South Dakota Integrated Resource Plan

2020

NorthWestern Energy

Delivering a Bright Future

TABLE OF CONTENTS

Cover - NorthWestern Energy has 128 substations to reliably serve our 63,800 South Dakota electric customers.

TABLE OF FIGURES

TABLE OF TABLES

1. EXECUTIVE SUMMARY

1.1. Overview of NorthWestern's 2020 South Dakota Integrated Resource Plan

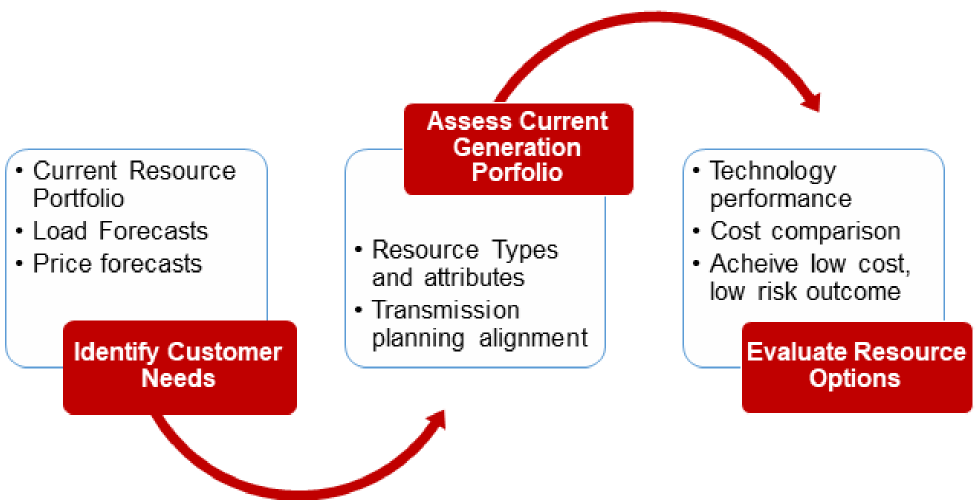
NorthWestern Energy's 2020 South Dakota Integrated Resource Plan provides a roadmap to inform the development of an adequate energy supply for the coming years. The Plan presents an evaluation of different potential generation resource portfolios that could meet the needs of our South Dakota electric customers reliably, safely, and affordably over a ten-year time horizon. This process involves the assembly and analysis of a wide range of data on loads, prices, and resource performance, along with technical information on resource costs and capabilities, all of which is discussed throughout this document.

NorthWestern is a member of the Southwest Power Pool ("SPP"), which creates benefits for NorthWestern's customers but also entails certain responsibilities and requirements for NorthWestern as a member of the broader community of market participants. These benefits and requirements are incorporated throughout NorthWestern's analysis and discussed where relevant throughout this Plan.

This Plan analyzes how a variety of generation resource portfolios might perform across a range of future conditions. Planning requires the consideration of information about the future, which means it must consider information that is not known with certainty—including forecasts of prices and electric loads—and incorporate assumptions about the costs and characteristics of different factors, such as generating technologies (among other things).

Accordingly, the Plan does not result in specific decisions about new resources to add to NorthWestern's generation portfolio[1]. Instead, the Plan provides information about the system's likely future needs under different conditions and evaluates various resource types based on their generic costs and characteristics. The Plan thus serves as a useful foundation to guide future resource determinations, which necessarily must take into account more specific information. NorthWestern remains flexible and responsive as the future unfolds and will reassess the options along the way when pursuing the actions identified in this plan as likely to meet our customers' needs reliably, affordably, and safely.

The analysis presented in this plan is based on historical data, forecasts of energy needs (both at peak demand times and over sustained periods), and estimates of a wide range of other relevant factors. The following graphic depicts the major categories of information used and the ways this information is processed and evaluated.



1.2. Developments following the 2018 IRP

Since NorthWestern filed its previous IRP in 2018, a fire at Huron in January 2019 destroyed Huron Unit 2 (43 MW). NorthWestern issued a Request for Proposal ("RFP") in the second quarter of 2019 to replace the capacity lost in the fire, plus the capacity at Huron unit 1 (a total of 58.7 MW) and the evaluation process was completed with a resource selection at the end of 2019. The resource selected was 60 MW of gas-fired internal combustion engines to be constructed at Huron, and which is expected to be online by the end of 2021. A more detailed discussion of the process that led to this resource selection is provided in Chapter 5.

The timeline below represents the roadmap as informed by current portfolio assumptions and conditions. NorthWestern files a new Integrated Resource Plan every two years.

1 Such decisions about specific resource selections would only result following the analysis of detailed and specific information of the candidate resources. (These are typically received in response to a formal Request for Proposal ("RFP") but may also arise through unforeseen opportunities or offers).

1.3. Modeling Results

Based on an analysis of a range of representative resource types, the modeling results presented in Chapter 8 suggest that the most cost-effective resources to replace the retiring units at Aberdeen and Yankton are reciprocating internal combustion engines. However, any actual resource additions would be made only after a rigorous evaluation of specific resource options and engineering specifications.

1.4. Action Plan

Following the development of this Plan, and consistent with the major findings of NorthWestern's previous resource plan, the key near-term actions for NorthWestern include:

- Continued construction of the replacement generation at Huron, expected to achieve commercial operation at the end of 2021.
- Develop and issue a Request for Proposals (RFP) for approximately 40 MW of new generation, to replace aging generating units at Aberdeen and Yankton. This RFP is targeted for issuance in the first half of 2021, with the goal of bringing the replacement resources online in 2025. However, this timeline will be subject to the Southwest Power Pool's interconnection process, which has recently been experiencing delays of two to three years, and sometimes longer.[2]
- Continued participation in discussions about the future emissions compliance obligations for the Coyote Generating Station, monitoring the likely status of this unit and evaluating the costs and benefits of continued investments in Coyote as compared with alternatives for reliable capacity.

NorthWestern will file its next integrated resource plan in 2022.

2 See SPP Three-Phase Interconnection Study Process presentation, 9/19/2019. https://spp.org/documents/60683/gi%20three%20phase%20education%20session%20presentation.pdf

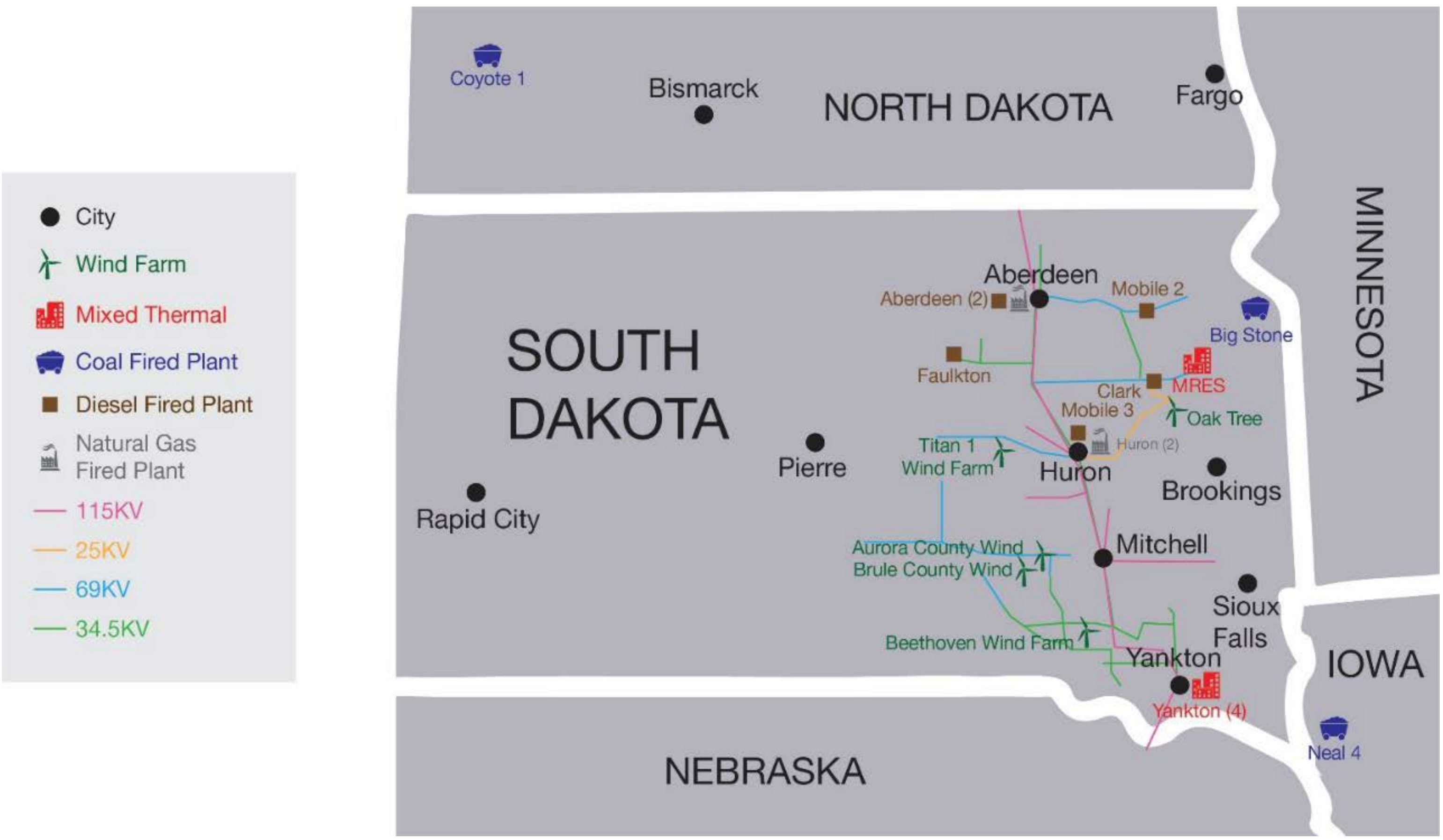
2. LOAD AND RESOURCE BALANCE

Highlights

- NorthWestern's peak load needs and annual energy requirements have recently grown at a moderate rate, peaking around 335 MW in summer and 320 MW in winter.
- A fire at the Huron Generating Station required NorthWestern to accelerate the replacement of 58 MW of generation capacity. The evaluation of replacement resource options is complete and construction is underway of 60 megawatts (MW) of reciprocating internal combustion engines.
- NorthWestern has several aging generation units in Aberdeen and Yankton that will need replacement in the near future.
- NorthWestern purchased and deployed eight 1-MW mobile generation units to support our customers' needs for local reliability.

NorthWestern Energy is a regulated electric and natural gas utility serving 734,800 customers across Montana, South Dakota, and Nebraska. Our South Dakota electric customer base is made up of 63,800 customers in 110 communities. Our electric services are provided utilizing over 3,500 miles of transmission and distribution lines and we meets our customers' electricity needs with a diverse portfolio of generation assets located both within South Dakota and outside the state.

FIGURE 1 MAP OF SOUTH DAKOTA GENERATION ASSETS



NorthWestern must have an adequate supply of generation resources to maintain reliable service for our customers and to meet the requirements of participating in the Southwest Power Pool (SPP).

2.1. Energy and Capacity Needs

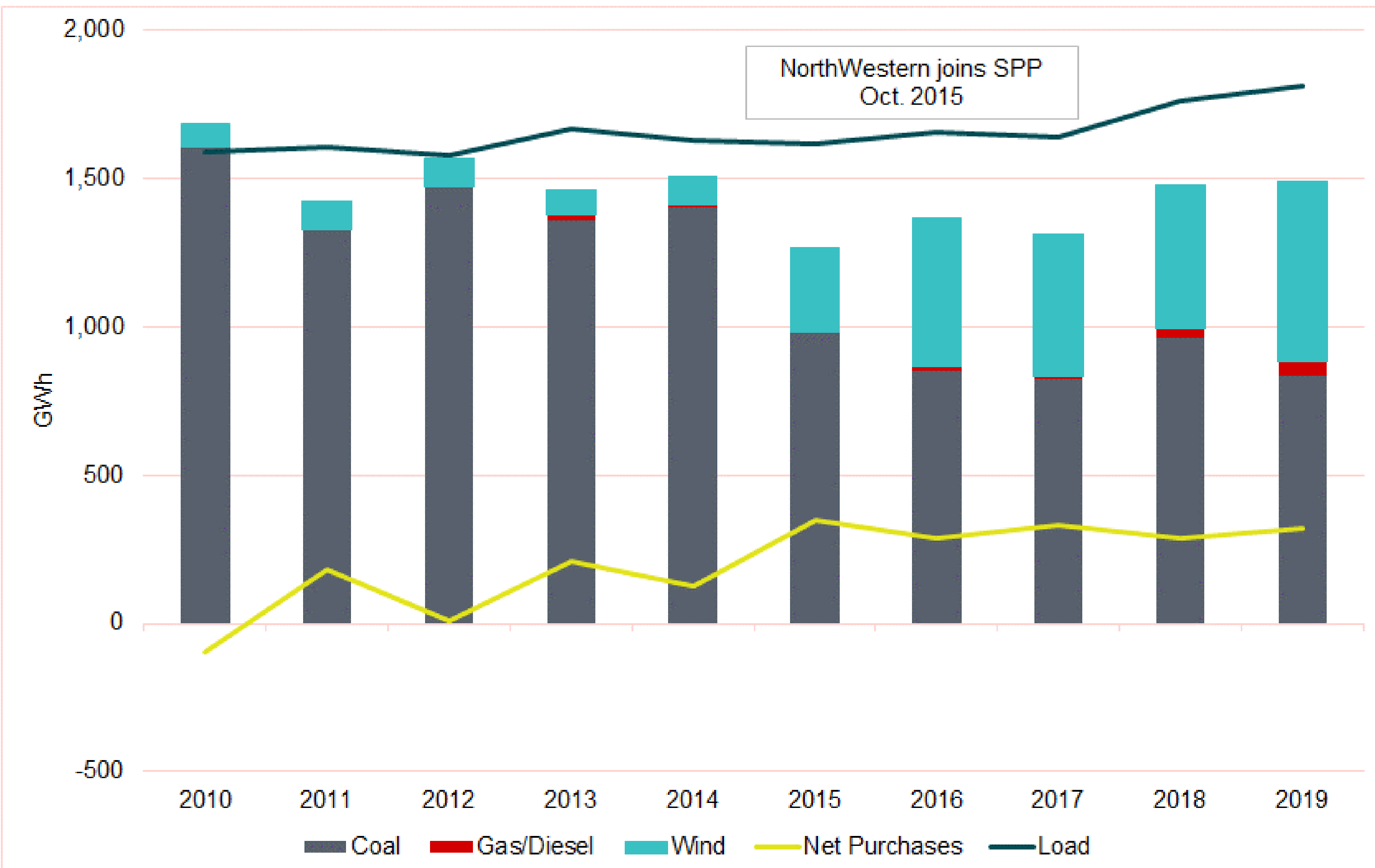
NorthWestern's customers continue to have steady but modest growth in the total energy they consume each year, as well as in their peak energy needs. The analysis throughout this plan—as is typical in resource planning—considers energy and capacity needs separately:

Energy is the total amount of electricity that customers use in a given time period and is commonly measured hourly, monthly, daily, or annually. It is typically measured in megawatt-hours (MWh) or gigawatt hours (GWh). In 2019, total energy delivered to NorthWestern's customers was approximately 1,811 (GWh), which is 11.1% more than 5 years before.

