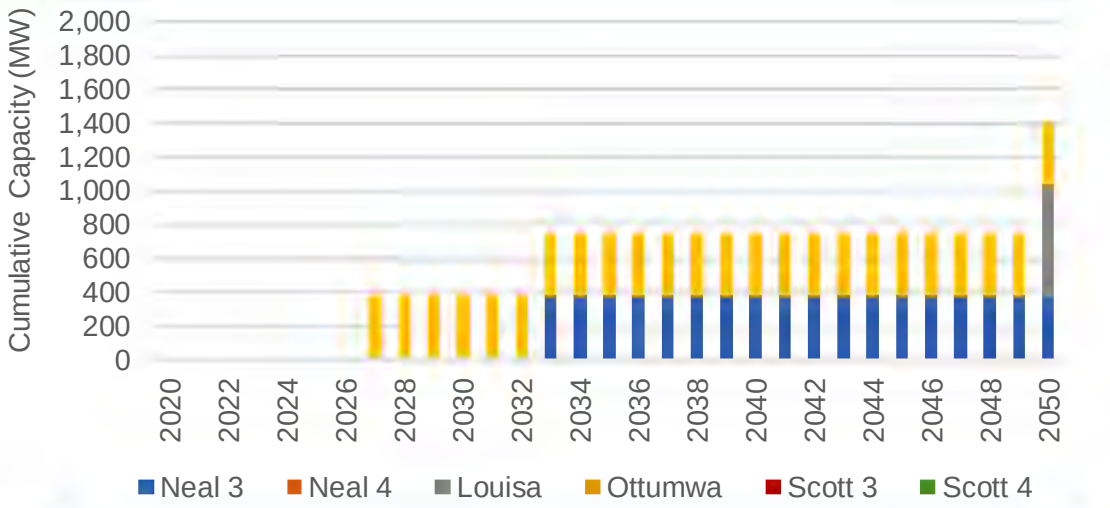
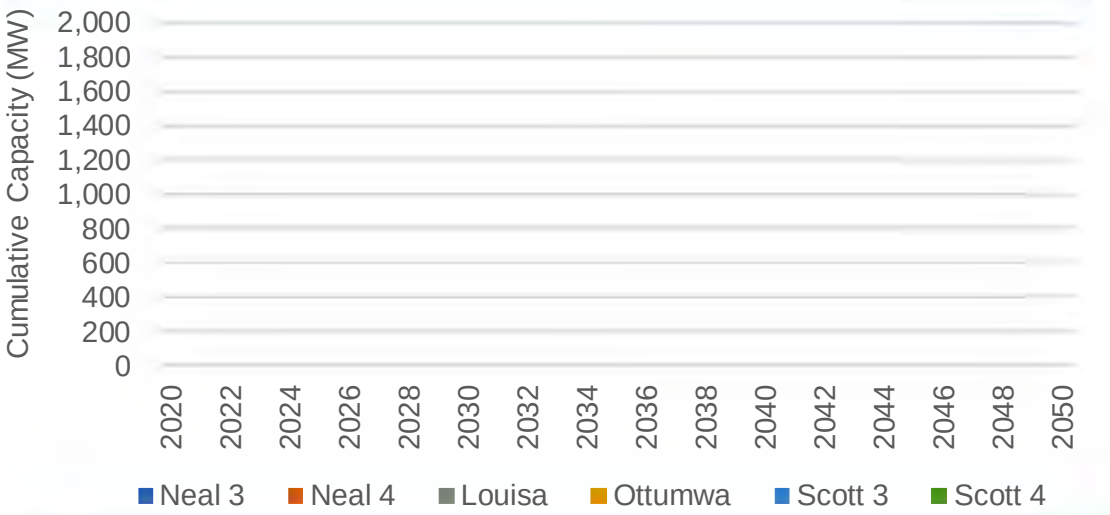
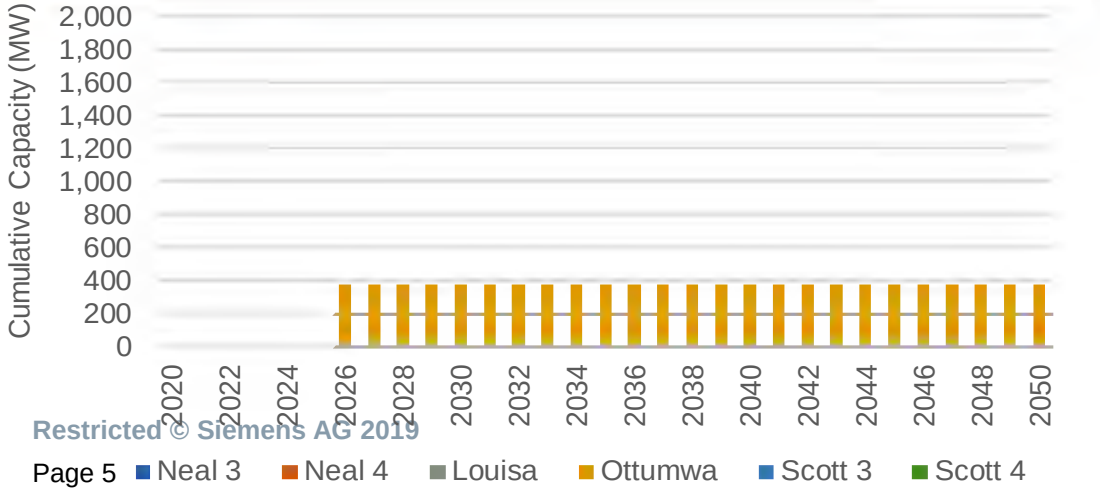
Reference w/ Carbon Retirements (MW)



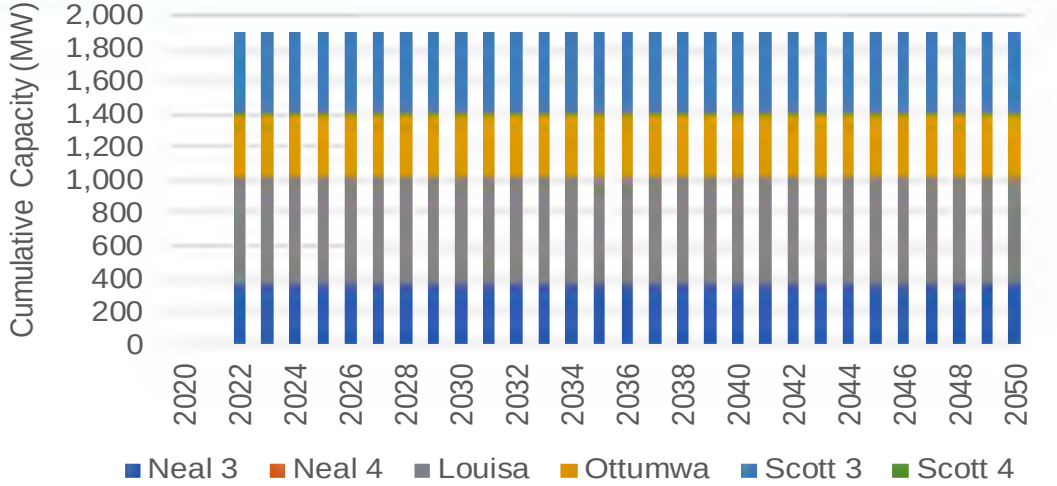
High Case Retirements (MW)



Reference No Carbon Retirements (MW)



Low Case Retirements (MW)



Retirement Candidate Units - Summary All Sensitivities

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	Neal 3	Neal 4	Louisa	Ottumwa	Scott 3	Scott 4
2A) Reference with CO2	2033		2050	2027		
2B) Reference with CO2 High MEC Load	2033		2050	2027		
3A) Reference No CO2				2026		
3B) Reference No CO2 High MEC Load						
4A) High Case						
4b) High Case High MEC Load						
5A) Low Case	2022		2022	2022	2022	
5b) Low Case High MEC Load	2022		2022	2022	2022	

- The high MEC load sensitivities only impacted the retirement candidate determination for the Reference Case No CO2 scenario. The higher MEC load supported the continued operation of Ottumwa while the unit was determined to be a retirement candidate under the base MEC load.

Power and Capacity Price Impacts – Removing Retirement Candidates from the Market

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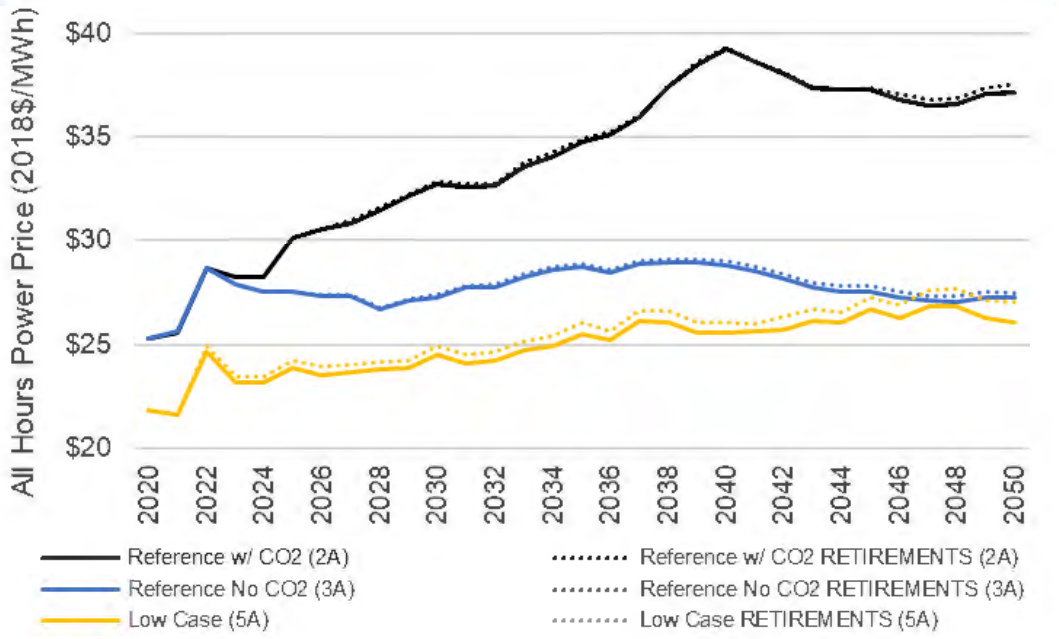
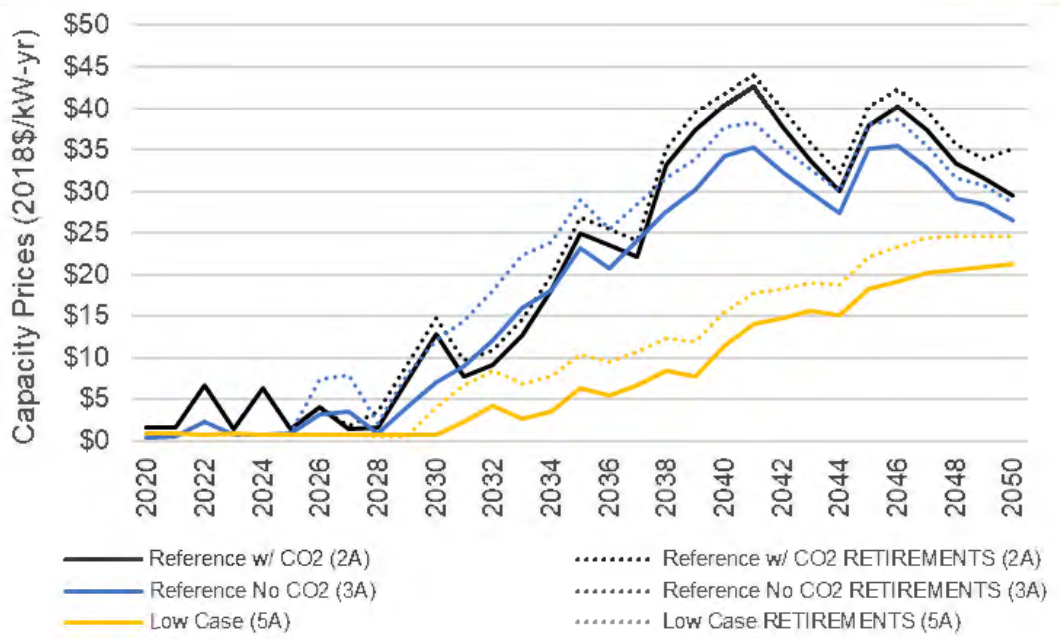
MEC Power Prices (2018$/MWh)



Capacity Prices (2018$/kW-year)



- MEC power prices increased, albeit modestly, with capacity from retirement candidate units removed from the market (annual delta < $1/MWh).
- Capacity prices increased as well indicative of tighter reserve margins in absence of the retirement candidate units in the market. As a simplifying assumption, no direct capacity replacements were assumed following candidate retirement dates.

Local Capacity Impacts of Retirement

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- Retirements of multiple MEC coal units in the near-term and without replacement could trigger penalties for not meeting MISO's Local Clearing Requirements (LCR) needed for each zone and would need to be evaluated further. (The LCR for zone 3 was 7,960 MW for the 2019-2020 PRA.)
  - CONE for LRZ3 in 2019-2020 was $239.51/MW-day v. MISO clearing price of $2.99/MW-day
- Because this analysis explicitly was simplified to exclude consideration of replacement capacity by MidAmerican, market capacity prices used rely on MISO and LRZ3 excluding MidAmerican's contributions.
- High capacity retirements without replacement, however, could trigger the CONE penalty for the LRZ.