Capacity is the maximum amount of energy that a generator or portfolio of generation can provide over a period of time , whether at a brief moment in time or sustained for a longer period. This represents the capability of the system to meet the needs of the system's customers when those needs peak, which is often during extreme weather. Capacity is measured in megawatts (MW). In 2019, NorthWestern's peak load was 333 MW.

These two needs—energy and capacity—are the key drivers of energy supply planning because a utility like NorthWestern must plan to have sufficient energy to meet customers' needs over a prolonged period, but must also have a system with the capacity to meet the highest momentary energy demand over the course of the year. Figure 2 shows NorthWestern's annual energy deliveries for the past 10 years.

FIGURE 2 ENERGY DELIVERED TO CUSTOMERS, BY YEAR (GIGAWATT HOURS)



NorthWestern's load typically peaks in the summer, though our winter peak loads have grown in recent years. The tables below show the size and characteristics of NorthWestern's historical peaks in summer and winter. In general, we see the following:

- Summer peaks generally occur in the evening (hours 16-18) while winter peaks are usually in the morning (hours 8-9)
- Summer peaks correspond with temperatures above 79 °F and winter peaks with temperatures below 8 °F
- 60% of summer peaks occurred in July and 60% of winter peaks occurred in January

TABLE 1 HISTORIC SUMMER PEAKING CONDITIONS

Year	Summer Peak Capacity Requirement (MW)	Peak Date	Peak Hour	Average Territory Temperature (°F)
2010	311	8/11/2010	17	80.33
2011	341	8/1/2011	16	86.67
2012	329	7/19/2012	18	82.33
2013	295	8/27/2013	17	82.50
2014	302	7/21/2014	18	79.50
2015	306	9/3/2015	17	79.33
2016	331	7/20/2016	17	84.50
2017	336	7/17/2017	16	83.67
2018	330	7/11/2018	15	82.32
2019	333	7/15/2019	14	80.57

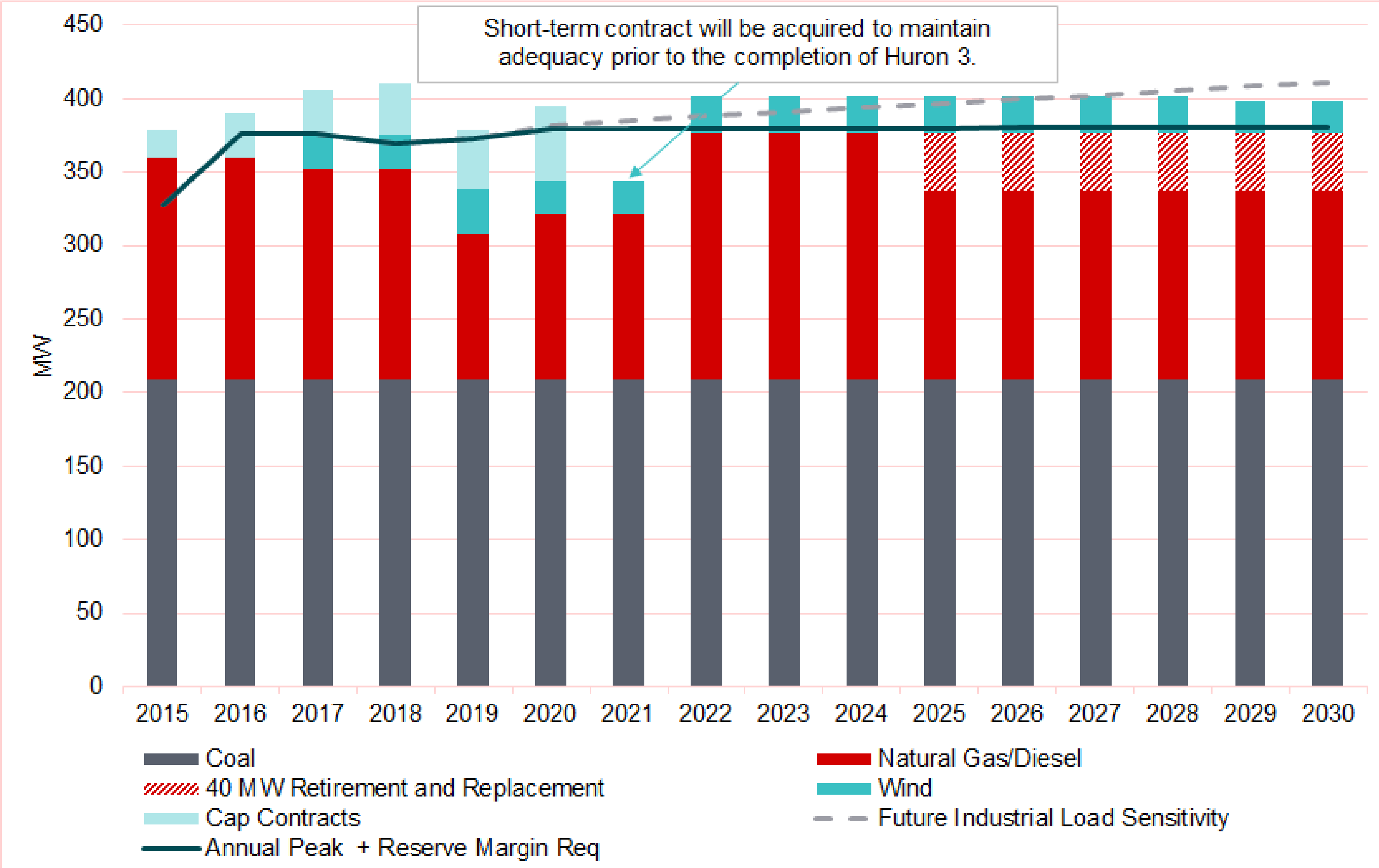
TABLE 2 HISTORIC WINTER PEAKING CONDITIONS

Year	Winter Peak Capacity Requirement (MW)	Peak Date	Peak Hour	Average Territory Temperature (°F)
2010	278	1/7/2010	19	-4.50
2011	281	2/8/2011	8	-7.83
2012	274	1/19/2012	8	-1.17
2013	265	12/23/2013	9	-9.67
2014	286	1/6/2014	9	-10.17
2015	301	1/13/2015	8	7.00
2016	290	12/15/2016	8	5.00
2017	298	12/27/2017	9	2.67
2018	310	1/16/2018	18	-3.00
2019	319	1/29/2019	17	-2.80

NorthWestern is required by SPP to maintain adequate generation capacity to meet our forecast peak loads plus a planning reserve margin (PRM) of 12% above the forecast peak. After the completion of the Huron project, we expect to have sufficient capacity to meet our reserve requirements. However, as noted earlier, we will need to replace several of our existing resources that are near the end of their useful lives. Chapter 8 evaluates scenarios for replacing NorthWestern's aging generation. The 2020 Plan and the analysis described here build on the detailed engineering assessment of NorthWestern's resource fleet that was presented in the 2018 IRP.

NorthWestern's historic and projected capacity position over the next ten years is shown in Figure 3. The drop in capacity in 2019 is a result of a fire at Huron Generating Station. This capacity was replaced with a short-term capacity contract in 2019 and 2020, and we expect to do the same in 2021. Longer term, the shortfall will be replaced by a new 60 MW unit at Huron, which will begin service at the end of 2021. Figure 3 also shows the expected retirement and concurrent replacement of approximately 40 MW of capacity required for NorthWestern to maintain resource adequacy while replacing aging units at Aberdeen and Yankton.

FIGURE 3 SOUTH DAKOTA CAPACITY REQUIREMENT (MW)



NorthWestern's total system load is relatively small and the addition of a new large customer can thus have a meaningful increase in energy and capacity needs. Such a scenario is shown as a sensitivity in the projections of our capacity position and considered in the analyses discussed in the resource portfolio modeling section. Such an increase in load could be driven by the addition of single large industrial customer or by several smaller customers.

2.2. Load Forecast

The load forecast is a critical component to planning for future energy supply needs. NorthWestern has seen moderate but steady growth in our customers' annual energy consumption as well as our peak capacity needs. This section describes the forecasts of both energy and peak capacity needs into the future. These forecasts are inputs for the simulation analyses described in Chapter 8.

2.2.1. Energy

The total annual energy used by NorthWestern's customers has grown steadily over the last 10 years, increasing from approximately 1,765 GWh in 2018 to 1,811 GWh in 2019. Starting with 2020, this is forecast to increase at an average rate of 0.70% for the next ten years. Figure 4 below reflects this continued growth anticipated in residential consumption and the commercial sector. The red line is the forecast used in our portfolio modeling (see Chapter 8) that includes all historical load plus known, new industrial customers. The composition of this line is shown in Table 3. Energy requirements for 2030 are expected to reach 1,826 GWh. Unexpected increases or decreases in industry activity or energy conservation within NorthWestern's territory could significantly affect future energy requirements.

FIGURE 4 ANNUAL ENERGY DELIVERIES – HISTORIC AND FORECAST

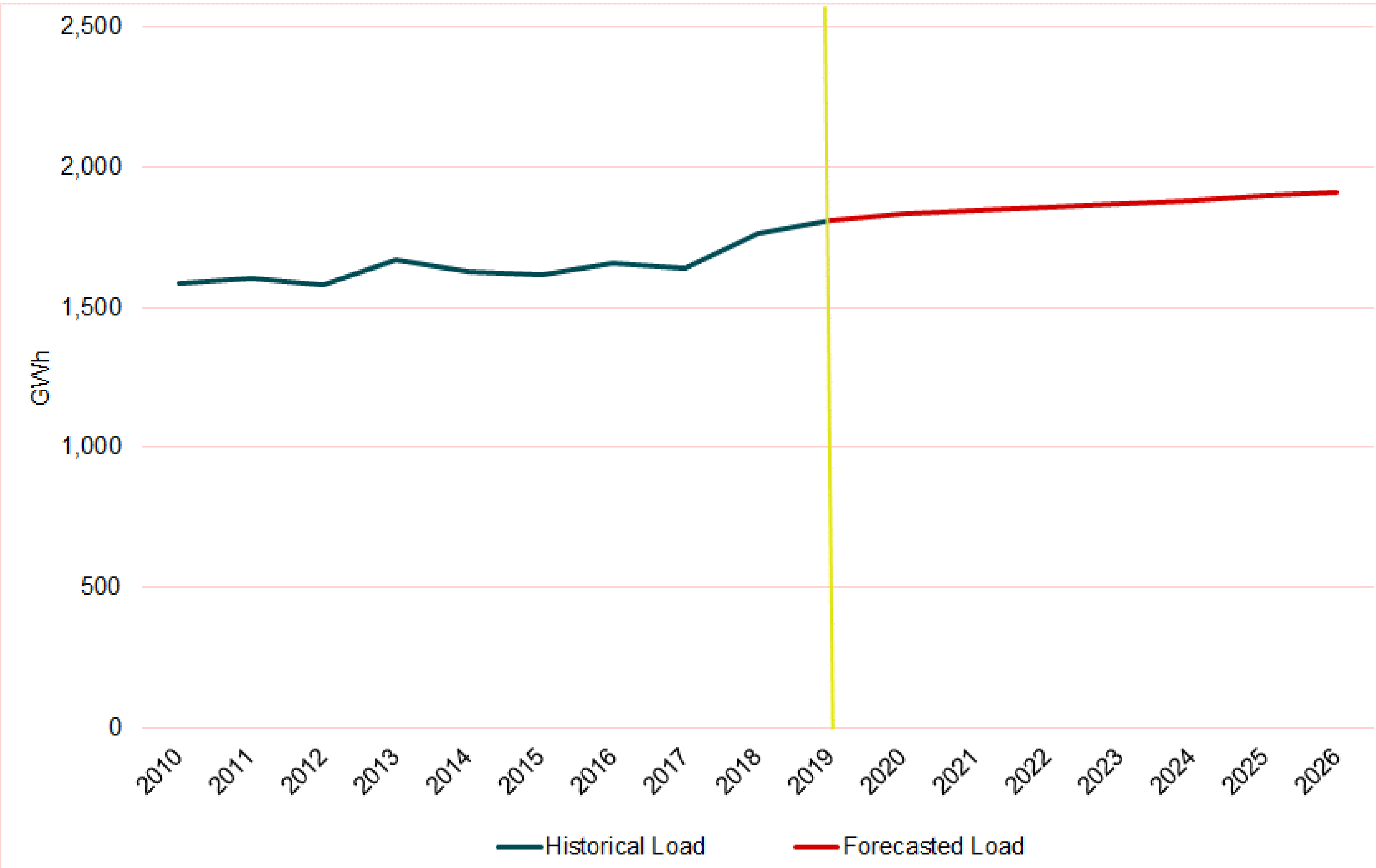


TABLE 3 ANNUAL ENERGY FORECAST

Year	Electric Energy (GWh)	Annual Load Growth (%)
2020	1,836.17	1.40%
2021	1,848.25	0.70%
2022	1,860.34	0.70%
2023	1,872.43	0.60%
2024	1,884.51	0.60%
2025	1,896.60	0.60%
2026	1,908.69	0.60%
2027	1,920.77	0.60%
2028	1,932.86	0.60%
2029	1,944.95	0.60%

2.2.2. Capacity

Most of NorthWestern's load and its need for capacity is created by residential and small commercial customers. Thus, due to the high demand of electricity for purposes of space heating and cooling, the system load shape varies seasonally. This also causes NorthWestern's system to be called upon to meet maximum demands during summer and winter extreme temperature events.

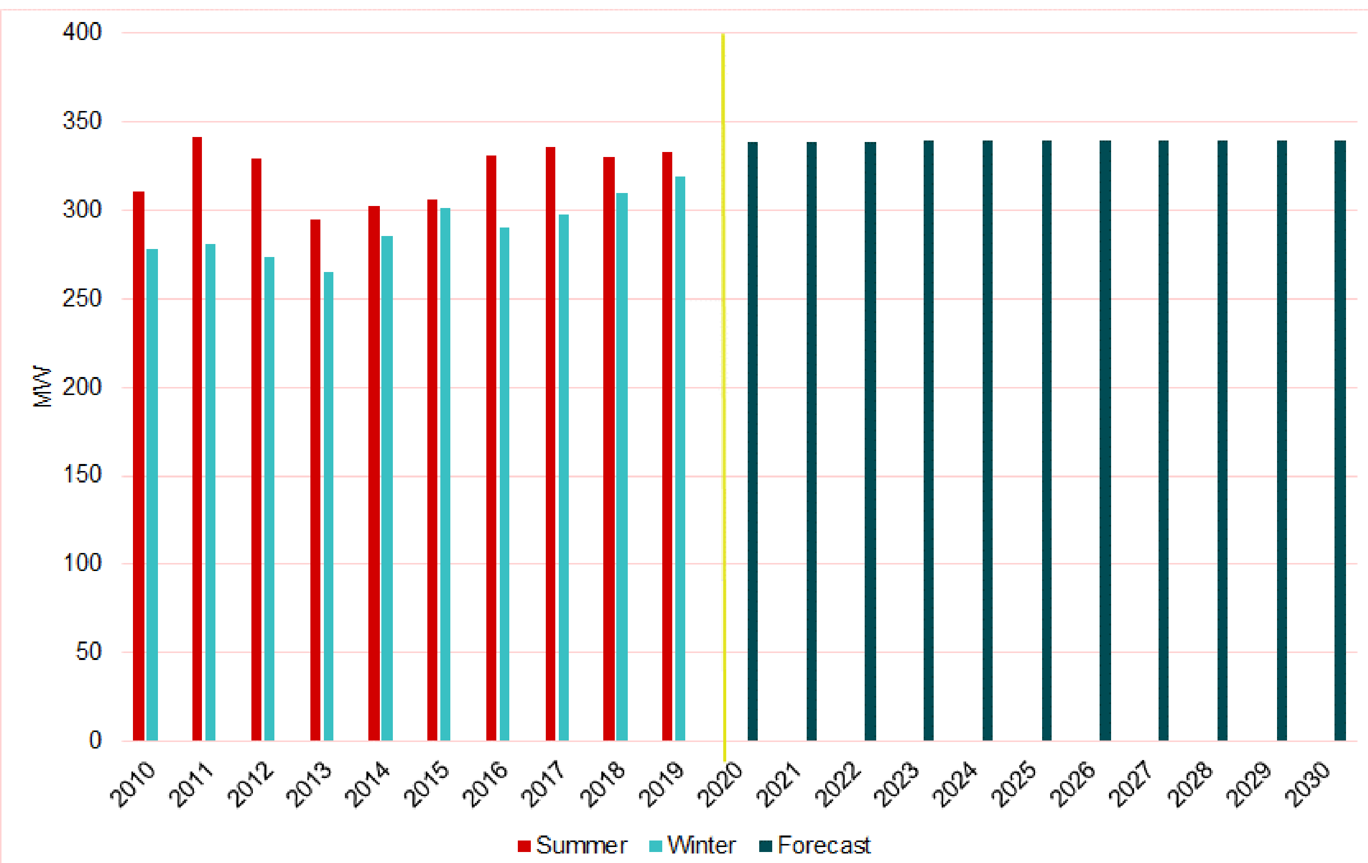
Figure 5 shows NorthWestern's peak loads over the past 10 years along with forecasted annual peaks through 2030. In all years, the annual peak occurs in the summer. As shown in Table 4, peak loads are expected to decrease in 2020, but steadily increase by 0.1 MW each year into the planning horizon.

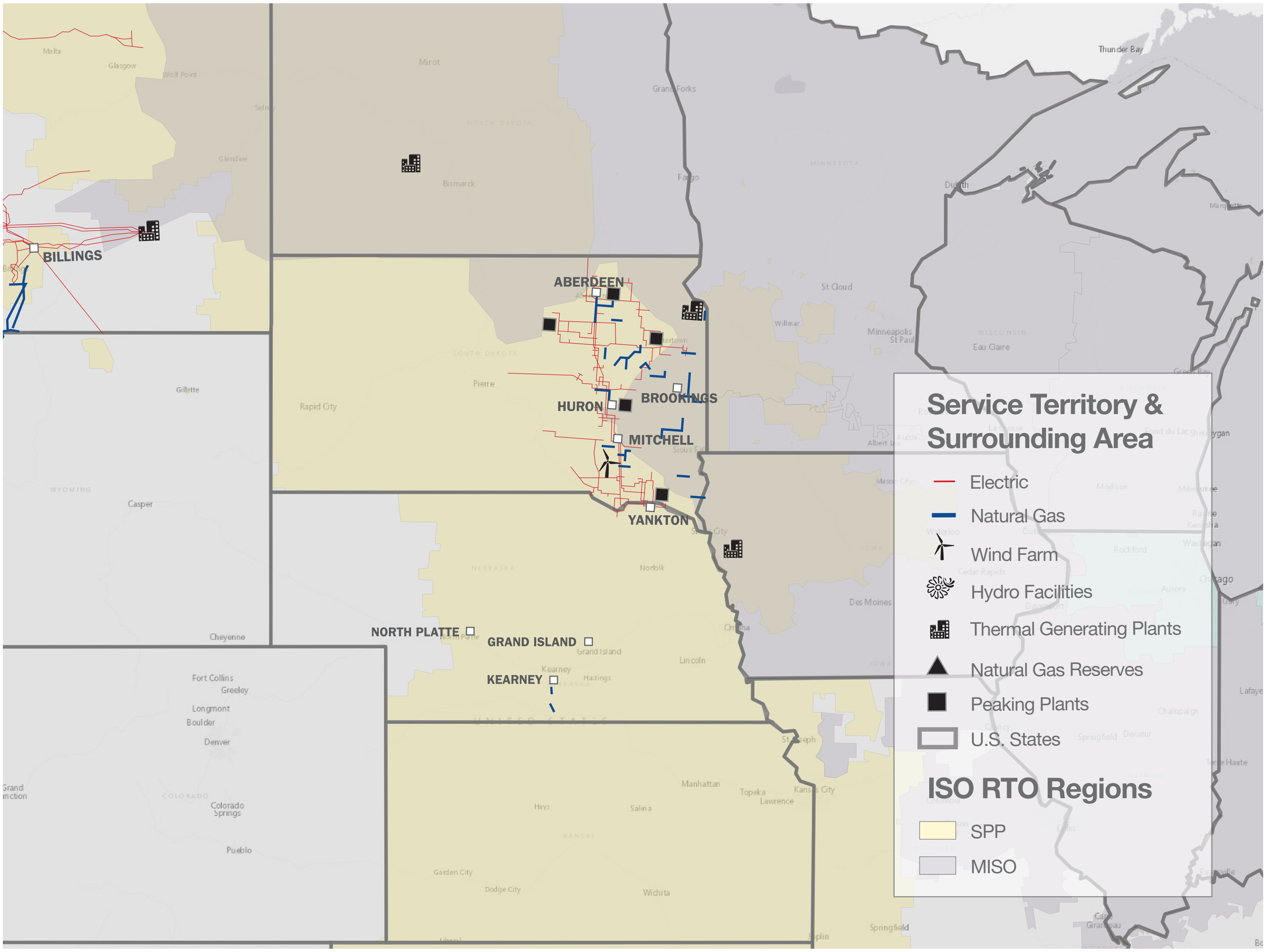
As mentioned in the prior chapter, NorthWestern is required to maintain a 12% PRM in the SPP. Forecasted peak loads for the next 10 years can be found in the table below. These values include the 12% PRM.

TABLE 4 FORECAST OF PEAK CAPACITY NEEDS

Year	Peak Capacity Demand (MW)	Increase (%)	Increase (MW)
2020	338.8	-1.20%	-4.2
2021	338.8	0.00%	0.1
2022	338.9	0.00%	0.1
2023	339.0	0.00%	0.1
2024	339.1	0.00%	0.1
2025	339.2	0.00%	0.1
2026	339.3	0.00%	0.1
2027	339.4	0.00%	0.1
2028	339.5	0.00%	0.1
2029	339.6	0.00%	0.1

FIGURE 5 HISTORIC AND FORECASTED PEAK LOADS, 2015 – 2030





2.3. Southwest Power Pool – Structure and Requirements

NorthWestern is a member of the Southwest Power Pool (SPP), which is a regional power coordination authority that provides transmission and marketing services at the day-ahead and real-time scheduling intervals for its 100 member companies and their 17.5 million customers. The SPP provides benefits to its members' customers by facilitating a more efficient operation of the larger system, which is achieved through its daily management activities and through its annual Resource Adequacy requirement. The SPP coordinates the generation of 818 plants and over 66,000 miles of transmission lines and 5,000 substations within its 546,000 square mile territory spread over 14 states.

SPP members like NorthWestern commit their transmission and generation assets into SPP and then buy and sell wholesale energy and reserves on a day-ahead and real-time basis to meet their loads. The SPP coordinates these wholesale power and transmission activities. To date, NorthWestern has transferred control of 339 line miles of 115 kV facilities and over 97 line miles of 69 kV facilities. All of our SPP controlled facilities reside in the SPP's Upper Missouri Zone (UMZ, which is also known as Zone 19).

The SPP maintains an annual resource adequacy requirement among its members to assure that the entire system has an adequate supply of energy to meet the peak needs of its member companies. SPP requires its member companies that are Load Responsible Entities ("LRE") to hold a 12% Planning Reserve Margin ("PRM").

The PRM of the LRE in SPP is varied and is based on the generation assets of each LRE. NorthWestern carries the minimum requirement for its generation portfolio, compared to most of the other LRE's in the region that carry more than 12%. Based on the 2020 SPP Resource Adequacy process, the actual PRM of the region as a whole is expected to decline until 2025, where it declines to 12.5%. NorthWestern's PRM is on the lower side when compared with other SPP entities. The majority of SPP members carry a PRM in excess of 20%.

FIGURE 6 SPP 2020 PLANNING RESERVE MARGIN (SOURCE: JUNE 2020 SPP ADEQUACY REPORT[3])

Interestingly, in 2020, NorthWestern holds among the lowest planning reserve margin among its investor owned utility peers in SPP. This is subject to change over time as utilities are retiring thermal units and replacing that capacity, often with Variable Energy Resources ("VERs"). The following table offers a comparison of our 2020 Resource Adequacy position relative to our peers.

TABLE 5 INVESTOR-OWNED UTILITY PRM COMPARISON

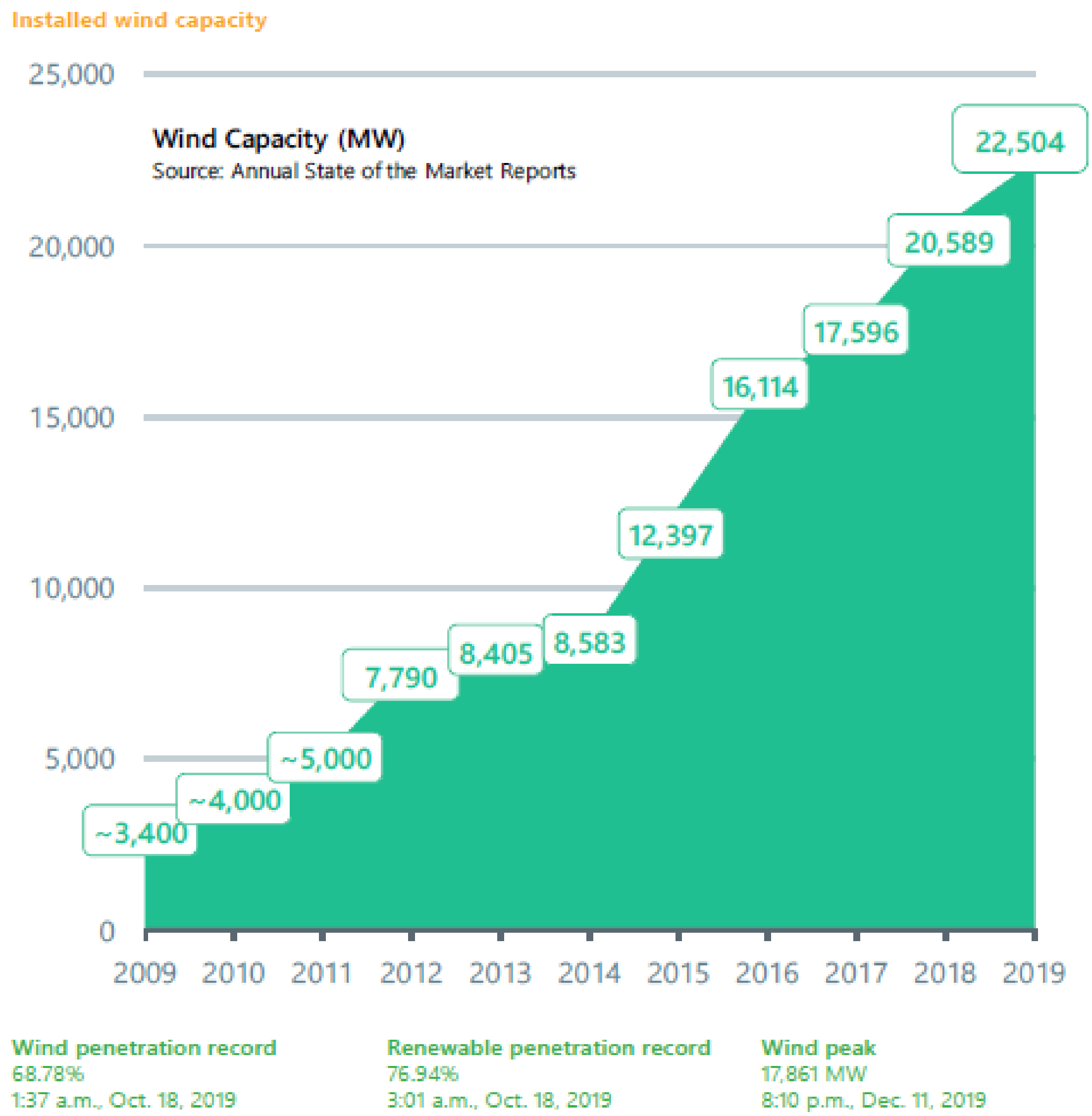
Investor-Owned Utility	2020 Resource Adequacy %
Liberty Utilites (fka Empire)	28.57%
Midwest Energy	26.13%
MidAmerican Energy (subsidiary of Berkshire Hathaway)	25.50%
Westar (Subsidiary of Evergy)	24.07%
American Electric Power	22.02%
NorthWestern Energy SD	16.44%
SouthWest Public Service (subsidiary of Xcel Energy)	15.67%
OK Gas and Electric	12.02%