Customer v. Company View Coal Economics

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- The all in costs associated with retiring v. retaining retirement candidate units were calculated. These considered the economics from MidAmerican's perspective (company view) and the customer perspective representing the marginal cost difference of retaining the units in the portfolio v. retiring and relying on market for energy and capacity needs.
- The results indicate that the economics of retiring candidate units is economic versus retaining candidate units in scenarios where more than one candidate unit was identified (Reference w/ CO2 and Low Case).
- In the Reference No CO2 scenario where only one candidate retirement unit was identified, the economics of retaining the unit was close, with a marginal indication that retaining the unit [redacted] was more cost optimal.

	Reference w/ CO2	Reference No CO2	Low Case
Company View			
Net System Cost, w/ CO2 Costs	Retire	No Retire (marginal)	Retire
Net System Cost, w/out CO2 Costs	Retire	No Retire (marginal)	Retire
Customer View			
Net System Cost, w/ CO2 Costs	Retire	No Retire (marginal)	Retire
Net System Cost, w/out CO2 Costs	Retire	No Retire (marginal)	Retire

Key Findings

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- The use and usefulness of the MEC coal units are expected to be supported in the short- to mid-term due to the planned retirement of baseload capacity in MISO and an expected rise in natural gas prices.

- Longer term, the presence of a carbon regulation placing a moderate or greater price on carbon emissions has the potential to compromise the utilization and overall economics of the MEC coal units in the market.

- Higher MEC load with the potential addition of large customer(s) was found to have a minimal impact on coal unit use and usefulness when dispatching to MISO more broadly. However, this higher MEC load would notably increase MEC coal unit use under a self supply assumption.

- The analysis found Walter Scott units 3 and 4 to perform strong in most scenarios. George Neal units 3 and 4 demonstrated the lowest utilization followed by Ottumwa and Louisa.

Key Findings Cont.

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- Economic retirements were determined based on unit dispatch and market conditions (i.e. power and capacity prices).
  - Low power market pricing and low load resulted in the most economic retirements occurring early in the Study Period in the Low Case.
  - Conversely, no economic retirements were found under high power market pricing and high load in the High Case.
  - Under reference market conditions, Ottumwa and possibly Neal 3 could be uneconomic over the Study Period. The presence of a carbon tax is expected to place additional pressure on the economic viability of these units.

- Economic assessment of retiring versus retaining candidate units indicated that retiring candidate coal units is economically advantageous both from the customer and company perspective in most scenarios assessed where candidate units were identified.

- Assuming pure market replacement when retiring candidate units as compared to retaining units, scenarios considered indicate retiring units is largely preferred. Key drivers include the market price for power and capacity as well as the broader MISO market supply position relative to load. No new build replacement costs were assessed in this analysis.

Key Findings Cont.

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- This analysis considered market replacement for candidate retirement units. Replacement resources for candidate retirement units were not considered.

- The consideration of alternate specific resources is recommended as a next step to further understand the value of the MidAmerican coal units as replacement capacity would be required to backfill capacity and energy from any retired coal units.

- The outlook for market pricing has the potential to vary greatly under different future market states. Additionally, potential future changes in MISO market structure can also impact future market pricing. The market pricing outlooks in this analysis aimed to capture reasonable ranges of these, but uncertainty remains.

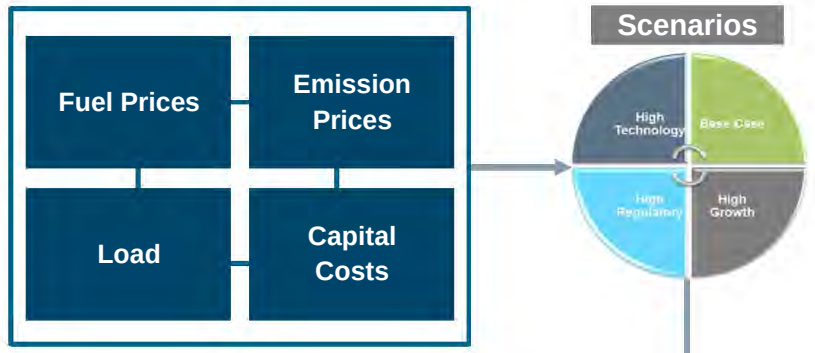
- Considering the value of the coal units relative to other resource options to meet MidAmerican's expected load would provide an alternate comparison to benchmark the value of the coal unit in the portfolio.

Approach

Approach

1) Dispatch Analysis	**Siemens Energy Business Advisory performed an hourly dispatch simulation of the entire MISO market and adjoining markets using AURORAxmp® by Energy Exemplar. The simulation was performed from 2019 through 2050 (the study period).**
2) Scenarios & Sensitivities	**Scenarios as defined by Siemens, one High Case and one Low Case for electric prices, with sensitivities for the MidAmerican load forecast. The High Case and Low Case are plausible high and low bound market conditions to assess the impacts to coal unit economics. A scenario considering dispatch of the units to MidAmerican load only was included. Reference outlook including and excluding a price on carbon were considered. Sensitivities considering the addition of potential large customer(s) in MidAmerican territory were run.**
3) Financial Analysis	**Financial analysis was performed based on dispatch modeling results to assess the economics of each unit and included:** • **Identification of retirement candidate units for each scenario & sensitivity** • **Assessment of cost to operate v. market replacement assuming the unit(s) are offline**

Dispatch Analysis – Overview of Aurora



- Capacity
- Heat rate
- Availability
- Costs

Unit Parameters

Portfolio Options

Regional Footprint & Interconnections

AURORAxmp®

- Hourly Dispatch
- Dynamic Build & Requirements
- Detailed Market Representation

Power Prices

Plant Generation

Portfolio or Unit Costs

Financial Analysis

- Determination for economic retirement
- Calculation and comparison or retirement v. replacement cost from the company and the customer perspectives

Scenarios and Sensitivities Analyzed

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Noting the range of plausible future market outcomes, several scenarios and sensitivities were performed to more comprehensively assess the coal unit economics and risk factors.

Scenarios designed to assess the impacts of:

- Self supply v. market dispatch
- Presence or absence of a price of CO2
- High price environment
- Low price environment

Sensitivities considered for each scenario:

- Base v. higher MidAmerican load (due to potential addition of large industrial customer(s))
- Financial analysis considers a carbon price applied as a carbon permit w/ allocations and as tax or fee for all carbon emitted

Scenarios
1. MidAmerican Self Supply
2. Reference Case w/ Carbon
3. Reference Case No Carbon
4. High Case
5. Low Case

Financial Analysis

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- To fully value the coal units, a financial analysis was performed.

- The financial analysis included the following calculations :
  - Calculation to determine economic retirement or candidate retirement units over the study period
  - In instances of retirement candidate units, assessment of retirement v. replacement costs were performed from the company perspective (i.e. cost to the company) and from the customer perspective (i.e. impacts to rates / net revenue requirements)

- Unit-level planned capital, O&M, depreciation and cost of capital were provided by MidAmerican.

Scenarios and Sensitivities

Scenarios and Sensitivities Performed

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Scenarios	Scenario Description	Base Load	High Load
1) MidAmerican Self Supply	Self supply from existing generation resources against MidAmerican load. Reference outlook for market fundamentals including a moderate national price on carbon starting in the mid 2020s. Shortfalls are addressed through market purchases of energy and/or capacity (i.e. no resource expansion performed).	X	X
2) Reference Case w/ Carbon	Reference outlook for market fundamentals. This scenario includes a moderate price on carbon starting in the mid 2020s. MidAmerican units are dispatched to the market based on MISO prices and load.	X	X
3) Reference Case No Carbon	Reference outlook for market fundamentals. This scenario assumes a carbon price is not implemented over the study period. MidAmerican units are dispatched to the market based on MISO prices and load.	X	X
4) High Case	The High Case is characterized by a strong economy driving higher demand for electricity and natural gas prices relative to the Reference Cases. A moderate carbon price is included starting in the mid 2020s. MidAmerican units are dispatched to the market based on MISO prices and load.	X	X
5) Low Case	The Low Case is characterized by a weaker economy driving lower demand for electricity and natural gas prices relative to the Reference Cases. This scenario assumes a carbon price is not implemented over the study period. MidAmerican units are dispatched to the market based on MISO prices and load.	X	X

Reference Case

Economy

- Stable economic growth through the study period
- Assumed inflation ~2 percent annually
- Natural gas prices average ~$3.50/MMBtu in real terms over the study period

Regulation

- Reference Case with Carbon includes a moderate price on carbon emissions beginning in the mid 2020s ($0 assumed in the Reference Case No Carbon)
- Existing RPS requirements are met, no other notable increase or change in emission policy (i.e. CSAPR / NAAQS remain unchanged)

Demand

- Load generally reflects extended MISO load outlook
- Expected EE, DER, and electrification embedded
- Overall MISO growth rates vary by region (average 0.33% CAGR over the study period)
- MidAmerican base load assumed; MidAmerican high load sensitivity run

Reference Case Overview

- Represents the expected case based on current market fundamentals
- Commodity forecasts based on Siemens Energy Business Advisory's latest reference outlook and MidAmerican inputs
- Natural gas prices increase slightly on increased demand but remain below $4/MMBtu in real terms (~$6.75/MMBtu nominal in 2050)
- Renewables increase to meet RPS and exceed RPS where renewables are economic as new builds to meet reserve requirements

High Case

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Economy

- Strong economy supporting higher overall demand for energy
- Higher natural gas prices supported by strong domestic and export demand
- Natural gas prices average ~$4.85/MMBtu in real terms over the study period

Regulation

- Carbon prices reflect that of the Reference Case w/ Carbon, a moderate price starting in the mid 2020s
- No other notable increase or change in emission policy (i.e. CSAPR / NAAQS remain unchanged), existing RPS requirements assumed

Demand

- Higher regional load driven by strong economy relative to the Reference Cases and increased electrification demand
- Overall MISO growth rates vary by region (average 0.87% CAGR over the study period)
- MidAmerican base load assumed; MidAmerican high load sensitivity run

High Case Overview

- Represents an outlook of higher power market pricing driven by a stronger economy
- Natural gas prices are greater in the High Case relative to the Reference Cases
- Load is greater in the High Case
- Renewables increase to meet RPS and exceed where economic as new builds to meet reserve requirements

Low Case

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Economy

- Sluggish economy supporting lower overall demand for energy
- Lower natural gas prices due to weaker demand and due to the economy both domestically and export demand
- Natural gas prices average ~$2.05/MMBtu in real terms over the forecast period

Regulation

- No carbon price assumed ($0 all years)
- No regulation of natural gas production, additional recoverable reserves discovered
- No other notable increase or change in emission policy (i.e. CSAPR / NAAQS remain unchanged), existing RPS requirements assumed

Demand

- Lower regional load driven by weaker economy and focus on efficiency and demand side measures
- Overall MISO load growth rates vary by region (average 0.25% CAGR over study period with generally flat peak load)
- MidAmerican base load assumed; MidAmerican high load sensitivity run

Low Case Overview

- Represents an outlook of lower power market pricing driven by a weaker economy
- Natural gas prices are lower in the Low Case relative to the Reference Cases
- Load is lower in the Low Case
- Renewables increase to meet RPS and exceed where economic as new builds to meet reserve requirements

Scenario and Sensitivity Assumptions Matrix

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Scenarios	Gas Price	MISO Load	Carbon Price	MidAmerican Load Sensitivity
1) MidAmerican Self Supply	reference	reference	reference	1a) base 1b) high
2) Reference Case w/ Carbon	reference	reference	reference	2a) base 2b) high
3) Reference Case No Carbon	reference	reference	$0	3a) base 3b) high
4) High Case	high	high	reference	4a) base 4b) high
5) Low Case	low	low	$0	5a) base 5b) high

Financial Analysis – Economics of Retire v. Market

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Financial Analyses	Approach
Economic Retirement by Unit	Plants that would likely retire due to insufficient Revenues to cover Going Forward Costs for any three consecutive years, where: • **Market Revenues** = revenues from all sources including energy revenues, capacity revenues and ancillary services (if applicable) • **Going Forward Costs** = Non-fuel VOM (MidAmerican's estimate of VOM/MWh times simulated (AURORA) generation in MWh's) + Fuel Costs + Variable Environmental Costs + Annual Capital Spend (from MidAmerican) + Fixed O&M attributed to the unit (from MidAmerican)
Economic Value – Company View	Comparison of the Net Present Value (NPV) of the net system impact of the operating cash flow (annual term "a" described below) of an uneconomic plant to the NPV of market replacement cost of energy and capacity lost by retiring the unit instead (annual term "b" described below). Compare a) vs. b): **a) Net System Cost; No Retirement Case** (unit continues to operate) **b) Net System Cost; Candidate Generator Retirement** (unit is retired and not replaced, energy and capacity needs for the portfolio are purchased from the markets)
Economic Value – Customer View	Comparison of the NPV of the net revenue requirements (annual term "a" described below) of to the NPV of market replacement cost of energy and capacity lost by retiring the unit instead (annual term "b" described below). Compare a) vs. b): **a) Net System Cost; No Retirement Case** **b) Net System Cost; Candidate Generator Retirement Case**

Overview of Key Assumptions

Key Input Assumptions

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Key inputs in the analysis reflect Siemens Energy Business Advisory's latest market outlook for the eastern interconnect. Key market assumptions include:

- Fuel prices
- Emission / environmental costs
- Load
- Planned unit retirements and new builds
- Cost of new builds

Some owned unit parameters were provided by MidAmerican. A summary of coal unit parameters modeled are below:

Plant Name	Nameplate Capacity (MW)	MEC Share of Capacity (%)	MEC Share of Capacity (MW)
WALTER SCOTT 3	690	72%	497.1
WALTER SCOTT 4	800	66%	526.4
LOUISA	745	88%	655.6
NEAL 3	510	72%	367.2
NEAL 4	644	41%	261.3
OTTUMWA	727	52%	380.0