3 SPP 2020 Resource Adequacy report available at https://spp.org/spp-documents-filings/?id=18274

2.3.1. The SPP's Resource Mix is Changing

The generation mix within the SPP is changing with the retirement of coal and growth in the use of natural gas and renewable resources. The SPP recently set a record by serving its load at one moment in time with over 75% renewable generation and the significant amount of renewable generation is evident on an annual basis as well.[4] This has been driven largely by a rapid increase in the amount of wind generation within the SPP's footprint. This increase is expected to continue into the future, with wind capacity additions outpacing thermal retirements, and a significant amount of wind in SPP's interconnection queue.[5]

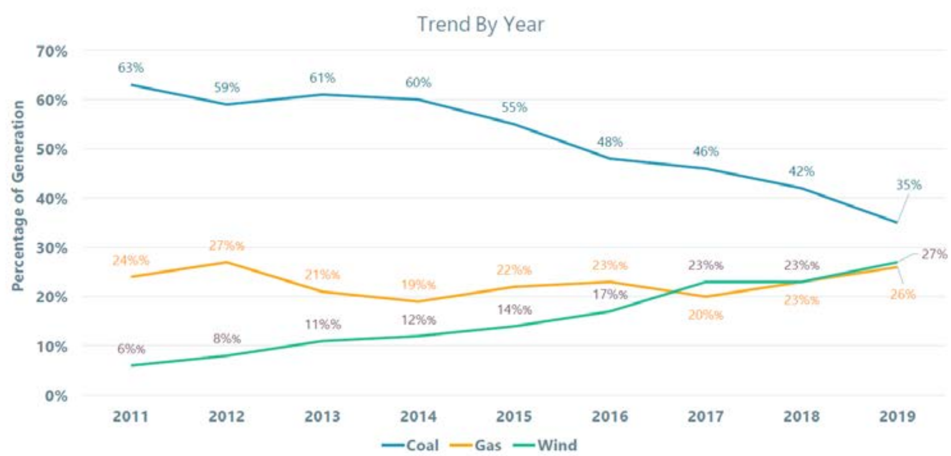
FIGURE 7 SPP INSTALLED WIND, 2009 – 2019 (SOURCE: SPP ANNUAL REPORT)



Wind generation within the SPP has climbed to similar levels as gas generation while coal generation continues to decline. The increase in variability of generation associated with this shift can affect prices and cause operational challenges. The ancillary services required to balance the rapid increase and decrease in weather-driven generation continues to grow, which increases the value of generation that can be dispatched quickly. High levels of intermittent generation can challenge even the most sophisticated system forecasting tools, which has resulted in the SPP increasing the number of instances where it called for "conservative operations" in 2019 due in large part to wind variability on its system.[6] Partly as a result of the growth in intermittent generation, the SPP has re-evaluated its methods for calculating the capacity contribution of wind, solar, and energy storage. The consequences of this for NorthWestern's resource planning analyses are discussed in Chapter 4.

4 This record occurred on October 18, 2019, at 2:05 am.
5 SPP 2019 State of the Market Report https://www.spp.org/documents/62263/2019%20asom%20stakeholder%20presentation.pdf
6 2019 SPP Annual Report, page 14.

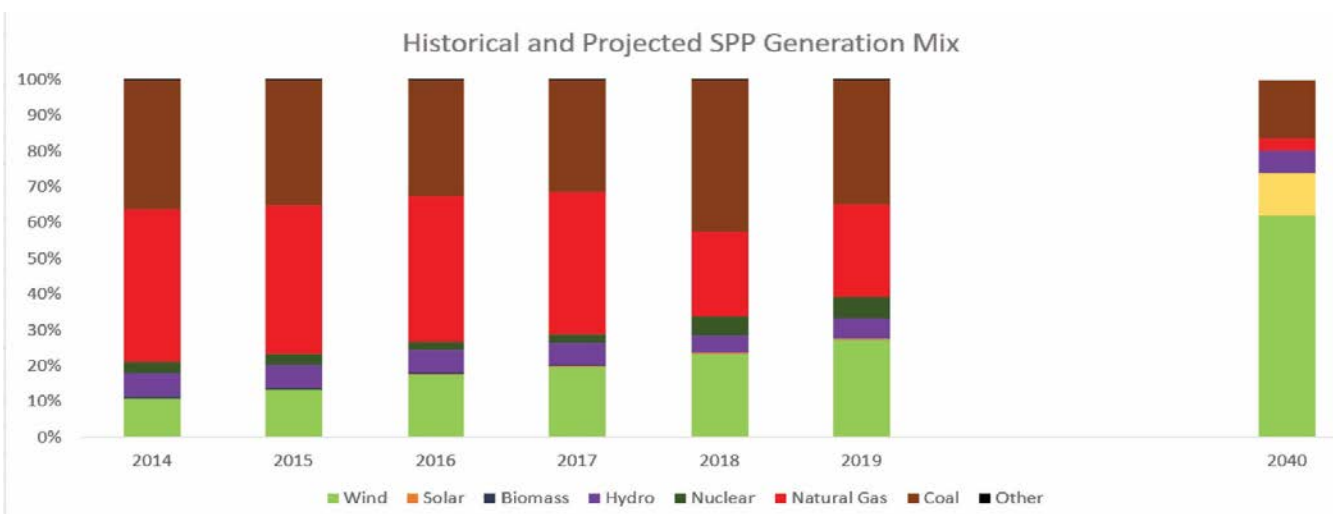
FIGURE 8 SPP PERCENTAGE OF GENERATION (SOURCE: INTRODUCTION TO SPP[7])



As discussed in greater detail in Chapter 4, the increase in nameplate VER generation capacity in SPP is not equivalent to an increase in Accredited Capacity to meet peak summer conditions.

SPP will continue to add VERs to its system into the future. The figure below shows our projections of SPP's generation mix in 2040.

FIGURE 9 HISTORICAL AND PROJECTED SPP GENERATION MIX (SOURCE: ASCEND ANALYTICS)



As of May 21, 2020 SPP had 98,560 MW of projects in its interconnection queue. The following table displays the resource fuel type breakdown:[8]

TABLE 6 SPP INTERCONNECTION QUEUE

Resource Type	MW
Wind	54,440
Solar	32,982
Storage	7,069
Gas	3,973
Other	96

Most of the projects in the SPP interconnection queue are VER resources. In SPP, as mentioned above, VER installations are outpacing thermal retirements. There are numerous reasons for this: comparatively lower and declining capital and O&M costs, a public desire for renewable energy, and policy preferences that favor renewable generation.[9] This policy preference exists at the local and state level, as well as among many investor-owned utilities and companies.

7 https://spp.org/documents/31587/spp101%20-%20an%20introduction%20to%20spp%20-%20all%20slides%20for%20print.pdf
8 SPP 101 Presentation https://www.spp.org/documents/31587/spp101%20-%20an%20introduction%20to%20spp%20-%20all%20slides%20for%20print.pdf
9 https://www2.deloitte.com/content/dam/Deloitte/us/Documents/energy-resources/us-2020-renewable-energy-industry-outlook.pdf

NorthWestern owns the 80-MW Beethoven wind farm and also receives wind energy through four power purchase agreements (PPAs) for wind power in South Dakota.

Not all of the projects in the interconnection queue will reach commercial operation. However, even if some of these projects reach commercial operation, the stability and coordination requirements of SPP will continue to be essential. Regardless, an interconnection queue of this size may create challenges in SPP's ability to be responsive. SPP has in recent years worked to simplify and streamline its interconnection process to accommodate the volume of requests it receives. We will have to take this interconnection volume in to consideration when building our RFP timeline to replace existing capacity.

2.4. NorthWestern's Upcoming Resource Retirements and Replacements

NorthWestern has begun a staged approach for retiring the aging generation in our fleet and replacing some units with more modern and efficient resources. Throughout the replacement process, NorthWestern continues to pursue the most cost-effective resource portfolio to meet the Resource Adequacy requirements of the SPP and to provide reliable service for NorthWestern's local load areas. This process began with a Fleet Assessment study conducted by HDR as part of our 2018 IRP and involves both near-term and longer-term changes in our generation portfolio:

Near Term:

Over the next three to five years, NorthWestern plans to retire about 35 MW of existing generation at the Aberdeen and Yankton locations (see Chapter 4 for a discussion of these retirements). NorthWestern will identify replacement capacity through a competitive solicitation process. This generation will be replaced with about 40 MW of new generation, which is targeted to begin service by the beginning of 2025.

Longer Term:

NorthWestern will be impacted by the second round of Regional Haze regulations at the Coyote plant, of which NorthWestern owns a 10% share. These regulations are expected to require compliance by 2028. If Coyote's owners determine to continue to operate the plant beyond 2028, the plant will require investments in some form of emissions controls. The potential remediation scenarios and costs are described in more detail in Chapter 4. If Coyote does not continue to operate, NorthWestern will need to replace this capacity in order to maintain the adequacy of our resource portfolio.

Chapter 7 discusses the likely technologies that may be used for these replacements and Chapter 8 presents analyses of various candidate resource portfolios that could meet NorthWestern's resource needs.

NorthWestern has multiple generation resource siting options along its transmission system. Primary locations include Aberdeen, Yankton and Mitchell. The particular constraints and benefits associated with these locations will be important to consider when actual resource decisions are made, though they are not specifically incorporated into the simulation modeling presented.

3. PRICE FORECASTS

Highlights

- NorthWestern forecasts that power prices will decline at a low-to-moderate rate, driven by continued increase in variable energy resources with no fuel costs.
- The price of natural gas available to NorthWestern's generators in South Dakota remains at historic lows and is forecast to remain relatively low during the coming decade. However, regulations on carbon emissions or other market conditions could cause this to change.

NorthWestern uses forecasts of future prices of power, coal, and natural gas when evaluating potential additions to our current portfolio. These forecasts define the expected (average) value of power and fuel prices and NorthWestern evaluates potential resource additions or retirements by simulating a range of values around these averages to reflect the inherent uncertainty in future conditions. NorthWestern uses the PowerSimm™ modeling software to conduct these simulations, which are described in Chapter 8 for more detail.

3.1. Electricity Price Forecast

To forecast future electricity prices, NorthWestern begins with forward market quotes for the SPP North Trading Hub from the Intercontinental Exchange (ICE). The quotes from the first 15 trading days of the most recent quarters (Q1 and Q2 of 2020) are used to create an average forecasted price to the end of the period in which forward markets are liquid. Based on recent quotes, this period extends to around the end of 2028. Thereafter, a forecast of the implied market heat rate (IMHR) is used as an escalation factor to extend the forecast through the remainder of the planning horizon.[10]

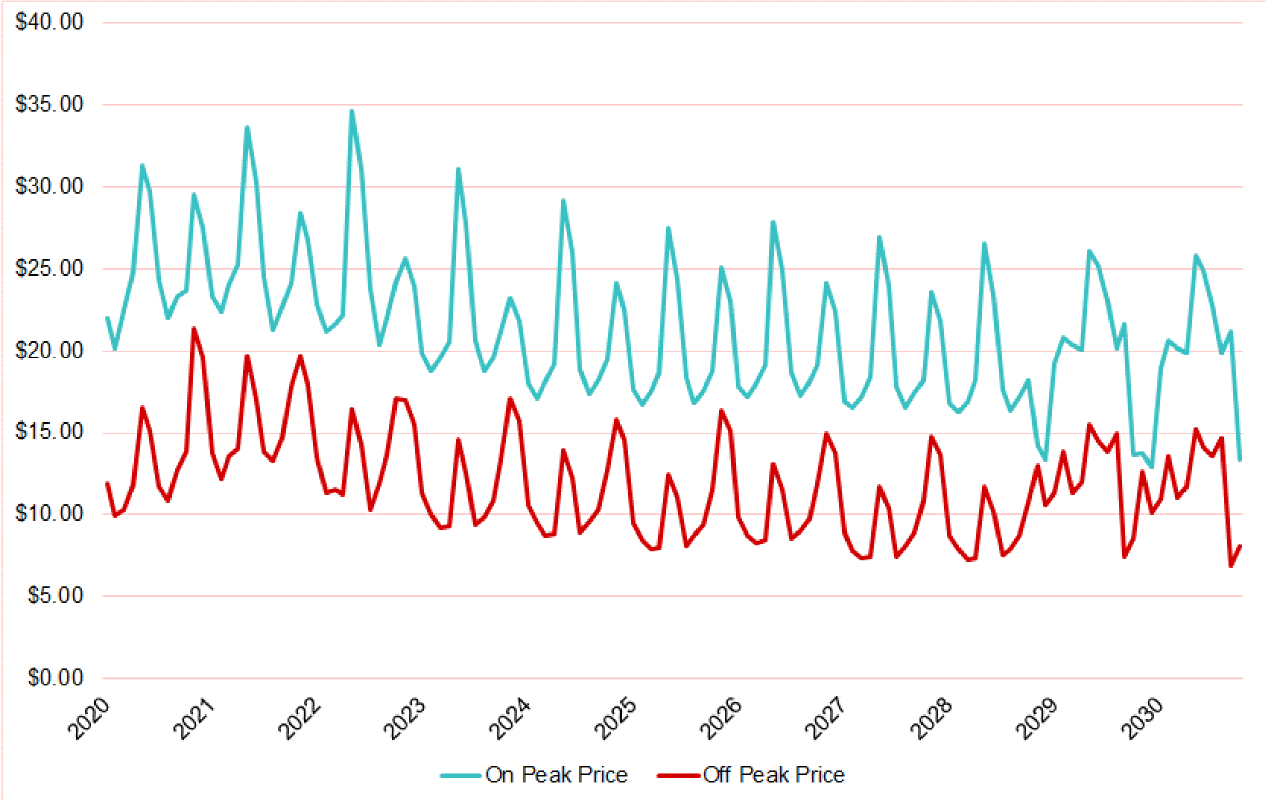
TABLE 7 ELECTRIC PRICE FORECASTS

Electric Price Forecasts			
Year	HL - On Peak ($/MWh - Nominal)	LL - Off Peak ($/MWh - Nominal)	Around the Clock ($/MWh - Nominal)
2021	$25.72	$15.89	$20.46
2022	$24.93	$14.06	$19.12
2023	$22.28	$11.91	$16.74
2024	$20.56	$11.50	$15.72
2025	$20.05	$10.45	$14.92
2026	$20.51	$10.88	$15.36
2027	$19.71	$9.81	$14.42
2028	$19.42	$9.71	$14.23
2029	$19.81	$12.23	$15.76
2030	$19.52	$11.88	$15.44
10-Year Lev.	$23.21	$12.95	$17.73

10 Implied market heat rate (IMHR): The heat rate necessary for a natural gas generator to operate economically. It is calculated by dividing the price of power by the price of natural gas.

Coyote Station, located near Beulah, North Dakota, began commercial operations in 1981. NorthWestern is one of four joint owners of the plant.

FIGURE 10 ELECTRICITY PRICE FORECAST - SPP NORTH



As discussed elsewhere in this Plan, there has been a significant increase in VER generation both in SPP and throughout the United States. This will have an impact on future prices.

The following charts depict the relationship between pricing and renewable penetration in SPP. Figure 11 shows the the historic average monthly SPP day-ahead price. Figure 12 shows how the increased amount of VERs on SPP's system impacts price volitity on a real-time basis. Price volatility is the change in day-to-day pricing, measured in degress of variation.

FIGURE 11 MONTHLY AVERAGE DAY-AHEAD PRICES, SPP (2015 – 2019)

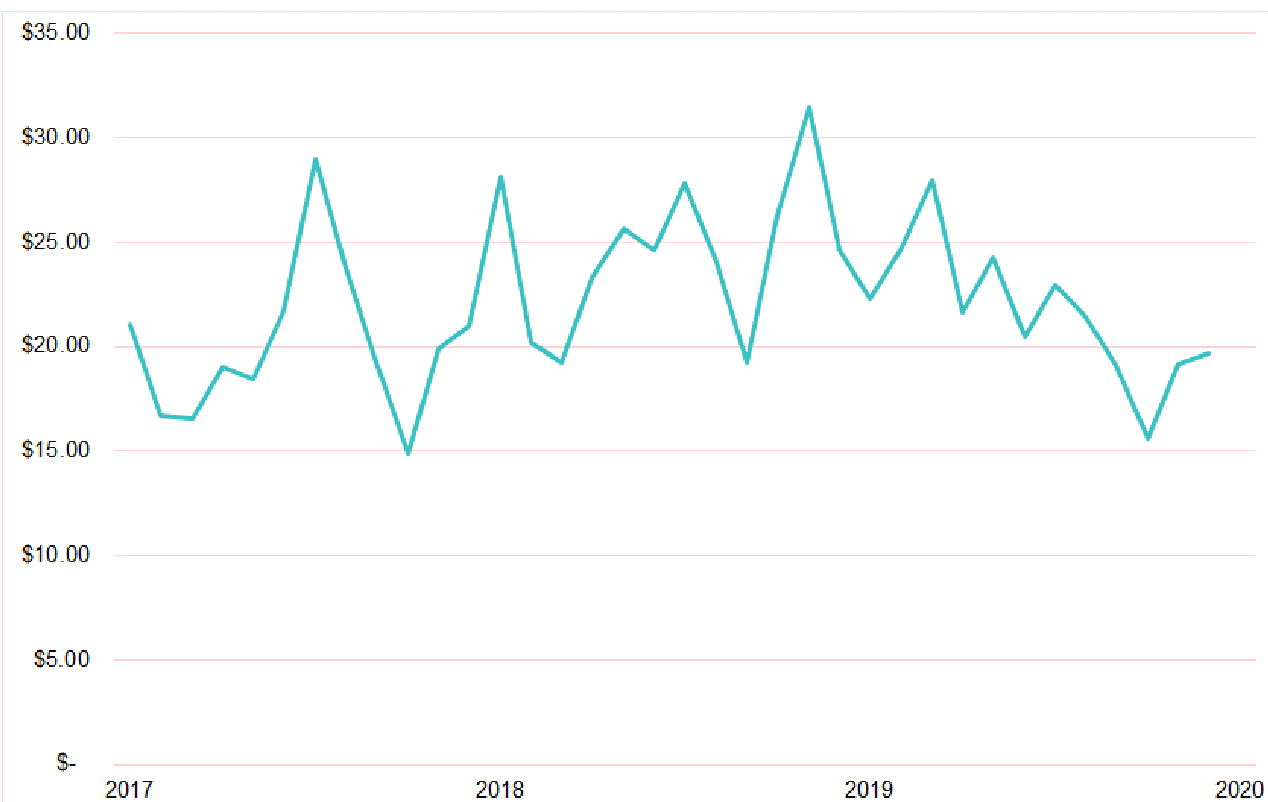
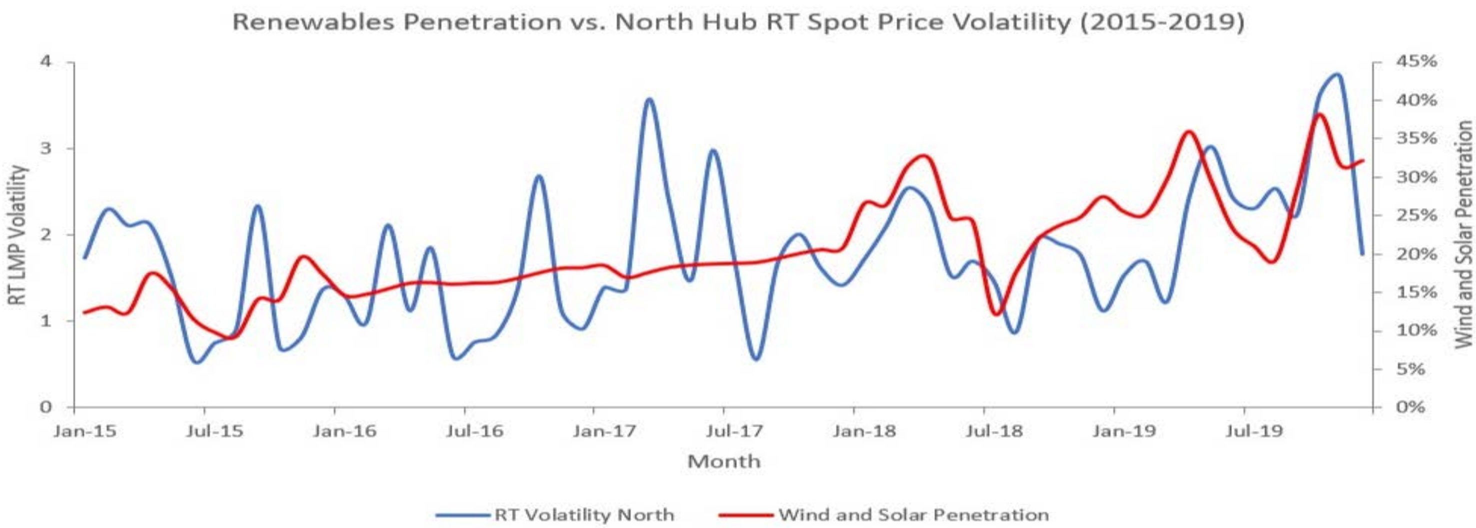


FIGURE 12 SPP VER PENETRATION AND REAL TIME PRICE VOLATILITY (2015 – 2019)



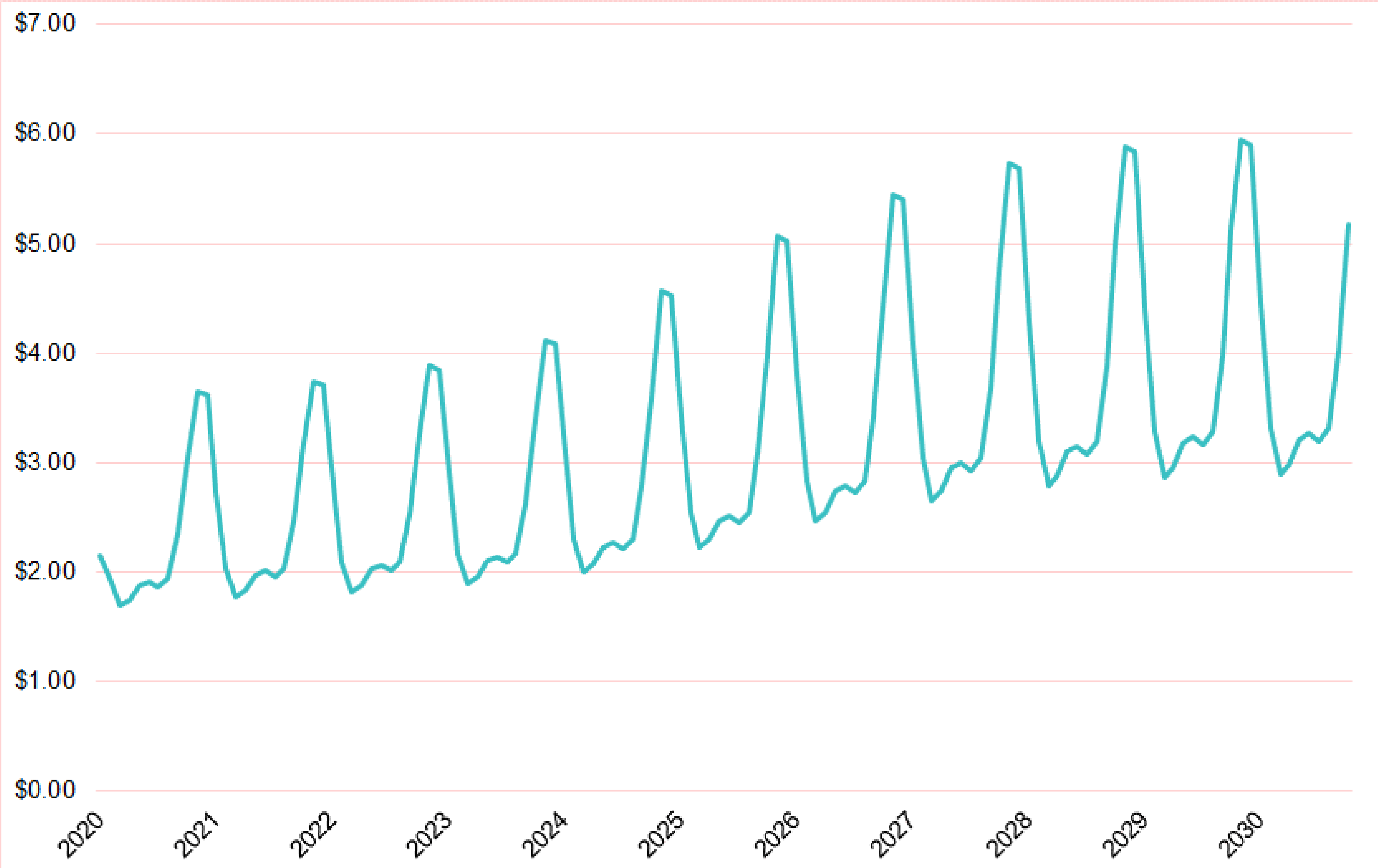
3.2. Natural Gas Price Forecast

Natural gas price forecasts are calculated using market quotes from ICE at the Northern Natural Gas Ventura Hub. As with the electricity price forecast, the quotes from the first 15 trading days of Q1 and Q2 of 2020 are averaged to create the forecast for the initial years. The forecast is then extended beyond the liquid period through the remainder of the planning horizon by using the nominal gas price projection reported in the Energy Information Administration (EIA) 2020 Annual Energy Outlook as an escalation factor.

TABLE 8 NATURAL GAS PRICE FORECAST

Natural Gas Price Forecasts	
Year	HL - On Peak ($/MMBTU - Nominal)
2021	$2.44
2022	$2.50
2023	$2.59
2024	$2.75
2025	$3.05
2026	$3.39
2027	$3.64
2028	$3.83
2029	$3.94
2030	$3.97
10-Year Lev.	$3.32

FIGURE 13 NATURAL GAS PRICE FORECAST - VENTURA



3.3. Coal Price Forecast

Coal price forecasts are derived from existing supply contracts for Big Stone through 2025, Coyote through 2024 and Neal through 2029 as a starting point for projections. An annual escalation rate of 1.02% is used to complete the forecast for the remainder of the planning period. The escalation factor is equal to the 20-year average inflation escalation for Gross Domestic Product (GDP) as provided by the U.S. Bureau of Economic Analysis.