[redacted]

* Modeled as heat rate curves as provided by MidAmerican

Key Input Assumptions – Natural Gas Prices by Scenario

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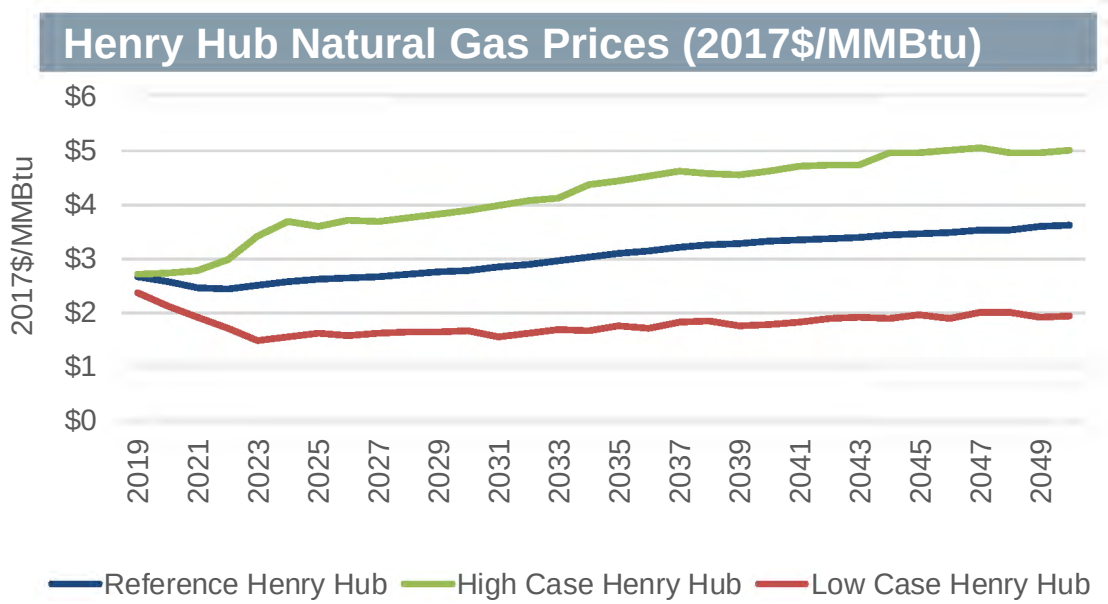

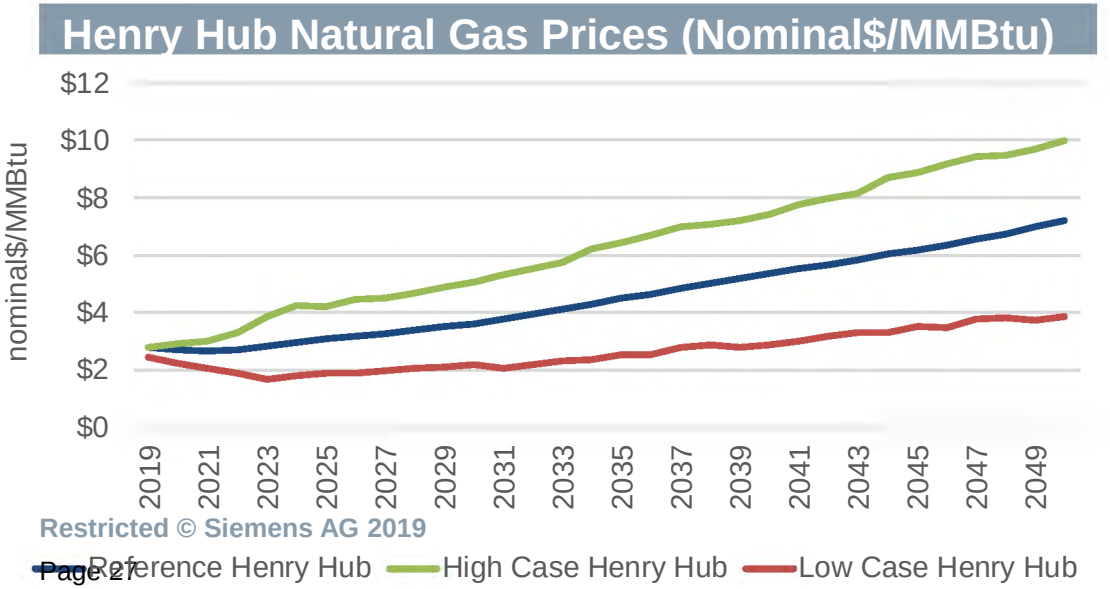

- Siemens Energy Business Advisory's reference natural gas prices represent current market pricing in the near term transitioning to fundamentals-based projections starting in 2021. Additional demand in the form of LNG and other exports as well as pipeline builds to alleviate major production region constraints are expected in the early 2020s. Prices are expected to remain below $4/MMBtu in real terms over the Study Period.

- **High** – high demand and some limits on production have the potential to support prices higher relative to the reference outlook over the Study Period.
- **Low** – low demand and continued finds of low cost supply have the potential to support prices below the reference outlook over the Study Period.

Key Input Assumptions – Coal Prices

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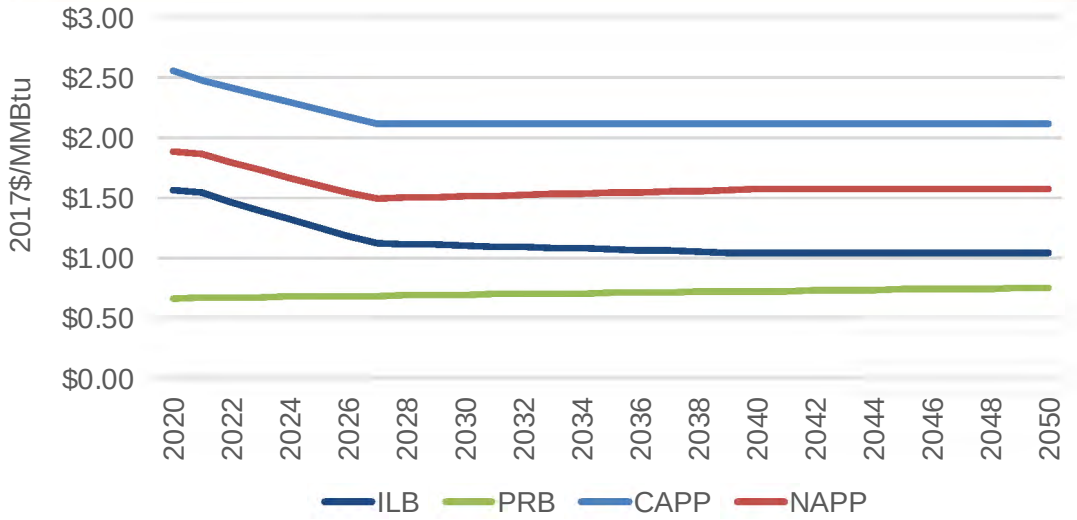
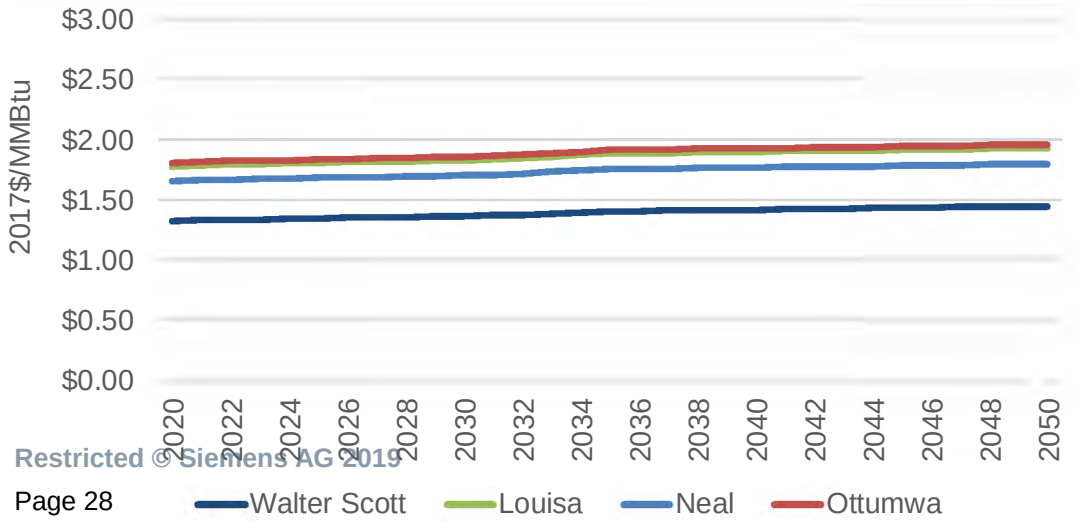
Market Coal Supply (2017$/MMBtu)



Delivered MEC Unit Coal Prices (2017$/MMBtu)



- PRB – slight real price increase projected due to reserve depletion
- ILB – price decline projected near term and relatively flat thereafter reflecting significant reserves of low-cost longwall mined coal available at these price levels to meet expected demand.
- CAPP & NAPP – price decline in the near term due to declining demand, despite real declines in mining productivity in these regions

- All MidAmerican units consume PRB coal. Delivered fuel costs used in the analysis represent Siemens Energy Business Advisory's commodity and transport projections accounting for unit-level transportation and handling.

Key Input Assumptions – Carbon Prices

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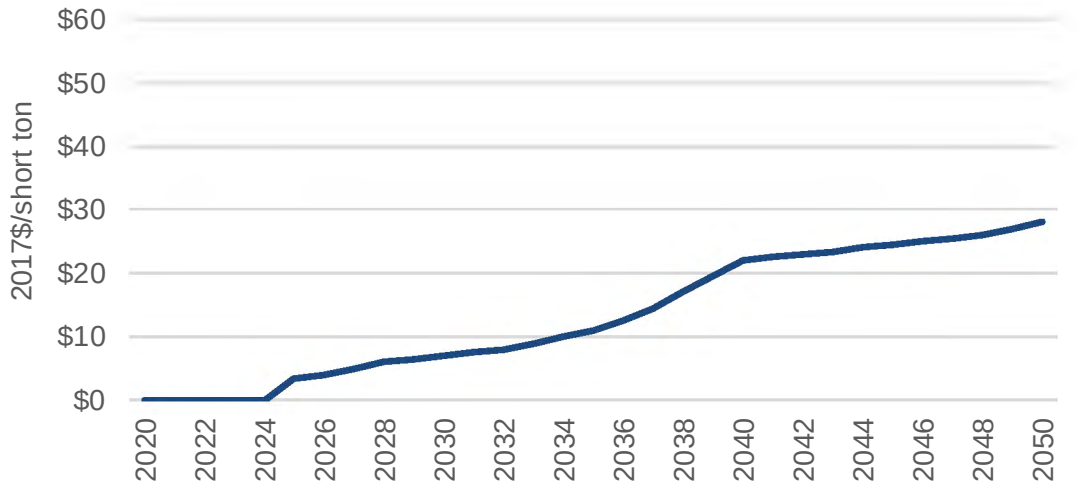
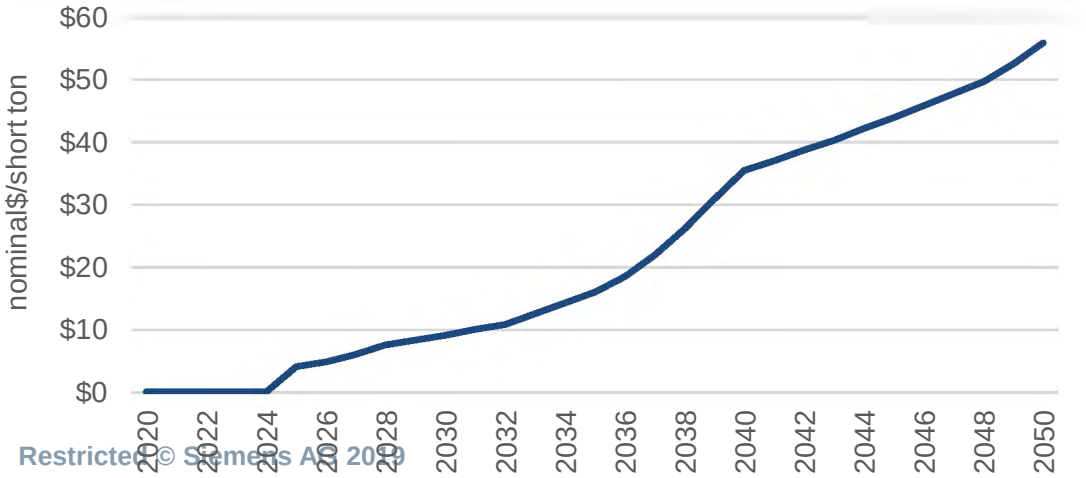
U.S. Carbon Prices (2017$/ton)

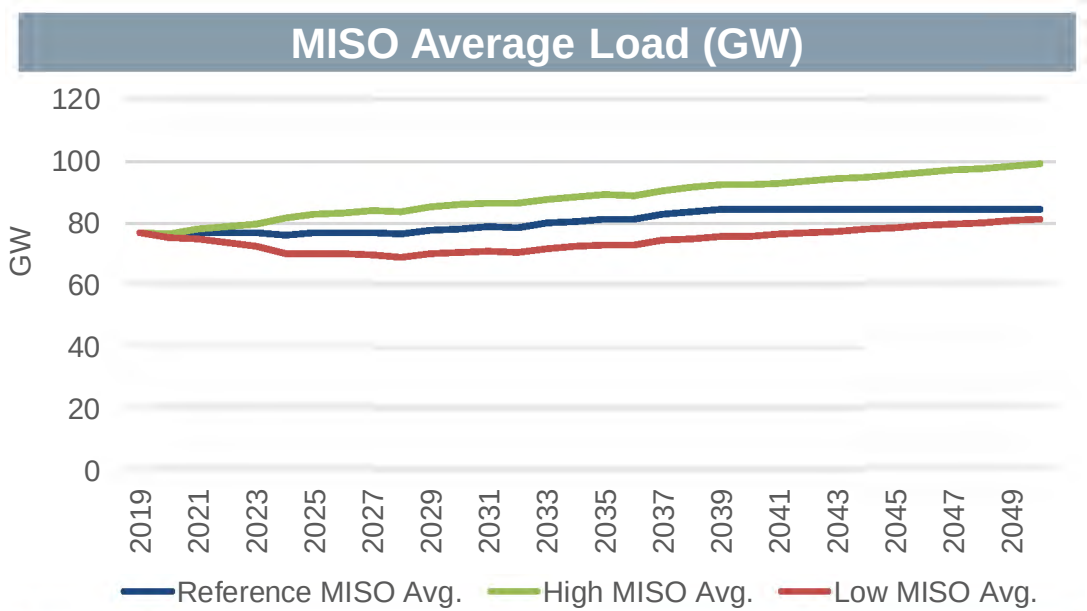


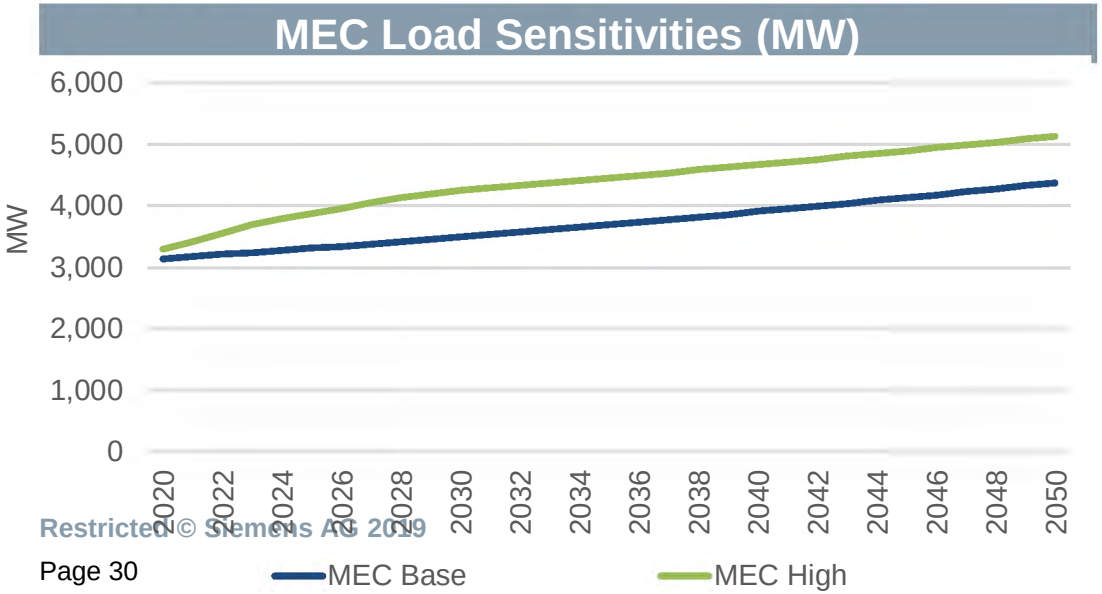
U.S. Carbon Prices (Nominal$/ton)



- Action to regulate carbon increased recently with carbon cap and tax proposals floated in Congress, the release of the Affordable Clean Energy (ACE) rule, and various state initiatives for carbon trading and carbon free generation requirements.
- As a result, a national price on carbon was included in select scenarios to consider the impact of a price on carbon on the economics of the coal units, even in absence of a specific defined policy at this time.
- The national outlook assumes a 2025 start date with a moderate price that increases to ultimately reflect expected pricing to drive a reduction in power sector emissions nationally ~55% below 2005 levels by 2050.
- No carbon price was assumed in the Reference Case No Carbon and the Low Case scenarios.

Key Input Assumptions – Regional and MEC Load





- Siemens Energy Business Advisory's projected load and load shapes were assumed for the modeled regions, with MidAmerican load provided for this share of LRZ3.

Load growth rates by scenario (%)

	MISO Base Load		MISO High Load		MISO Low Load	
	Average	Peak	Average	Peak	Average	Peak
2019-2021 CAGR	0.03%	1.07%	0.64%	0.39%	-1.19%	-1.66%
2022-2031 CAGR	0.26%	0.26%	1.02%	1.28%	-0.47%	-0.77%
2020-2050 CAGR	0.33%	0.33%	0.87%	0.89%	0.27%	0.00%

- MidAmerican Base load assumes projected load for current customer base and MidAmerican High load reflects load with the addition on one or more large potential customers with which discussions are underway.
  - Base – Average load growth 1.10%, peak load growth 0.9%
  - High – Average load growth 1.47%, peak load growth 1.20%

New Build Cost and Operating Parameters

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	Fossil			Renewable		Storage
Technology	Advanced 2x1 Combined Cycle	Advanced Simple Cycle Frame CT	Small Aero Simple Cycle CT	Utility Solar PV - Tracking	Onshore Wind	Lithium Ion Batteries
Fuel	Nat. Gas.	Nat. Gas.	Nat. Gas.	Sun	Wind	All
Construction Time, Yrs	3	2	2	1	2	<1
Size (MW)	950	343	51	50	100	20 MWh
Baseload Heat Rate (Btu/kWh), HHV	6,164	8,704	9,013	N/A	N/A	N/A
Average Heat Rate (Btu/kWh), HHV	6,536	8,704	9,013	N/A	N/A	N/A
VOM (2017$/MWh)	1.77	3.79	5.34	0.00	0.90	1.36
FOM (2017$/kW-yr)	15.59	9.34	15.39	20.29	35.84	31.57
Book Life	30	30	30	30	30	15
Debt Life	20	20	20	20	20	10
MACRS Depreciation Schedule	20	15	5	5	5	7
Cost of Equity (Utility / Merchant)	9.7% / 13.46%	9.7% / 13.46%	9.7% / 13.46%	9.7% / 13.46%	9.7% / 13.46%	9.7% / 13.46%
Cost of Debt (Utility / Merchant)	4.37% / 6.46%	4.37% / 6.46%	4.37% / 6.46%	4.37% / 6.46%	4.37% / 6.46%	4.37% / 6.46%
Equity Ratio (Utility / Merchant)	45% / 45%	45% / 45%	45% / 45%	45% / 45%	45% / 45%	45% / 45%
Debt Ratio (Utility / Merchant)	55% / 55%	55% / 55%	55% / 55%	55% / 55%	55% / 55%	55% / 55%
After Tax WACC (Utility / Merchant)	6.16% / 8.71%	6.16% / 8.71%	6.16% / 8.71%	6.16% / 8.71%	6.16% / 8.71%	6.16% / 8.71%

New Build Capital Cost Projections

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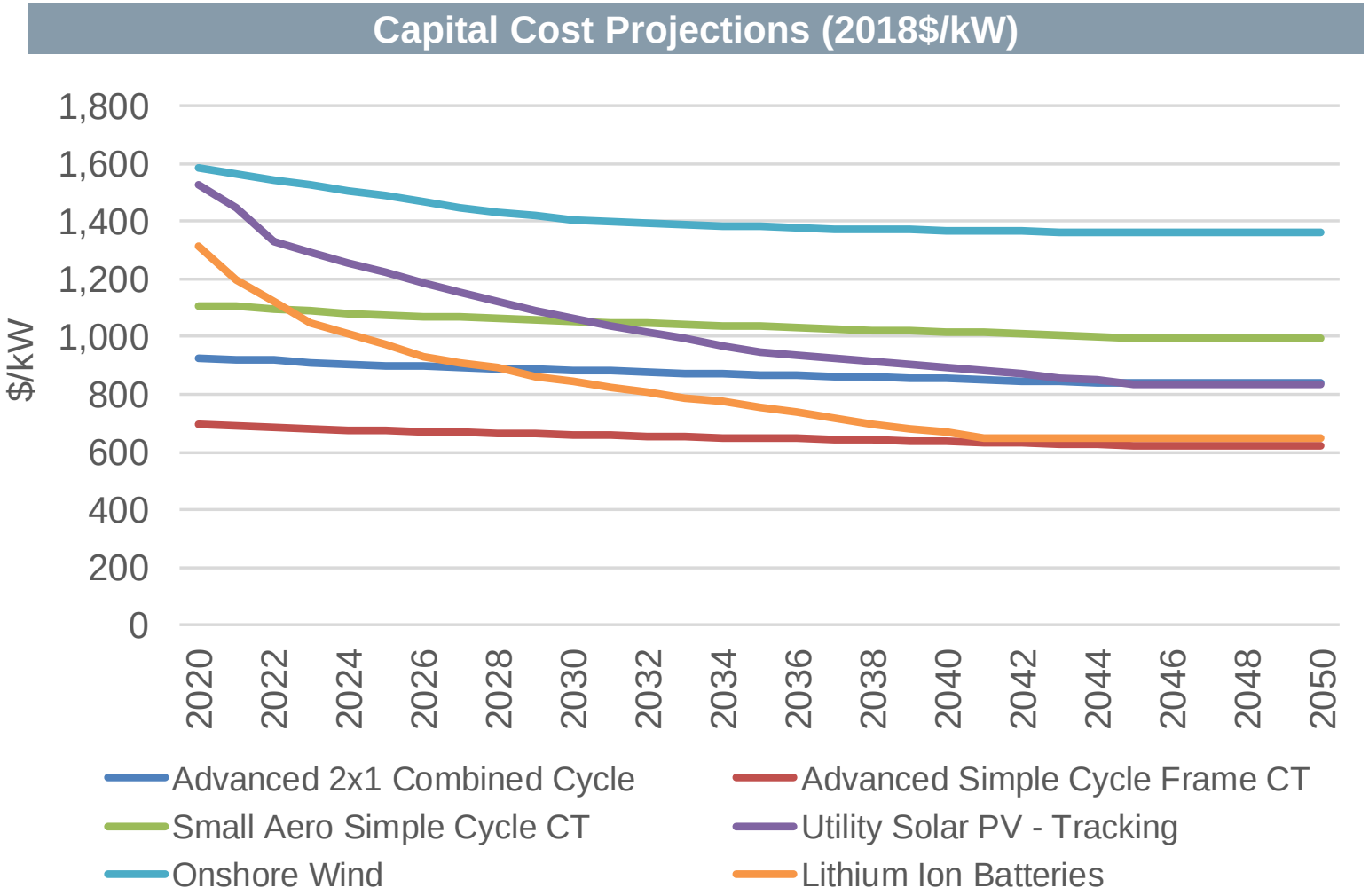

- Siemens Energy Business Advisory projects capital cost of new builds to meet regional load and maintain reserve margins.
- New natural gas plant costs including combined cycle and peaking units are expected to remain fairly constant noting the mature technology.
- Renewable and storage builds are expected to see continued cost declines over the study period.
  - **Wind** – moderate capital cost declines expected, as well as improvements in production from new wind builds
  - **Solar** – continued technology maturation and economies of scale expected to support continued price declines
  - **Battery storage** – cost declines projected as batteries increase in scale and application