TABLE 9 COAL PRICE FORECASTS

Coal Price Forecasts						
Year	Coyote ($/ton - Nominal)		Big Stone ($/ton - Nominal)		Neal ($/ton - Nominal)	
2021	$	29.40	$	27.44	$	31.08
2022	$	32.62	$	25.87	$	31.62
2023	$	30.66	$	25.95	$	32.45
2024	$	30.38	$	25.64	$	33.05
2025	$	30.99	$	31.96	$	33.60
2026	$	31.61	$	29.09	$	34.33
2027	$	32.24	$	29.67	$	34.97
2028	$	32.88	$	30.26	$	35.60
2029	$	33.54	$	30.87	$	36.25
2030	$	40.25	$	37.04	$	43.50
10-Year Lev.	$	34.38	$	30.96	$	36.55

4. NORTHWESTERN'S EXISTING RESOURCE PORTFOLIO

Highlights

- NorthWestern's existing resources are able to meet the capacity needs of our customers' peak loads, but some units in our generation fleet are aging and supply chain challenges limit the ability to continue maintaining and repairing some units.
- NorthWestern is a minority owner in three coal-fired resources located outside of South Dakota.
- This Plan evaluates replacement resources for the Aberdeen (MW) and Yankton (MW) units, which NorthWestern plans to replace in the near future.

4.1. Fuel Mix

NorthWestern's current resource portfolio includes coal, natural gas, wind, and power purchase agreements (PPAs) for wind energy, as well as other PPAs for capacity and energy. Taken altogether, this portfolio (both owned and joint-owned) has nameplate capacity of 527 MW, and a peaking capacity of 336 MW as measured by the SPP's capacity accreditation methods. In 2019, wind energy was used to serve one third of total load requirements.

FIGURE 14 ANNUAL ENERGY GENERATION BY FUEL SOURCE: 2016 – 2019

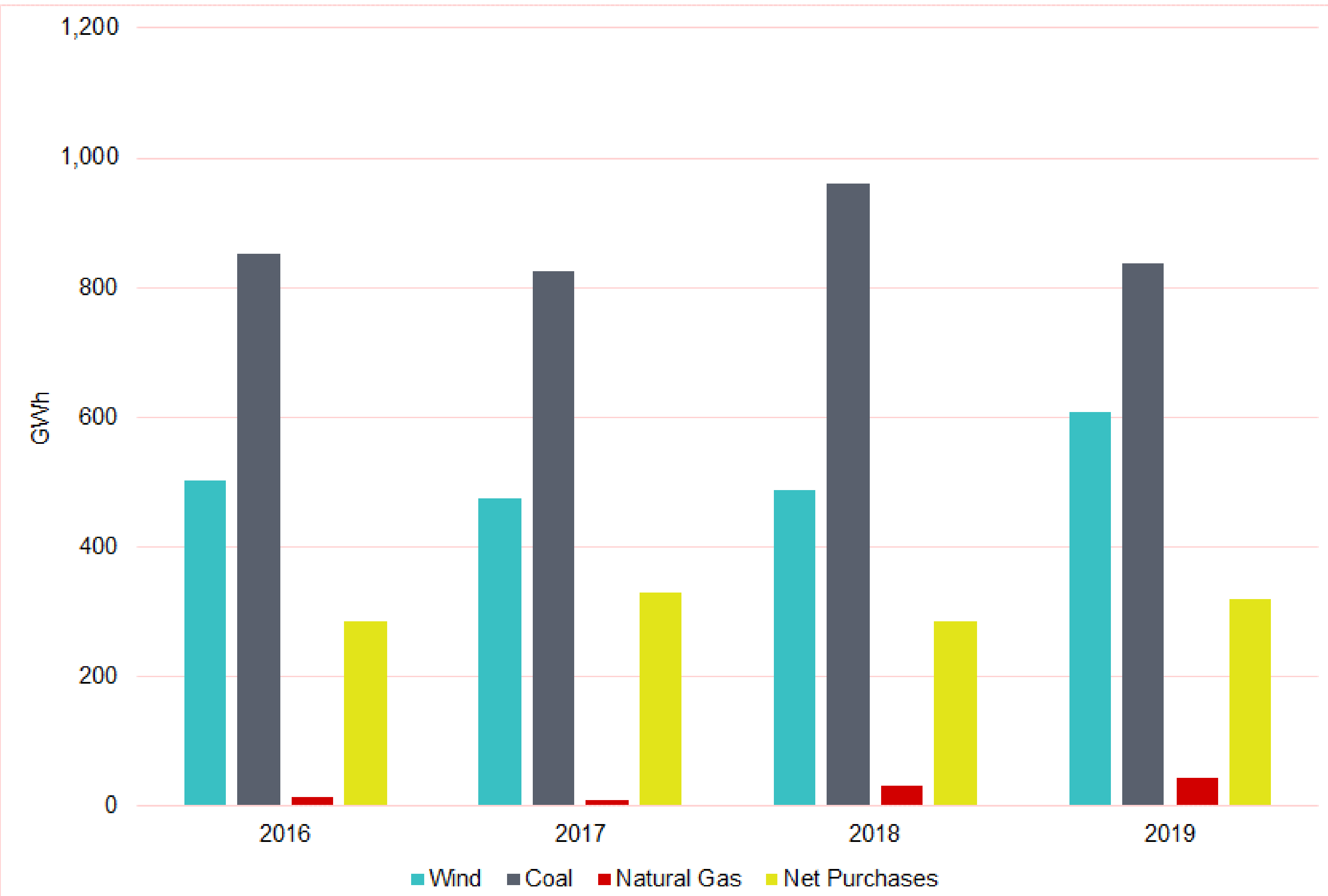
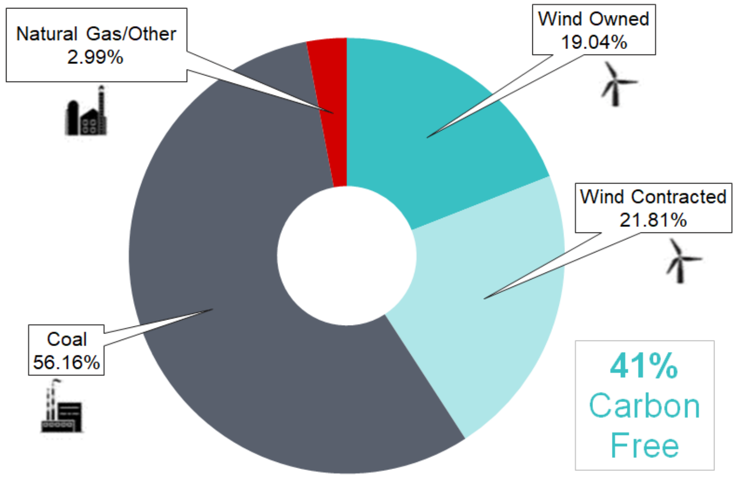


Figure 15 shows the breakdown of generation provided by resources on NorthWestern's system in 2019. Approximately 41% of energy was provided using a carbon free generation source. While coal still provided over 50% of energy from NorthWestern's system, this is a significant decrease from 2018 where it provided over 60%. Note that market purchases are not included in this graphic.

FIGURE 15 2019 ELECTRIC GENERATION PORTFOLIO: DELIVERED ENERGY



4.2. Generation Capacity

NorthWestern's existing resource portfolio has adequate capacity to meet our customers' forecast needs, but it includes several aging units that are in need of replacement. These replacement needs were assessed in detail in the unit-by-unit Fleet Assessment contained in the 2018 Resource Plan. Following the replacement of 60 MW at Huron (currently underway), the generation at Aberdeen 1 (28.8 MW) and Yankton 1-4 (totaling 13.6 MW) are the next resources that NorthWestern plans to retire and replace.Yankton unit 3 is not operational so any replacement scenario will include an equivalent replacement capacity.

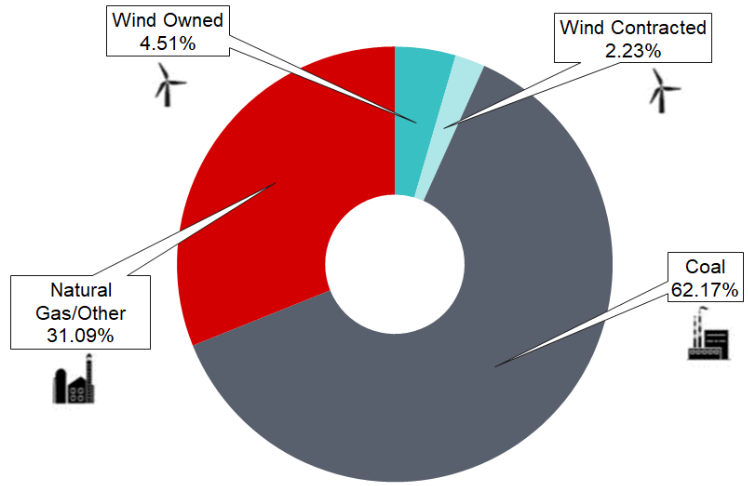
TABLE 10 NORTHWESTERN'S GENERATION RESOURCE PORTFOLIO

Generation Unit	Type	Fuel Type	Nameplate Capacity	Summer (Capacity)	Summer Capacity Contribution (% of Total Requrement)	Heat Rate (BTU / KWh-HHV)	COD
Aberdeen 1 (AGS)	CT	Diesel	28.8	21.5	6.40%	13,560	1978
AGS2	CT	NG / Diesel	82.2	58.5	17.40%	10,000	2013
Huron 1	CT	NG	17.6	10.8	3.21%	10,000	1961
Clark	RICE	Diesel	2.8	2.4	0.71%	10,700	1970
Faulkton	RICE	Diesel	2.8	2.0	0.59%	10,200	1969
Yankton (YGS) 1	RICE	NG / Diesel	2.3	1.8	0.54%	11,100	1974
YGS2	RICE	Diesel	2.8	2.4	0.71%	11,600	1974
YGS3	RICE	NG / Diesel	6.5		0.00%	10,800	1985
YGS4	RICE	Diesel	2.0	2.0	0.59%	9,400	1963
Mobile B	RICE	Diesel	1.8	1.4	0.42%	9,409	1991
Mobile C	RICE	Diesel	2.0	1.7	0.51%	8,853	2009
8, 1 MW Mobiles	RICE	Diesel	1.0	0.0	0.00%	9,524	2019
Big Stone	RICE	Diesel	0.3		0.00%		1975
Big Stone (JOU, 500 MW Total)	Steam	Coal	110.4	110.4	32.84%	10,739	1975
Coyote (JOU, 500 MW Total)	Steam	Coal	42.7	42.7	12.70%	11,077	1981
Neal 4 (JOU, 696 MW Total)	Steam	Coal	55.9	55.9	16.63%	9,949	1979
Beethoven Wind	VER	Wind	80.0	15.2	4.51%	N/A	2015
Rolling Thunder I Power Partners (Titan)	VER	Wind	25.0	3.0	0.89%	N/A	2010
Oak Tree Energy	VER	Wind	19.5	2.5	0.74%	N/A	2015
CED Aurora County Wind LLC	VER	Wind	20.0	1.0	0.30%	N/A	2018
CED Brule County Wind LLC	VER	Wind	20.0	1.0	0.30%	N/A	2018

The capability of a resource to provide generation when loads peak is not necessarily equal to its maximum technical capacity (often called "nameplate capacity"). This is because unforeseen outages might limit a dispatchable resource's availability, or the absence of wind or sun during periods of peak needs could limit the generation from weather-driven resources. Nonetheless, to ensure a reliable system, NorthWestern must identify the amount of generation capacity a resource is likely to provide during peak load conditions. With thermal or dispatchable resources, the amount of dependable capacity is roughly equivalent to the nameplate capacity of the resource less its anticipated outage rate. In the case of variable energy resources like wind and solar, the capacity that can reasonably be expected is a function of the correlation between the wind or solar and load conditions. Measuring this for planning purposes requires a more complex assessment method to understand how much NorthWestern and SPP can rely upon that resource to meet peak capacity needs.

Figure 16 shows the accredited capacity of NorthWestern's resources. Thermal resources provide over 93% of the dependable capacity for NorthWestern's customers. While wind has its own place in electricity service, it is important to notice that of the total 164.5 MW of wind on NorthWestern's system, only 22.7 MW can be counted on during peak times.

FIGURE 16 EXISTING ACCREDITED CAPACITY BY FUEL TYPE, 2019



4.2.1. Capacity from of Variable Energy Resources

NorthWestern follows the SPP's methods for determining the capacity contributed by variable energy resources (VERs). Under the SPP's current Planning Criteria, the contribution of a VER towards a utility's capacity requirement is determined by a Net Planning Capability (NPC) calculation.[11] This calculation is based on the hourly generation from the actual operation of a generation facility during the previous 3-10 years.[12] The accredited capacity of the VER is measured as the generation that the facility has provided in at least 60 percent of the peak load hours (i.e., the 60th percentile of generation). Peak load hours are defined as those containing the top 3 percent of loads during the peak load month of each year.

Under this method, NorthWestern's existing fleet of wind resources, which have a nameplate capacity of 164.5 MW, are capable of providing 22.6 MW of capacity.

TABLE 11 VARIABLE ENERGY RESOURCES FACILITY SIZE AND CAPACITY CONTRIBUTION

	Nameplate Capacity (MW)	Capacity Contribution (MW)	Capacity Contribution (% Nameplate Capacity)
Aurora	20.0	1.0	5.0[a]
Beethoven	80.0	15.2	19.0
Brule	20.0	1.0	5.0[a]
Oak Tree	19.5	2.5	12.6
Titan	25.0	3.0	12.0

Note: a) Resources with less than 3 years of operational data are assigned the SPP's default capacity contribution of 5%.

The SPP's NPC method considers generator-level information only and does not account for the total amount of renewable generation on the system or the correlations between renewable generators. The continued growth of wind and solar generation in the SPP has raised concerns since the NPC does not incorporate this information and has led SPP to look for a methodology that accounts for the level of renewable generation, and the correlation among this generation, when assessing the capacity contributions from renewable resources. The SPP has announced plans to switch to Effective Load Carrying Capacity (ELCC) as the recommended method of establishing the capacity credit

11 This method is described in the SPP Planning Criteria Revision 2.1, published in February 2020 and available at https://www.spp.org/documents/58638/spp%20effective%20planning%20criteria_v2.2_0316020.pdf

12 For periods of less than three years, SPP assigns a fixed capacity value until more generation history is established.

for wind, solar, and storage resources.[13] SPP is expecting to move from the current wind and solar accreditation methodology to an ELCC methodology beginning the summer of 2023. Until this time, NorthWestern will continue to use the SPP's NPC capacity accreditation for VER resources.