Results and Conclusions

Market Power Prices by Scenario

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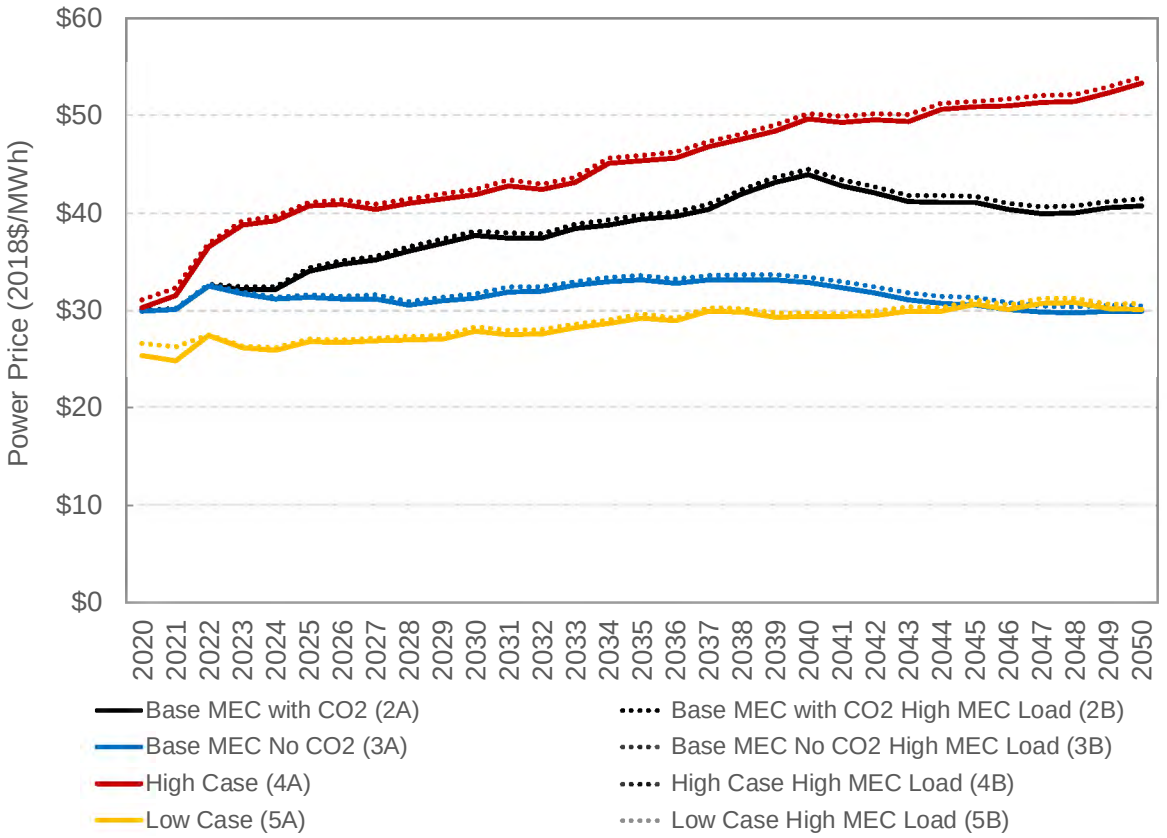
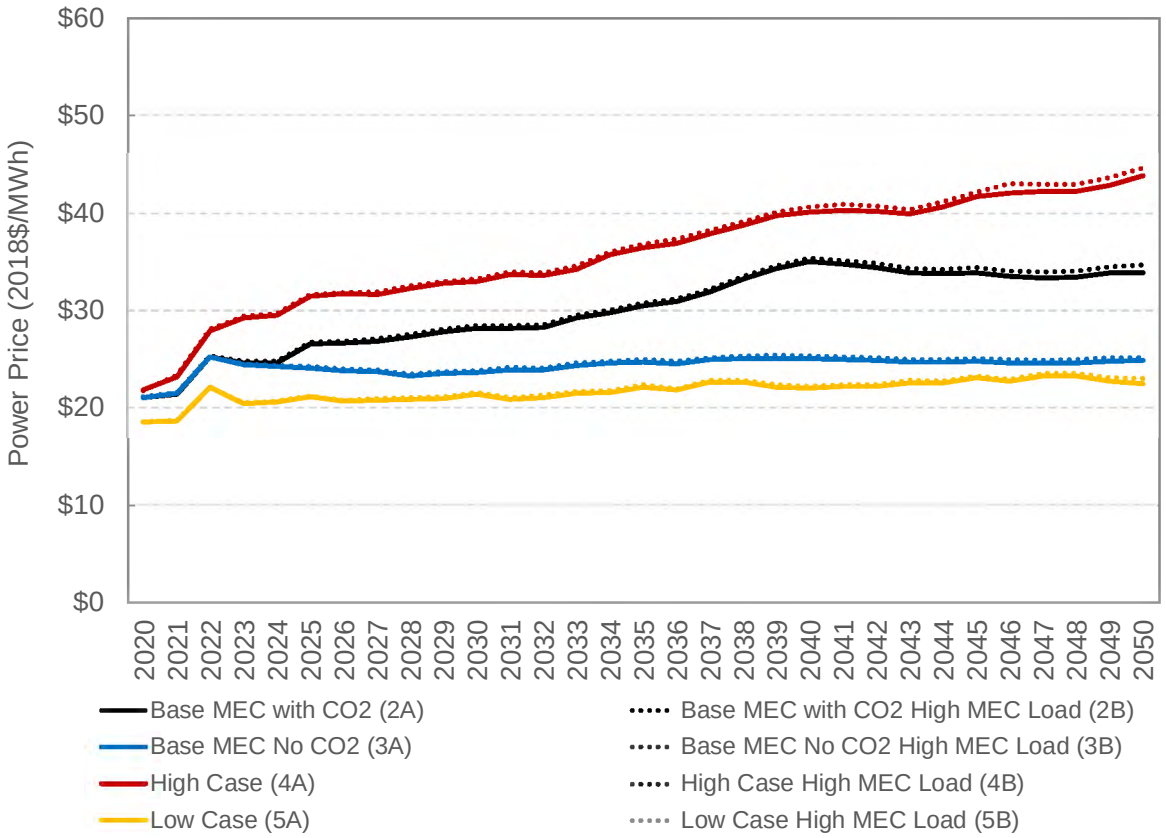
On Peak MEC Power Prices (2018$/MWh)



Off Peak MEC Power Prices (2018$/MWh)



Capacity Prices by Scenario

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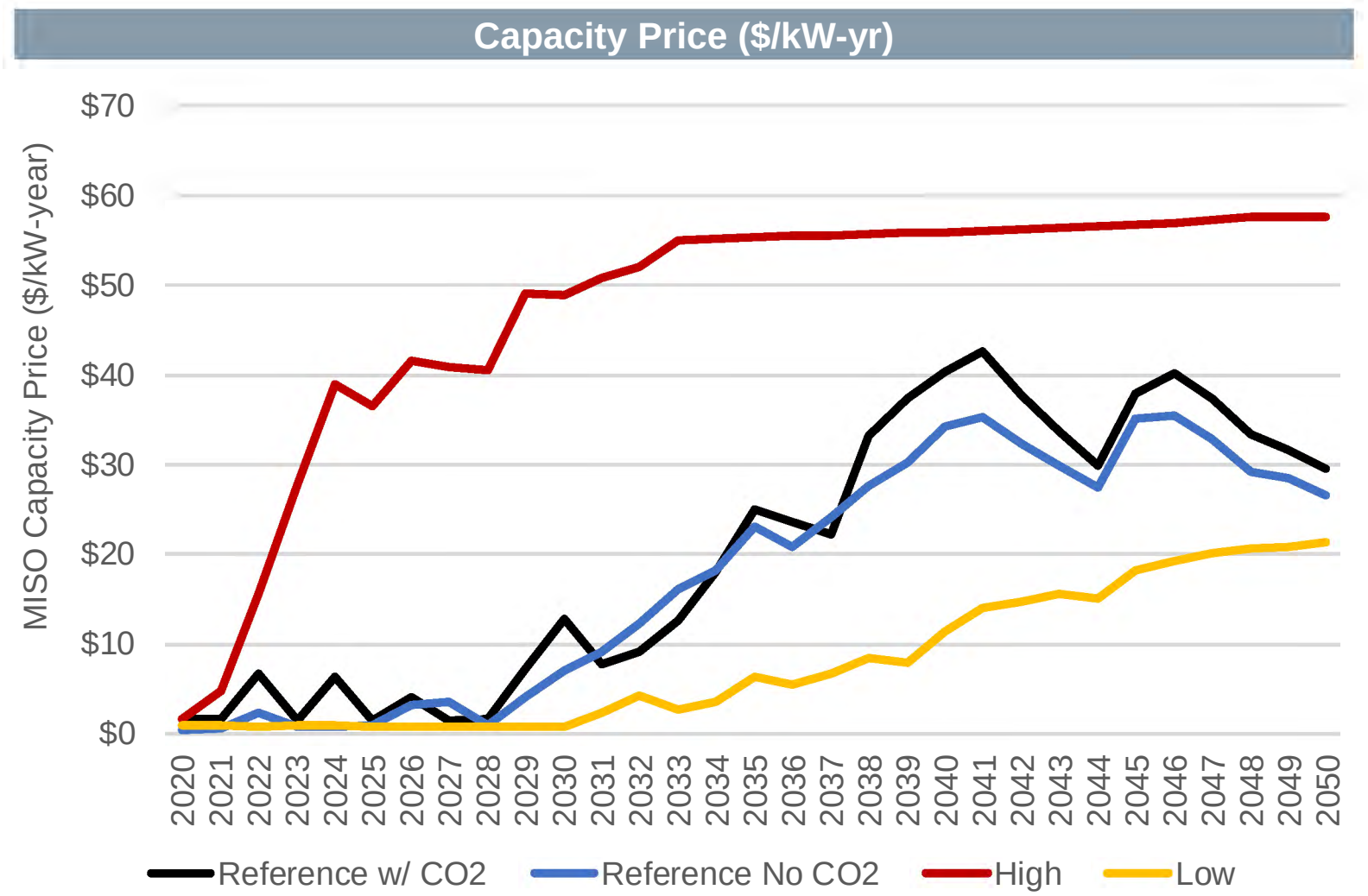
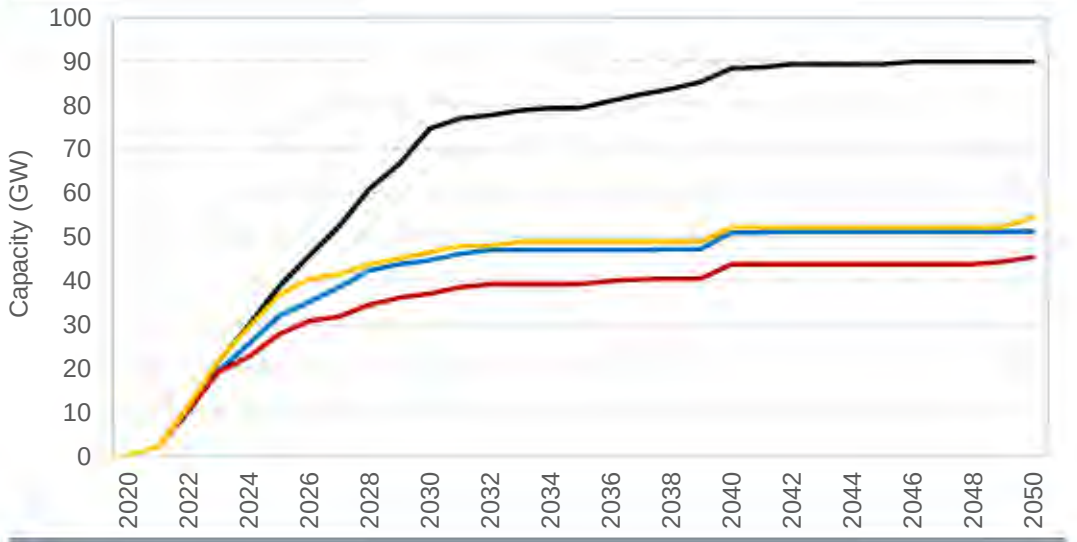


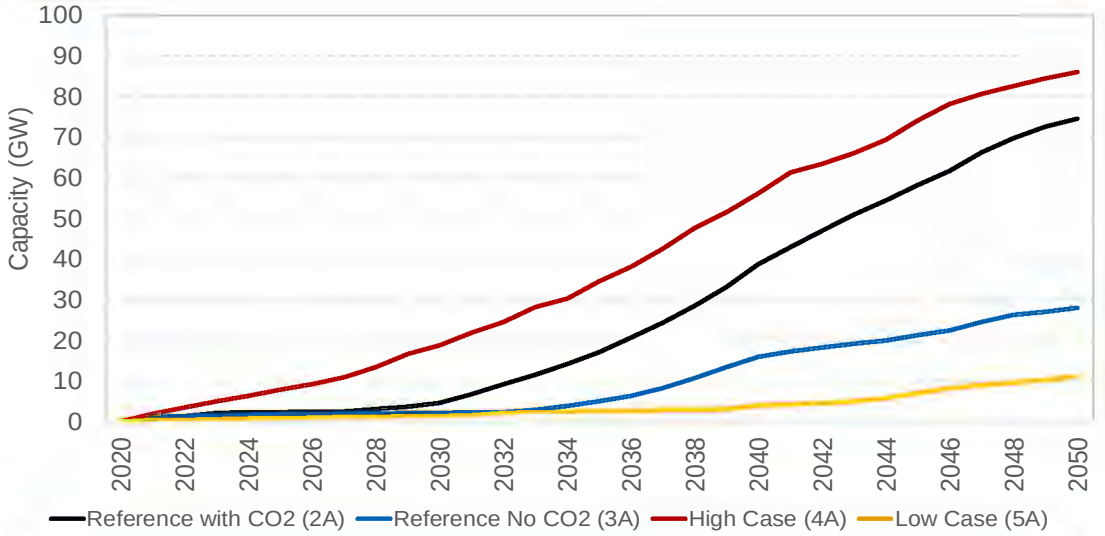
Note: Assumes declining capacity credit for solar going forward v. the current accreditation of 50%.

Regional Generation Builds and Retirements by Scenario (MISO, PJM, SPP)

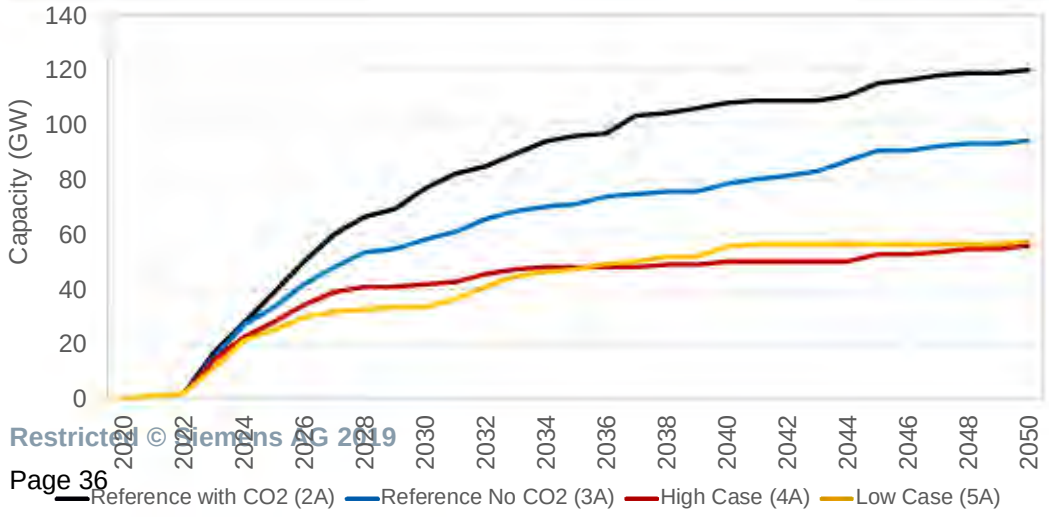
Coal Capacity Retirements (GW)



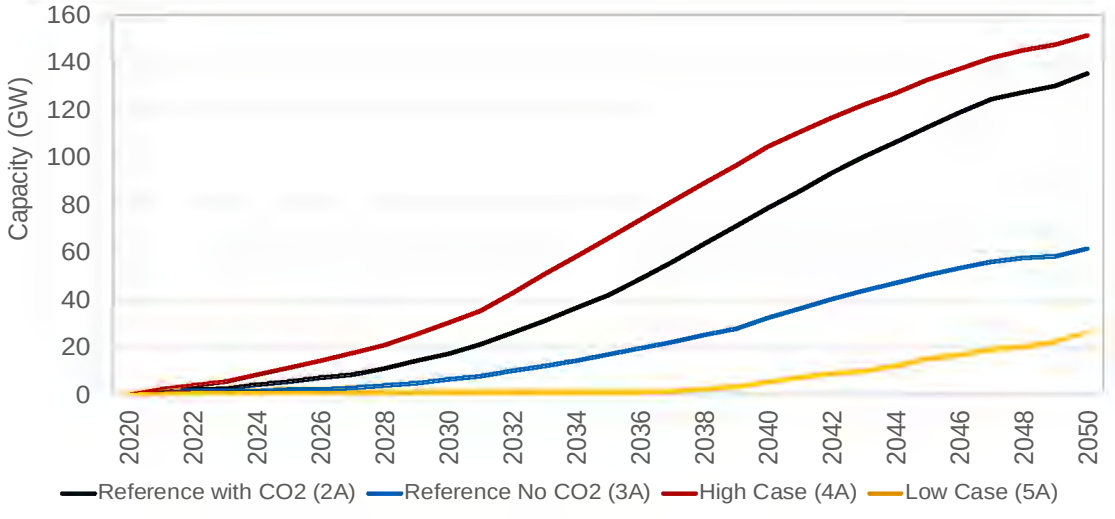
Solar Additions (GW)



Gas CC Additions (GW)



Wind Additions (GW)



Regional Coal Outlook (MISO and MEC)

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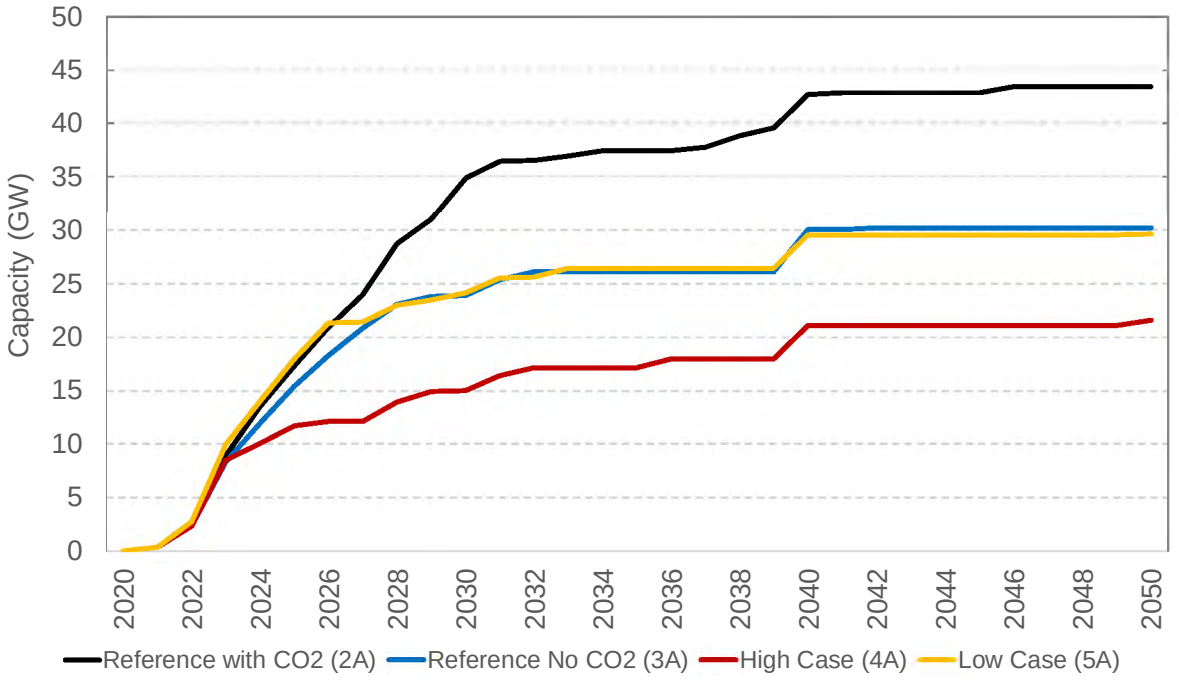
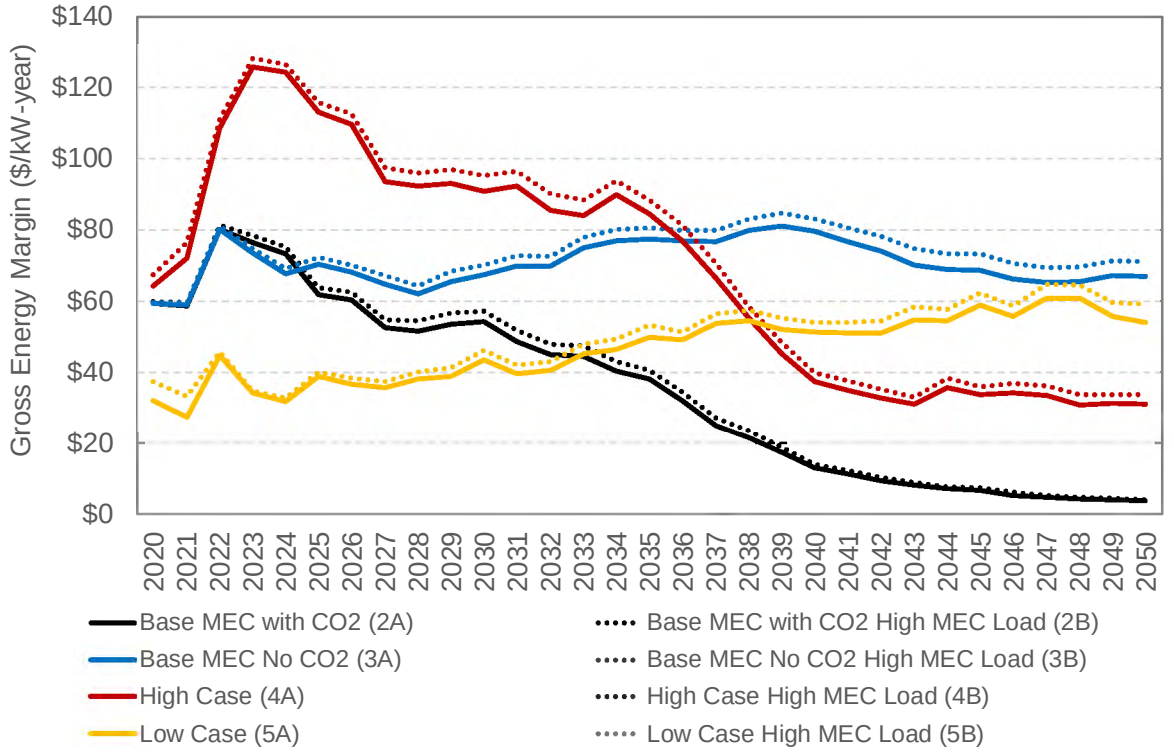
MISO Coal Retirements (GW)



MEC Coal Fleet Gross Energy Margin ($/kW-yr)



Average Utilization of MEC Coal Fleet by Scenario

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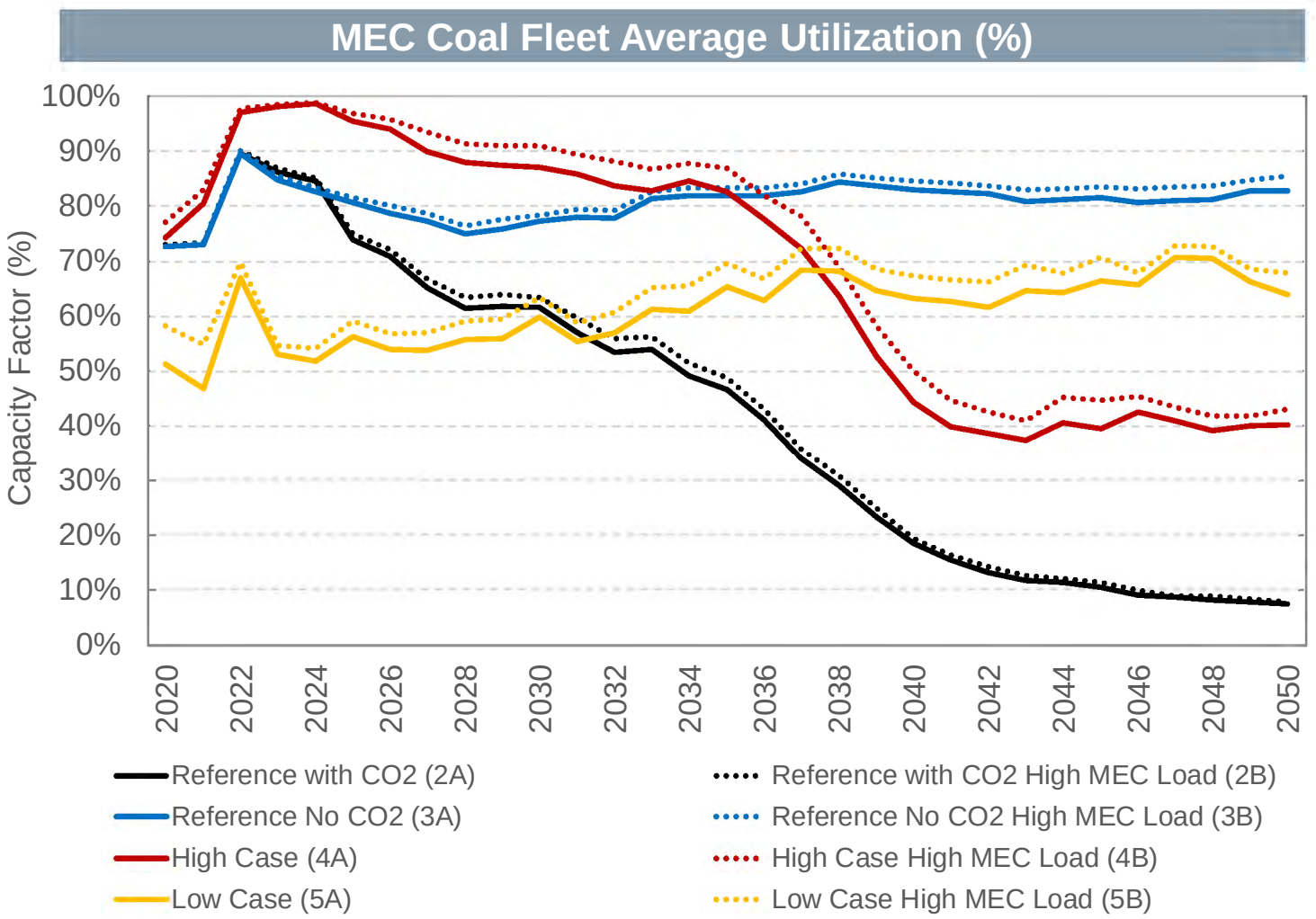

- The utilization of the MidAmerican units varies notably under the four market scenarios considered.
- The presence of a price on carbon in the Reference w/ CO2 Case and High Case drives down utilization as the carbon price increases in the 2030s and beyond.
- In the High Case, higher power prices delay and limit this decline in dispatch.
- In absence of a carbon price, the MEC unit dispatch remains fairly constant.
- Lower power prices in the Low Case supports lower overall utilization relative to the Reference No CO2 Case.