4.2.2. Capacity from Thermal Resources

SPP evaluates the capacity of thermal resources using the results of operational testing. The LRE is responsible for conducting operational testing on thermal units. The operational testing period is for a minimum of 1 hour during peak load conditions, and the facility must meet 90% of its previous testing value. It is NorthWestern's practice to test its thermal generation one time per year during the summer.

4.3. Current Resource Portfolio

4.3.1. Wind

NorthWestern owns the 80-MW Beethoven wind farm and also receives wind energy through four power purchase agreements (PPAs) for wind power in South Dakota.

TABLE 12 SUMMARY OF SOUTH DAKOTA PPAS

Facility Name	Owner	Size (MW)	COD	Termination Date	Capacity Contribution	Annual Production (MWh)
Titan	Titan Rolling Thunder Power Partners 1	25	2010	2028	12.00%	81,245
Oak Tree Energy*	ConEdison Clean Energy ("CED")	19.5	2015	2038	12.60%	69,912
Aurora *	CED	20	2018	2038	SPP 5%	62,596
Brule *	CED	20	2018	2038	SPP 5%	111,406
* PURPA Qualifying Facility						
Owned Resources						
Beethoven	NorthWestern Energy	80	2015	N/A	19.00%	283,878

NorthWestern's 80-MW Beethoven wind farm generates an average of 303 GWh annually and contributes 15.2 MW of planning capacity. Beethoven is located near Tripp, SD and consists of 43, 1.8 MW GE turbines that are maintained under a full-service agreement with General Electric.

13 The ELCC of a resource is quantified by calculating the expected loss of load (LOLE), in MW's, for a system 1) in a benchmark state, and 2) with the addition of the resource. The difference in LOLE, is then found by subtracting LOLE of (1) from (2), and dividing by the total capacity of that type of resource (wind/solar/battery) on the system to the produce a percentage of the resources nameplate capacity for which it will be credited. The ELCC methodology as used for wind and solar is described in a white paper by SPP staff published in August 2019 (https://www.spp.org/documents/61025/elcc%20solar%20and%20wind%20accreditation.pdf), and for battery storage and paired solar + battery resources in a commissioned report published in November 2019 (https://spp.org/documents/61387/astrape%20spp%20energy%20storage%20study%20report.pdf).

The Aberdeen Peaking Plant helps us respond to changing load conditions.

4.3.2. Natural Gas and Diesel Peaking Units

A peaking unit is one that can respond to changing load conditions quickly by ramping up or ramping down generation. NorthWestern's peaking units consist of nine reciprocating internal combustion engine ("RICE") units and two simple cycle combustion turbine ("CT") units. They have a combined summer peaking capacity of 93.7MW. The age of these units ranges from 51 years old to 1 year old, with several more than 40 years old. The smaller RICE peaking units (Clark, Faulkton, Yankton, Mobile B, and Mobile C) use diesel fuel or are dual-fueled with natural gas and diesel fuel.

TABLE 13 ABERDEEN GENERATING STATION

Aberdeen Generating Station		AGS1	AGS2
Type	-	CTG	CTG
Make	-	GE	Pratt & Whitney
Model	-	MW5001	FT8-3
COD	Year	1978	2013
Fuel	-	Fuel Oil	Dual Fuel
Capacity (Nameplate)	MW	28.8	82.2
Heat Rate	BTU/kWh - HHV	13,560	10,000

The generation at Aberdeen is critical because it is utilized to manage voltage regulation and maintain frequency on the transmission system.

Aberdeen Generating Station Unit 1

AGS1 is a 28.8 MW diesel oil-fueled CT that is restricted in its capabilities because of its age. It has the lowest historical availability in NorthWestern's fleet and one of the highest heat rates. Because of the age of the machine and limited support from the original equipment manufacturer (OEM), replacement parts often have to be reverse-engineered and custom-manufactured, and NorthWestern is concerned about growing challenges with obtaining replacement parts. While NorthWestern bids AGS1 into the SPP market, it is rarely called on for economic dispatch. AGS1 is typically only operated for testing or in emergencies and has further reduced operation since AGS2 came online in 2013.

AGS1 is thus a prime candidate for retirement. However, if AGS1 were retired, replacement capacity would likely be required on a MW-for-MW basis to support voltage regulation in the immediate vicinity. Pending further review, this could be an opportunity for NorthWestern to investigate storage technologies given their suitability for supporting voltage on the electric grid (e.g., fast start times). A storage installation option would likely require additional land at the site.

Aberdeen Generating Station Unit 2

Since AGS2 was placed into service, most of the operating hours for the dual fuel unit have been on natural gas fuel, with only a single gas curtailment event occurred that required operation on diesel. Recent studies completed by NorthWestern show that the installation of a demineralized water treatment plant on site could improve the AGS2 cost of generation by up to approximately $5/MWh, given the high cost of producing demineralized water via the current rental trailer systems. However, further investigation and study would be required to confirm this. Additionally, AGS2 has had some challenges with freeze protection systems and has had to make temporary improvements to keep the units available.

AGS2 is a relatively new 82.2 MW combustion turbine. However, the emissions permits for the Aberdeen location are based on both units and AGS2 therefore faces constraints as a result of the emissions from AGS1.

Based upon the vintage of the unit, historical reliability, and relatively low cost to generate power, AGS2 would not be suitable for retirement at this time. However, there are opportunities to optimize operating capability and cost-effectiveness going forward (e.g., addition of an on-site water treatment facility, removal of air operating permit dispatch limitations, etc.) that could increase its economic dispatch in both the energy and ancillary services markets.

AGS2 has an annual dispatch limitation given that all assets on the site are considered in the air permitting process. The air permit for AGS2 is based on the unit heat input and a rolling number of unit starts and stops for each 12-month period. Ideally, NorthWestern would not have any dispatch limitations on AGS2 given that it is currently the most cost-effective thermal unit in the South Dakota fleet. NorthWestern filed to extend its permit on AGS1 as a part of normal operations and has recently filed for increased dispatch of AGS2. Increased starts will better allow NorthWestern to optimize its operations at Aberdeen.

Huron Generating Station

There was a fire at HGS in January 2019 that resulted in a total loss of 43 MW Huron 2 Generating Station. The 17.6 MW Huron Unit 1 is still in place and will remain in place and ready to use until the new Huron unit is operational. Huron 1 was due for replacement as it is the oldest unit in the portfolio. As discussed elsewhere in this plan, this event accelerated the decision to add a 60 MW RICE as replacement generation at HGS. This new unit will be operational at the end of 2021, and will provide 60 MW of fast-response generation from 6 inline RICE units. The evaluation process that led to the selection of this resource is described in detail in Chapter 5.

Yankton Generating Station

The Yankton Generating Station ("YGS") has four reciprocating internal combustion engine ("RICE") units totaling 13.6 MW. This 13.6 MW includes YGS3, a 6.5 MW unit, that is not operational. Because of its age, it is rarely called on and it is not bid into the SPP market, thought it does contribute towards NorthWestern's accredited capacity as required by SPP's PRM requirements. YGS receives natural gas from a radial tap off of the Northern Natural Gas ("NNG") system and the Yankton area has limited access to natural gas supply because of pipeline infrastructure constraints on the NNG system.

Based upon the age of the units, the cost to bring YGS Unit 3 back into reliable operation, and the cost to maintain and operate the units relative to the amount of generation they provide, YGS is a prime candidate for replacement. Additionally, the locational marginal pricing ("LMP") is higher at Yankton than the other LMPs in NorthWestern's service territory, which means that adding newer and more efficient generation at the Yankton location may offer considerable savings for NorthWestern's customers. The generation at Yankton is located in the town of Yankton, and if NorthWestern chose to replace generation at Yankton, this would require the development of a greenfield site to accommodate new generation.

TABLE 14 YANKTON GENERATING STATION

Yankton Generating Station		YGS1	YGS2	YGS3	YGS4
Type	-	RICE	RICE	RICE	RICE
Make	-	Fairbanks Morse Engine			
Model	-	38TD8-1/8	38TD8-1/8	PC2	38TD8-1/8
COD	Year	1974	1974	1975	1963
Fuel	-	Dual Fuel	Fuel Oil	Dual Fuel	Fuel Oil
Capacity (Nameplate)	MW	2.3	2.8	6.5	2
Heat Rate	BTU/kWh - HHV	11,100	11,600	10,800	9,400

The units at Aberdeen and Yankton have the following capital and O&M costs scheduled for the next five years. Due to the age of these units, these costs are relatively low but are always subject to change, because mechanical equipment can break or otherwise fail, leading to potential unanticipated expenses.

The Yankton Generating Station has four reciprocating internal combustion engine units totaling 13.6 MW.

TABLE 15 CAPITAL COSTS

Capital ($1000)	2020	2021	2022	2023	2024
Aberdeen #1	$ -	$ 120	$ 105	$ -	$ -
Huron #1	$ -	$ -	$ -	$ -	$ -
Yankton	$ -	$ -	$ 530	$ 600	$ 425

TABLE 16 O&M COSTS

O&M ($1000)	2020	2021	2022	2023	2024
Aberdeen #1	$ 97	$ 99	$ 101	$ 103	$ 105
Huron #1	$ 224	$ 228	$ -	$ -	$ -
Yankton	$ 61	$ 63	$ 64	$ 65	$ 66

Clark and Faulkton

The Clark and Faulkton units are small 2.8 MW Fairbanks-Morse RICE units installed in 1970 and 1969 respectively. Initially, NorthWestern planned to retire these aging units when the mobile units were placed in service. However, due to the fire at Huron, Clark and Faulkton are still maintained in the portfolio. The units are fueled by diesel, used strictly for back-up service during transmission outages, and are not currently offered to the SPP market. Due to the age of the Clark and Faulkton engines, maintenance is becoming more difficult and costly. Replacement parts are not available and must be fabricated. In addition, there are only a few people available with the technical/mechanical knowledge to work on the engines and associated equipment.

Clark has been generally reliable with a historical availability in excess of 96%. However, a recent pump failure caused a month-long outage since a replacement pump could not be found and the old one had to be rebuilt. The building housing the engine is also in poor condition. If the Clark plant were to remain in-service on a long term basis, additional capital would have been required for upgrades and repairs.

4.3.3. Joint-Owned Coal Units

NorthWestern shares ownership of three jointly-owned coal-fired units (JOUs): Big Stone Unit 1 near Big Stone City, South Dakota; Coyote Station Unit 1 in Mercer County, North Dakota; and George Neal Generating Station Unit 4 near Sioux City, Iowa. Participation in JOUs requires that all parties coordinate decisions about the plant's operation and maintenance on an ongoing basis. This presents similar challenges to the overlapping transmission constraints discussed later in this Plan, as each party has different business objectives and operational planning constraints and goals.

TABLE 17 JOINT OWNED COAL UNITS

Joint-Owned Units		Big Stone	Coyote	Neal 4
Type	-	Cyclone	Cyclone	Pulverized
COD	Year	1975	1981	1979
Fuel	-	Coal	Coal	Coal
Capacity (Nameplate)	MW	474.0	427.0	644.0
Heat Rate	Btu/kWh - HHV	10,739	11,077	9,949
NorthWestern Ownership (SPP)	MW	111.0	42.7	56.0
	%	23.4%	10.0%	8.7%
Other Party Ownership (Organized Market)	%	Otter Tail Power 53.9% (MISO)	Otter Tail Power 35% (MISO)	MidAmerican Energy 36.6% (MISO)
	%	Montana-Dakota Utilities Co 22.7% (MISO)	Northern Municipal Power Agency 30% (MISO)	Interstate Power and Light 25.7% (MISO)
	%		Montana-Dakota Utilities Co 25% (MISO)	Corn Belt Power Co-op 8.7% (MISO)
	%			Other Fractional Owners (12), < 5 %

Coyote Station

Coyote Station ("Coyote"), located near Beulah, North Dakota, began commercial operations in 1981. NorthWestern is one of four joint owners of the plant and the only owner who is in the SPP (the remaining owners operate in MISO). Coyote is a coal-fired, cyclone burner, dry-scrubbed baseload plant with a total plant rating of 427 MW. NorthWestern's ownership share of Coyote is 10% or 42.7 MW. The fuel source is North Dakota lignite from an adjacent coal mine that is owned by North American Coal Company. NorthWestern is subject to a long-term coal supply contract for the Coyote facility, which carries significant penalties for early termination.

Coyote is subject to Federal EPA Regional Haze requirements (discussed in Chapter 9), which are implemented by North Dakota's Department of Environmental Quality (DEQ). The Regional Haze requirements were enacted to regulate emissions affecting visibility nationwide. Round one required a joint investment of $22M in air quality controls at the plant to meet the first set of regional haze compliance requirements around 2013. Round two is underway and will likely require additional improvements in plant emissions.

It is expected the final approved State Implementation Plan (SIP) will require capital investments at Coyote by 2028 to reduce emissions that effect visibility. There are several possible investments identified by the owners of Coyote Station to achieve reductions, and these will have associated capital costs and ongoing O&M costs.

Compared to other coal units in North Dakota, Coyote is an outlier in its high sulfur dioxide (SO_2) emissions. A Four Factor Analysis was performed to identify technically feasible control options to reduce emissions. The table below represents the range of emissions controls that were identified under the Four Factor Analysis to address Regional Haze, as well as their associated costs, including our anticipated share of those costs.

NorthWestern Energy owns a 10% share of the Coyote Generating Station or 42.7 MW.