Market Conditions Considered and Impacts to MEC Coal Units

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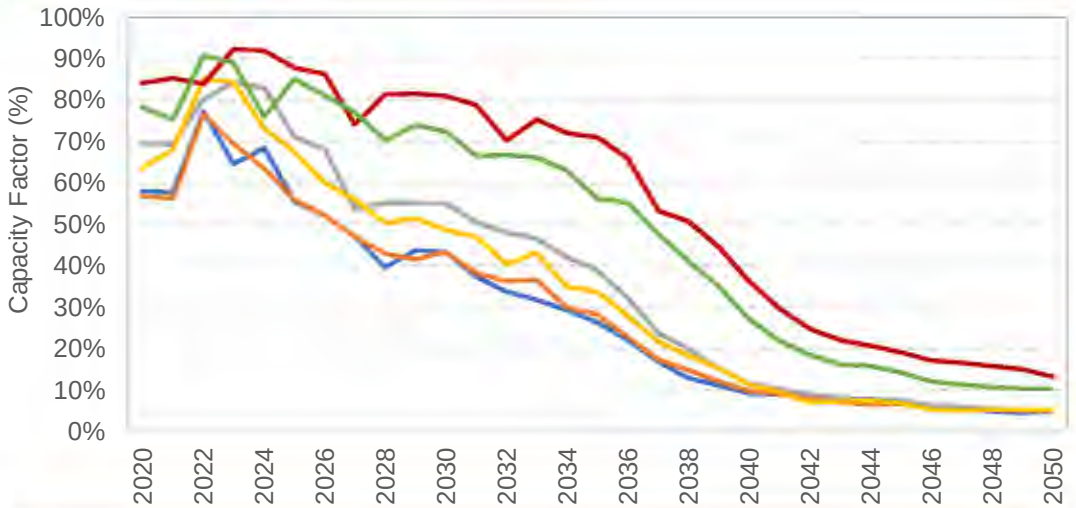
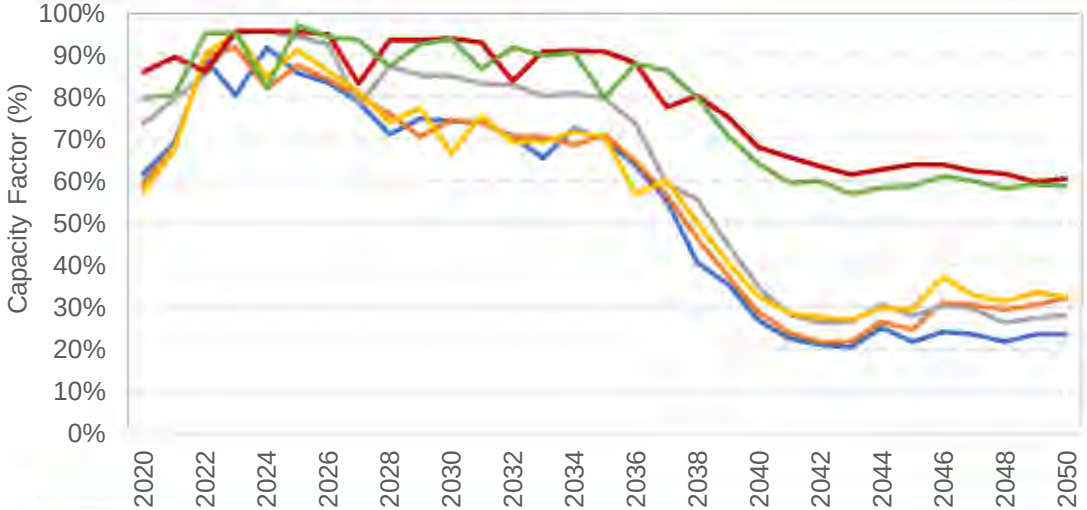
- Market futures with high penetrations of renewables challenge the economics of the MidAmerican coal units. This is evident in the high price scenarios including the High Case and the Reference with CO2 Case.
- Under market futures that maintain coal and gas units and support less renewable new builds, the MidAmerican coal units were shown to perform better. This was found to be the case under moderate and low power price levels.
- The analysis showed that a moderate to high price on carbon had a detrimental impact to the overall use and competitiveness of the MEC coal units in the market.
- Higher MidAmerican load with the potential addition of large customer(s) was found to have a minimal impact on coal unit use and usefulness when dispatching to MISO more broadly. However, this higher MidAmerican load would notably increase MEC coal unit use under a self supply assumption.

MEC Coal Unit Capacity Factor by Scenario

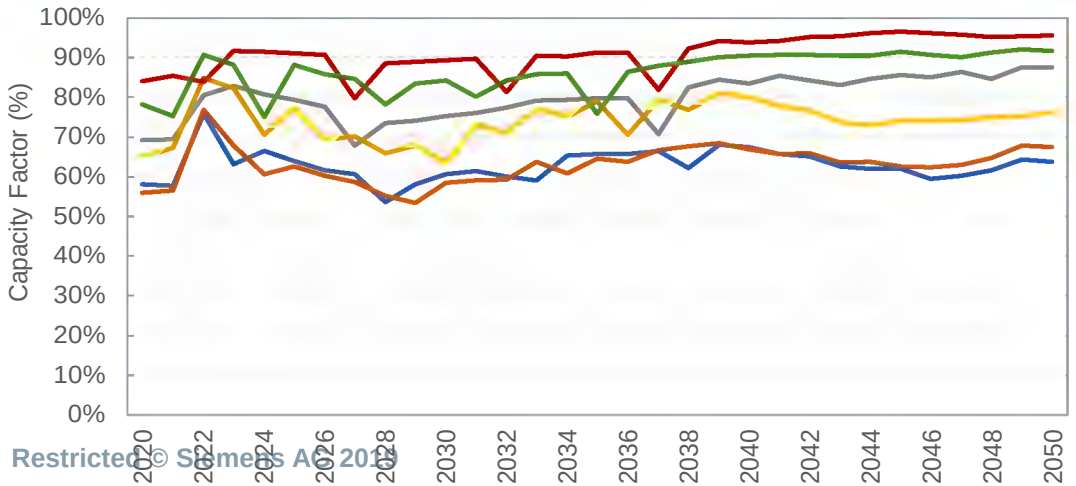
Reference Case w/ CO2 (%)



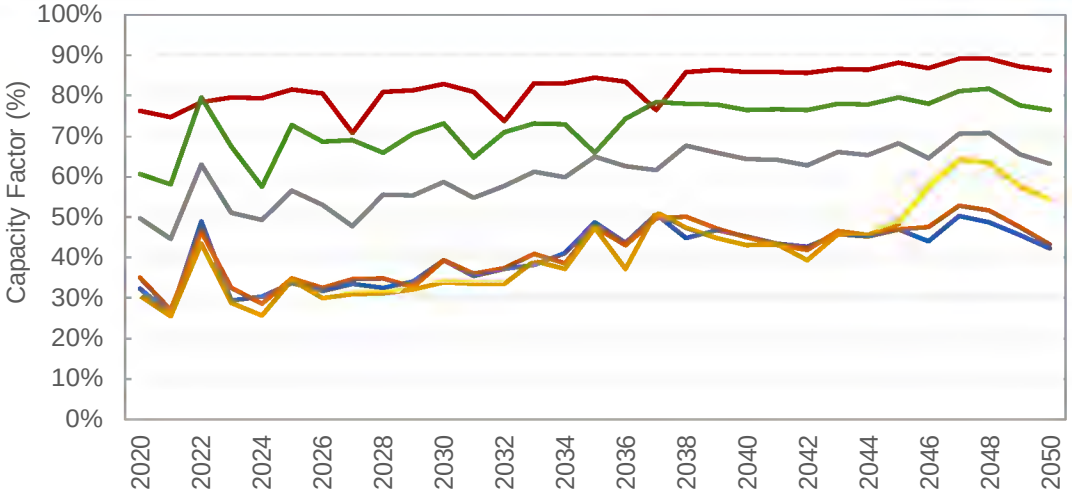
High Case (%)

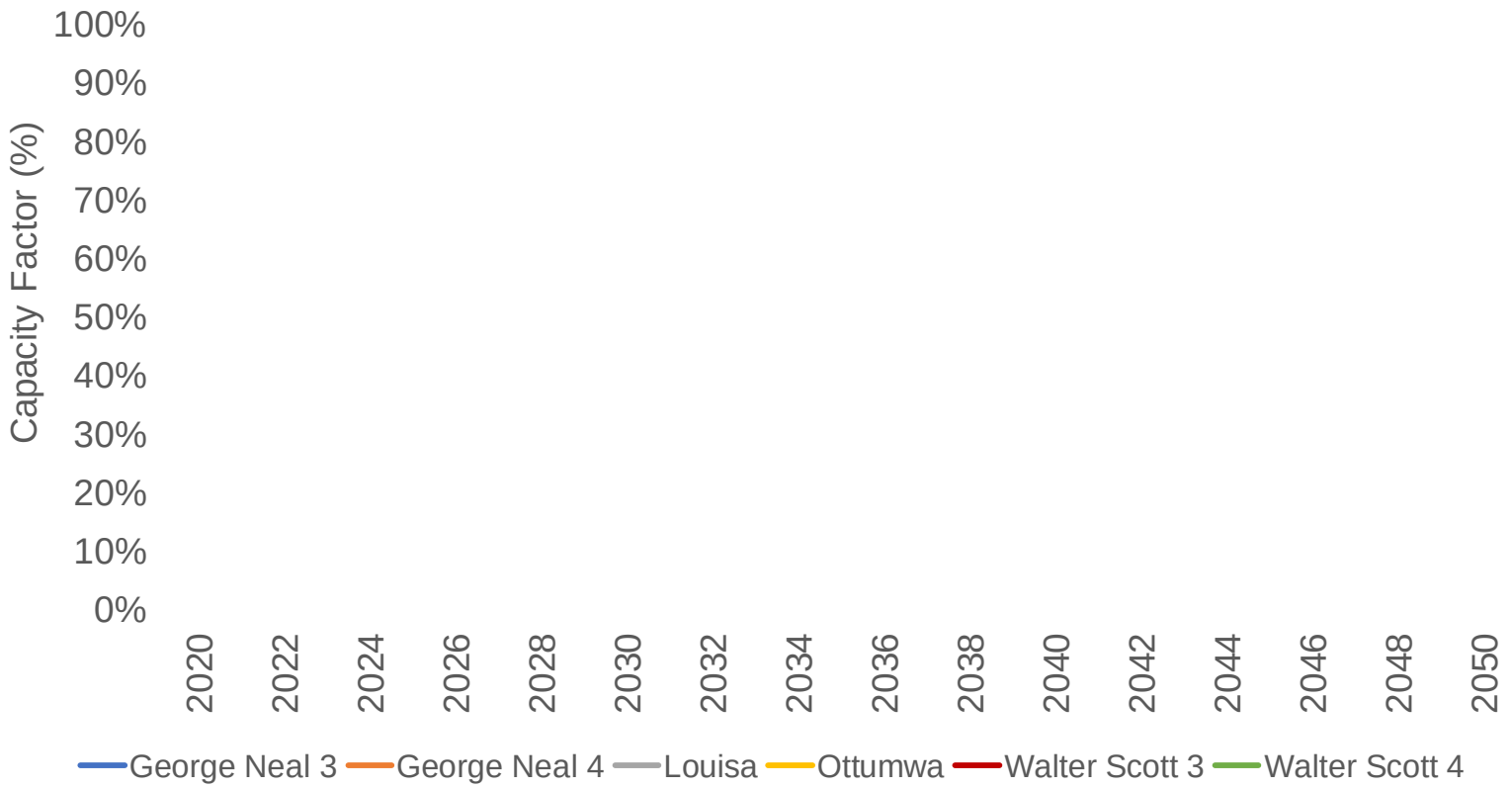


Reference Case No CO2 (%)



Low Case (%)





Note: solid line represents base MEC load, dotted line represents high MEC load sensitivity

- Dispatching to MEC load shows low utilization for all units in the early years of the Study Period due to adequate supply.
- The coal units are displaced by wind in many hours.
- The High MEC load sensitivity drives a significant increase in utilization for all coal units.
- Ottumwa, for example, has an average capacity factor of 32% in 2050 under MEC Base load conditions. This increases to 55% under the MEC High load sensitivity.

Economic Retirement Assessment by Scenario

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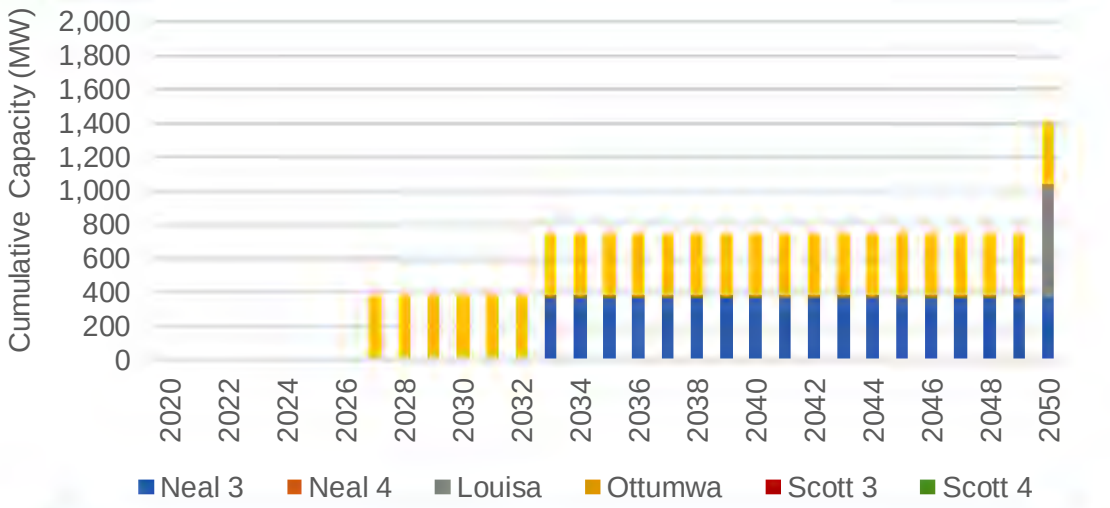
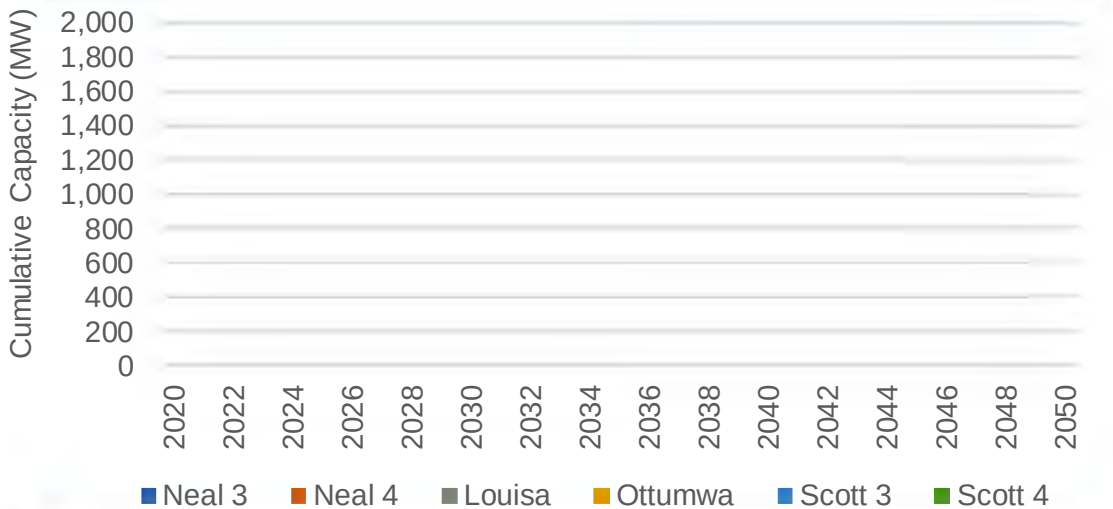
(Base MidAmerican load and carbon applied as a tax in relevant scenarios)

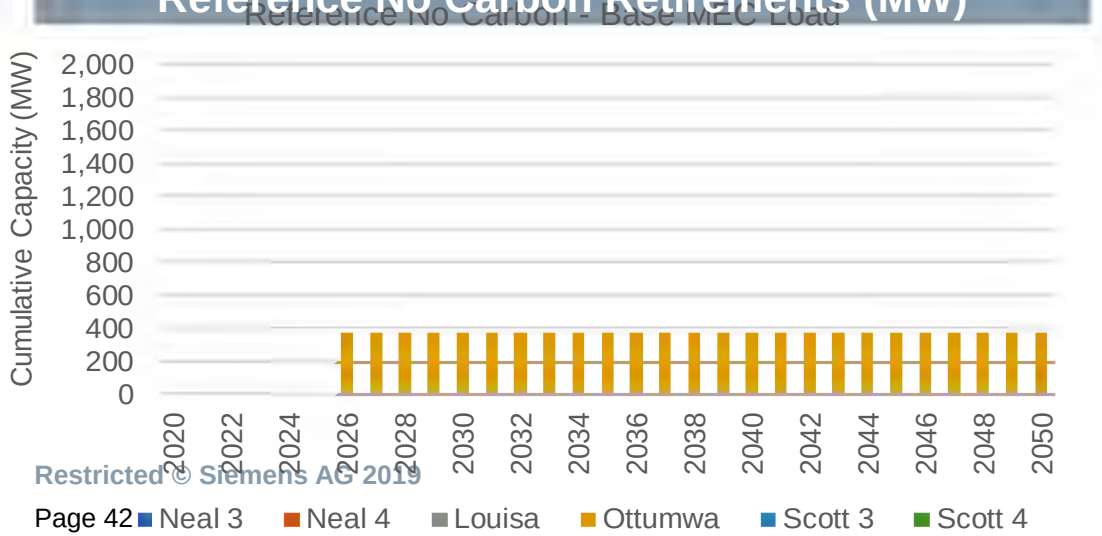
Reference w/ Carbon Retirements (MW)



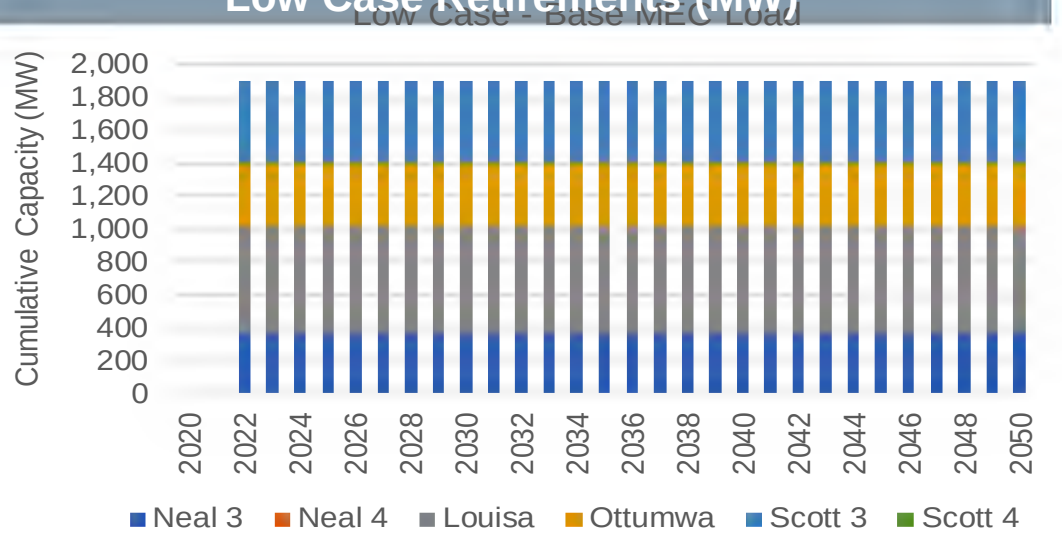
High Case Retirements (MW)



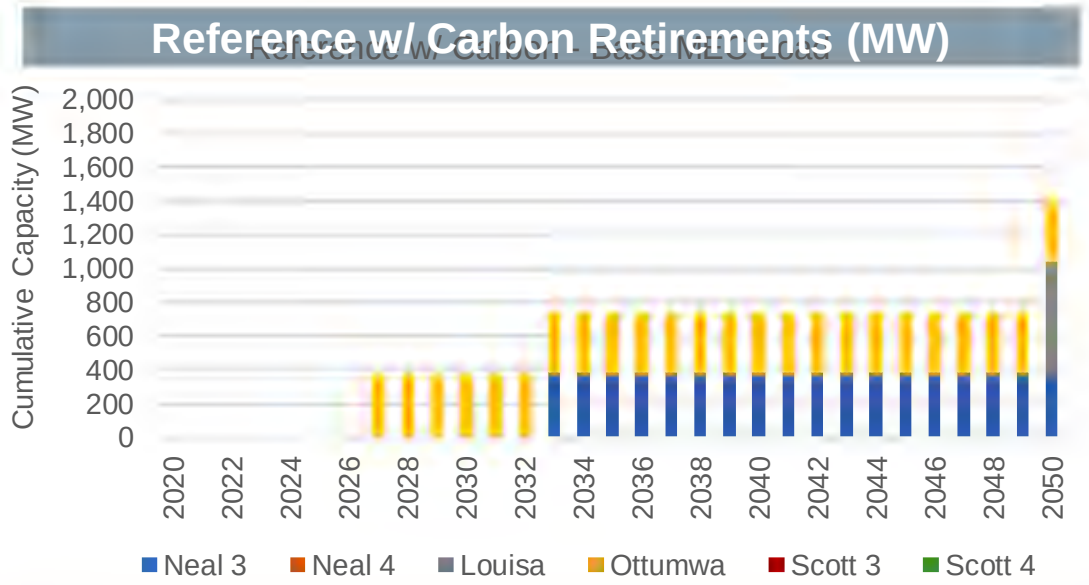
Reference No Carbon Retirements (MW)



Low Case Retirements (MW)



Economic Retirement Assessment – Reference w/ CO2

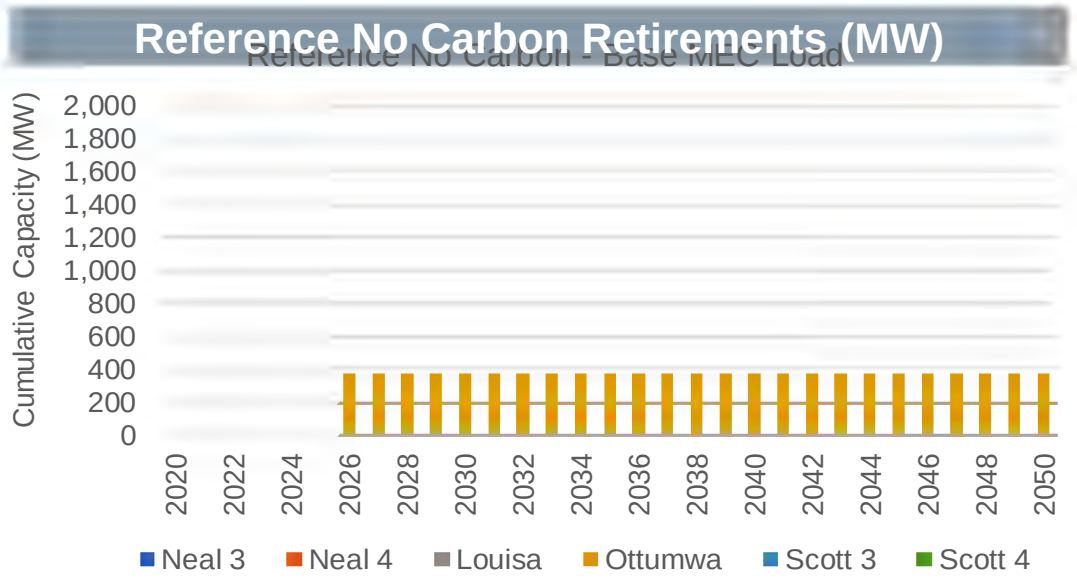


NPV Net System Impact ($000)

Reference w/ CO2 (2A)	Company View		Delta
	No Retirement Company View	Retirement Company View	
Net System Cost, w/ CO2 Costs	$ (151,482)	$ (112,478)	-25.7%
Net System Cost, w/out CO2 Costs	$ (86,997)	$ (47,906)	-44.9%
	Customer View		**Delta**
	No Retirement Customer View	Retirement Customer View	
Pre Tax Net System Cost, w/ CO2 Costs	$ 92,053	$ 46,004	-50.0%
Pre Tax Net System Cost, w/out CO2 Costs	$ 27,568	$ (18,569)	-167.4%

- Under the Reference w/ Carbon scenario, comparing the economics of retaining candidate retirement units v. retiring and relying on market for remaining system energy and capacity needs, the analysis found:
  - The net system impact of retiring the units was higher and therefore more favorable from the company view; and
  - The net system impact of retiring the units was lower and therefore favorable from the customer view.

Economic Retirement Assessment – Reference No CO2

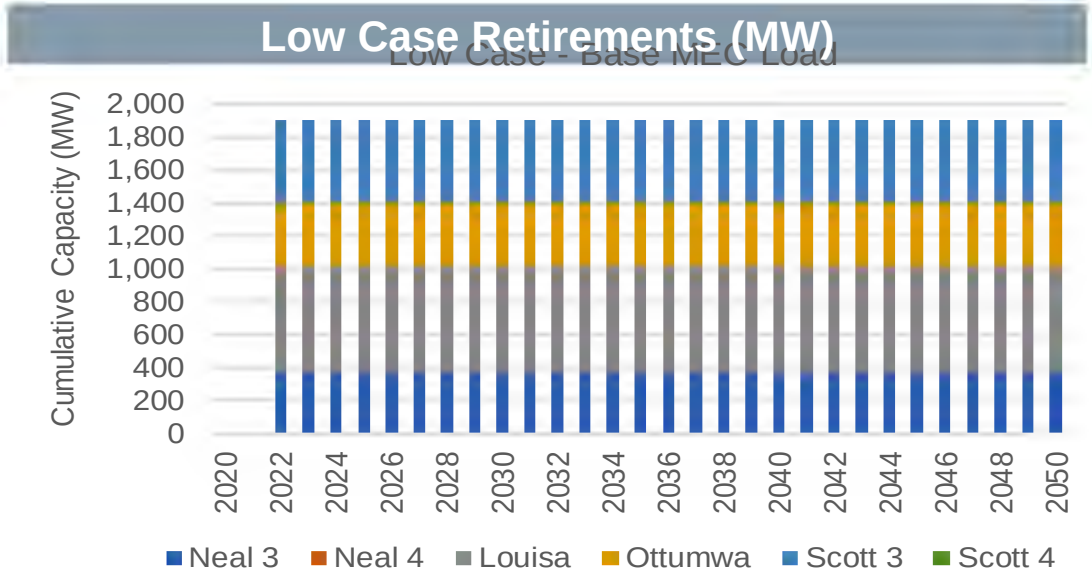


NPV Net System Impact ($000)

Reference w/o CO2 (3A)			
	Company View		Delta
	No Retirement Company View	Retirement Company View	
Net System Cost, w/ CO2 Costs	$ 374,549	$ 359,377	-4.1%
Net System Cost, w/out CO2 Costs	$ 374,549	$ 359,377	-4.1%
	Customer View		Delta
	No Retirement Customer View	Retirement Customer View	
Pre Tax Net System Cost, w/ CO2 Costs	$ (638,423)	$ (611,054)	-4.3%
Pre Tax Net System Cost, w/out CO2 Costs	$ (638,423)	$ (611,054)	-4.3%

- Under the Reference no Carbon scenario, comparing the economics of retaining candidate retirement units v. retiring and relying on market for remaining system energy and capacity needs, the analysis found:
  - The net system impact of retaining the units was higher and therefore more favorable from the company view; and
  - The net system impact of retaining the units was lower and therefore favorable from the customer view.

Economic Retirement Assessment – Low Case



NPV Net System Impact ($000)

Low Case (5A)	Company View		Delta
	No Retirement Company View	Retirement Company View	
Net System Cost, w/ CO2 Costs	$ (215,934)	$ (86,800)	-59.8%
Net System Cost, w/out CO2 Costs	$ (215,934)	$ (86,800)	-59.8%
	Customer View		**Delta**
	No Retirement Customer View	Retirement Customer View	
Pre Tax Net System Cost, w/ CO2 Costs	$ 182,070	$ 66,924	-63.2%
Pre Tax Net System Cost, w/out CO2 Costs	$ 182,070	$ 66,924	-63.2%

- Under the Low Case scenario, comparing the economics of retaining candidate retirement units v. retiring and relying on market for remaining system energy and capacity needs, the analysis found:
  - The net system impact of retiring the units was higher and therefore more favorable from the company view; but
  - The net system impact of retiring the units was lower and therefore favorable from the customer view.