TABLE 18 EMISSIONS CONTROLS FOR REGIONAL HAZE REGULATIONS

	Emissions Improvements (Tons/Year Removed)	Capital (Total $M)	NorthWestern's Estimated Share ($M)	Annual O&M ($M)	NorthWestern's Estimated Share ($M)
Sulfur Dioxide (SO_2)					
Operational Improvements	5,354	$ 0.5	$ 0.1	$ 2.0	$ 0.2
Dry Sorbent Injection + Operational Improvements	7,952	$ 24.3	$ 2.4	$ 12.7	$ 1.3
Scrubber Update + New Absorber	8,563	$ 127.8	$ 12.8	$ 6.3	$ 0.6
New Dry Scrubber	11,619	$ 242.6	$ 24.3	$ 20.6	$ 2.1
New Wet Scrubber	12,078	$ 324.7	$ 32.5	$ 22.5	$ 2.3
Nitrogen Oxide (NO_x)					
Selective Non-Catalytic Reduction (SCNR)	2,847	$ 19.8	$ 2.0	$ 3.1	$ 0.3
SCNR + Rich Reagent Injection	4,137	$ 56.9	$ 5.7	$ 8.0	$ 0.8

The DEQ is currently working on its draft State Implementation Plan ("SIP") and anticipates submitting the SIP to the EPA by 2021. The EPA is expected to take up to 18 months to respond to the SIP submission before issuing a final decision regarding the level of reductions in emission that it will require. The owners of Coyote are discussing potential options regarding potential compliance requirements. Until an EPA-approved North Dakota SIP is in place and it is known what level of investment may be required to meet new emissions requirements for Coyote, the Joint Owners will not know what level of investment may be required. Once it is known, however, the Owners will have to make a decision about the future of Coyote, which could include investing in the additional emissions controls and continuing to operate the plant, or retiring the facility. While we will participate in the decision-making process, NorthWestern will ultimately have to follow the decision of the other Joint Owners. We cannot take on the entire 500 MW plant as Coyote is too large a facility for our customers' average load, and the total compliance costs would place too great a cost burden on our customers.

There are a range of compliance scenarios with varying associated costs. The Joint Owners do not know what emissions levels will be required by the SIP for Coyote Station, so we have chosen to model the most extreme compliance scenario to understand the fullest potential impact in this round of regional haze requirements.

In Chapter 8, we model the strictest compliance cost scenario as well as the replacement of NorthWestern's share of Coyote's capacity.

Northwestern owns 23.4% of the Big Stone Plant, coal-fired, cyclone burner, non-scrubbed base load plant.

Big Stone Plant

Northwestern owns 23.4% of the Big Stone Plant ("Big Stone"), which is a 475 MW JOU operated by Otter Tail Power Company. NorthWestern is the only owner who is in the SPP (the others operate in MISO). Big Stone is a coal-fired, cyclone burner, non-scrubbed base load plant that was placed in service in 1975. The fuel source is Powder River Basin sub-bituminous coal delivered by Burlington Northern Santa Fe Railway Company.

NorthWestern's current contractual commitment for the Big Stone facility requires a 5-year notice prior to termination. In addition to the partial ownership of Unit 1, NorthWestern owns approximately 300 kW of diesel RICE capacity from the station.

Neal Energy Center Unit 4

Neal Energy Center Unit 4 ("Neal 4") is a 646 MW pulverized sub-bituminous coal, non-scrubbed base load plant located near Sioux City, Iowa. It is a JOU among 14 power suppliers and was placed in service in 1979. NorthWestern is the only owner of a significant plant share who is in the SPP (all other major owners operate in MISO). MidAmerican Energy Company is the principal owner and operating agent for the plant. The fuel source for Neal 4 is Powder River Basin sub-bituminous coal delivered by the Union Pacific Railroad.

The JOU agreement for Neal Unit 4 is effective through 2014 "or so long after as Unit 4 shall be used or useful for the generation of electric power." NorthWestern currently experiences some challenges with the Neal 4 unit given that it is being dispatched on the Midcontinent Independent System Operator (MISO) system economics.

NorthWestern has had concerns in the past with the operating decisions made by the majority plant owner, MidAmerican. MidAmerican has been dispatching the plant based on the majority of the ownership participating in the MISO Market rather than follow the fundamental principle of the Operating Agreement giving the owners the right to call upon generation up to ownership share. NorthWestern has attempted to resolve these issues through discussions with Mid-American. If the issues remain unaddressed, NorthWestern will continue to pursue their resolution, which may require arbitration.

4.4. Ancillary Services

Ancillary services are services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the transmission system in accordance with good utility practice. Generator characteristics that enable the provision of ancillary services such as shorter start-up times and faster plant ramp rates that allow the generator to respond to rapidly changing grid conditions. With increasing VER penetration on the grid, generating assets that are more responsive and have lower startup times and costs enjoy an advantage in the market. NorthWestern's existing South Dakota fleet is generally less competitive in these areas when compared to newer generation technologies, but the new Huron installation is expected to be highly responsive to SPP ancillary service needs.

4.5. Local Reliability

In general, NorthWestern's customer needs are met when SPP coordinates regional generation assets and dispatches those assets to economically serve load. However, disruptions can occur from equipment outages which are often caused by harsh weather conditions such as ice storms or tornadoes. It is critically important that NorthWestern avoid service disruptions, which can negatively impact our customers. This system reliability is managed at a local level of our system. NorthWestern has deployed mobile units to meet this distribution-level need. NorthWestern has also analyzed its ability to ride through a local outage on our system. The results of this analysis help inform future generation siting decisions.

Mobile Units

Following the 2018 Plan, NorthWestern added eight 1-MW diesel fired mobile reciprocating engine (RICE) units to its portfolio. These mobile units will provide system redundancy during transmission outages or during system maintenance. Each mobile trailer has two generators (.5 MW each). In addition to using the mobile generators to support system reliability events, NorthWestern will use the capacity from these mobile generators to meet the 12% PRM requirement in SPP. In the event that there is a reliability event in the area over the summer season (June 1st through September 30th), these generators can be called by SPP for load shedding purposes. As part of the PRM requirement, NorthWestern will need to have these generators interconnect at a point of interconnection ("POI"), ready to support any directive from SPP from June 1st through September 30th. NorthWestern has identified the Aberdeen Siebrecht Substation and the Yankton Northwest Substation as the two locations to store and interconnect these units starting June 1st. Per the SPP Business Practices, NorthWestern can only inject less than 5 MW at a POI to avoid needing to go through a SPP Generation Interconnection Study. To support this requirement, NorthWestern will only be interconnecting four generators at each of these two substations.

FIGURE 17 MOBILE UNITS

Riding Through a Transmission Outage

NorthWestern's service territory in South Dakota can experience severe winter weather that causes outages on the transmission system. During these outages, it can be impossible to import power from generating resources outside of NorthWestern's system. To assess the amount of generation capacity that may be needed to serve load in the event of a transmission outage during an extreme winter weather event, NorthWestern analyzed winter loads in three load center locations that may be suitable locations for adding new generation and are susceptible to transmission outages. To determine how much load each location likely needs to be served at any given point throughout the winter, NorthWestern calculated the distribution of historical loads after subtracting the load associated with large customers, which may be interrupted during emergency conditions to ensure reliable service for residential customers. The results provides a basis for considering the amount of capacity that would be required locally to ride-through a temporary transmission outage.

TABLE 19 DISTRIBUTION OF WINTER (NOV-MAR) LOAD (2015-2019)

	Minimum (MW)	Median (MW)	Maximum (MW)
Aberdeen	14.6	34.6	66.2
Yankton	6.2	26.8	51.7
Mitchell	17.4	30.4	48.7

NorthWestern Energy is currently building a 60 MW generating station in Huron.

5. REPLACING THE GENERATION LOST AT HURON

Highlights

- Following a fire that destroyed the Huron Generating Station, NorthWestern requested proposals for replacement generation and undertook a rigorous modeling process to evaluate the bids.
- After identifying the top bids for the short-list and engaging in final negotiations, NorthWestern selected a 60-MW RICE resource as the most cost-effective replacement. Construction of this resource is underway and commercial operation is expected by the end of 2021.

5.1. Before the Fire - 2018 Fleet Assessment

NorthWestern's generation fleet in South Dakota includes several aging units. NorthWestern's 2018 SD IRP included an evaluation of scenarios for retiring and replacing the old generation at Aberdeen, Yankton, and Huron. The generation at these locations has reliability concerns and NorthWestern faces challenges with repairing or replacing critical components due to the age of the units. The generators at Aberdeen, Huron, and Yankton were the primary focus of the replacement scenarios because of their age and size, but NorthWestern also evaluated lower-priority replacements at Clark and Faulkton. The conclusion of this fleet assessment was that a "distributed retirement" scenario—replacing 20MW at each of the three locations—was the preferred approach.

5.2. Events following the 2018 Plan – Fire at Huron

In January 2019, there was a fire at the Huron generating station that destroyed Huron Unit 2 (43 MW). This required NorthWestern to respond quickly to begin the process of replacing the lost generation. NorthWestern engaged Aion and HDR as the third-party administrator of the RFP. Following the Huron fire, NorthWestern developed and released a Request for Proposal (RFP) in April 2019 to select a replacement resource for the capacity lost at Huron. The RFP was not prescriptive in its resource location; Huron was identified as a preferred location, but was not the only acceptable location. The safety records of its bidders, along with their expertise and creditworthiness, were of significant importance to Northwestern in the selection process. The RFP requested bids ranging from 10 to 60 MW, though there was no explicit exclusion of larger projects. Bids were required to have an in-service date by the end of 2021 and the location preference was South Dakota. The RFP sought flexible, dispatchable capacity.

The types of bids solicited under the RFP included:

power purchase agreements (“PPA”), with a term of 20 years

Asset sales where the asset has a remaining useful life of at least 20 years

build transfer(“B-T”) agreements for construction-ready or projects otherwise fully designed and under construction;

demand response (“DR”) or demand side management (“DSM”) programs, and other alternative transaction structures

Engineer Procure Construct (EPC) bids for new generation at the Huron site

The RFP bids were evaluated in three stages:

NorthWestern received 40 unique proposals from 10 bidders.

Resource Preferences

The RFP gave preference to bids that demonstrated the following characteristics:

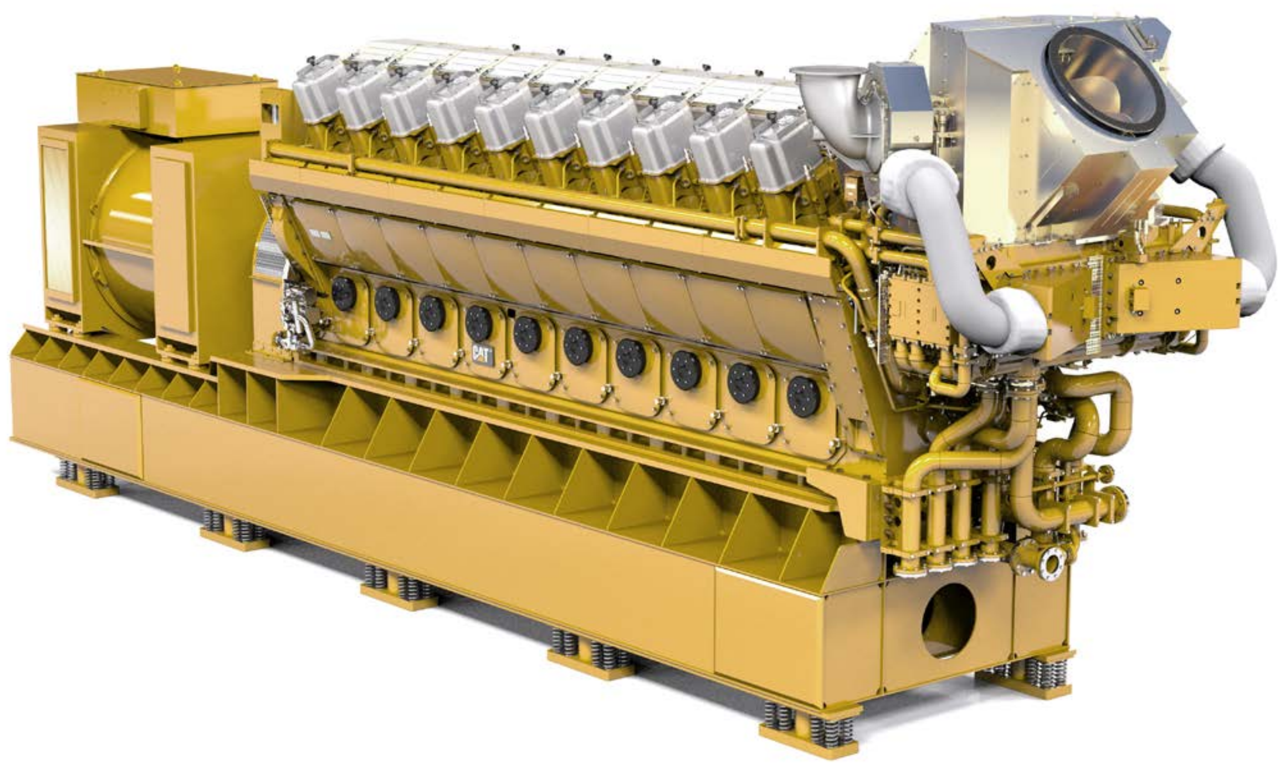
Complete Site Control

Generator Interconnect Agreement

Dispatch and Capacity accreditation using SPP methodology

Ability for the resource to meet some or all of a 24 hour ride through

FIGURE 18 CATERPILLAR RICE UNIT



Resource Selection

The most cost-effective bid that NorthWestern received in the 2019 RFP was a 60-MW natural gas fired Caterpillar RICE unit with a Selective Catalytic Reduction (SCR) post flue treatment. The SCR will allow for significant emissions reductions compared to the prior Huron 2 unit. Capital costs are approximately $80 million. This project will use the existing transmission interconnection with SPP, and will thus avoid a lengthy the interconnection process.

The project is scheduled to be online by the end of 2021.

NorthWestern owns 1,273 miles of transmission lines that play a vital role in moving the energy generated from our resources to our South Dakota customers.

6. NORTHWESTERN'S TRANSMISSION SYSTEM

Highlights

- NorthWestern has made recent infrastructure improvements on our Transmission system, but there are several locations on the transmission system with critical generation assets.

6.1. Introduction

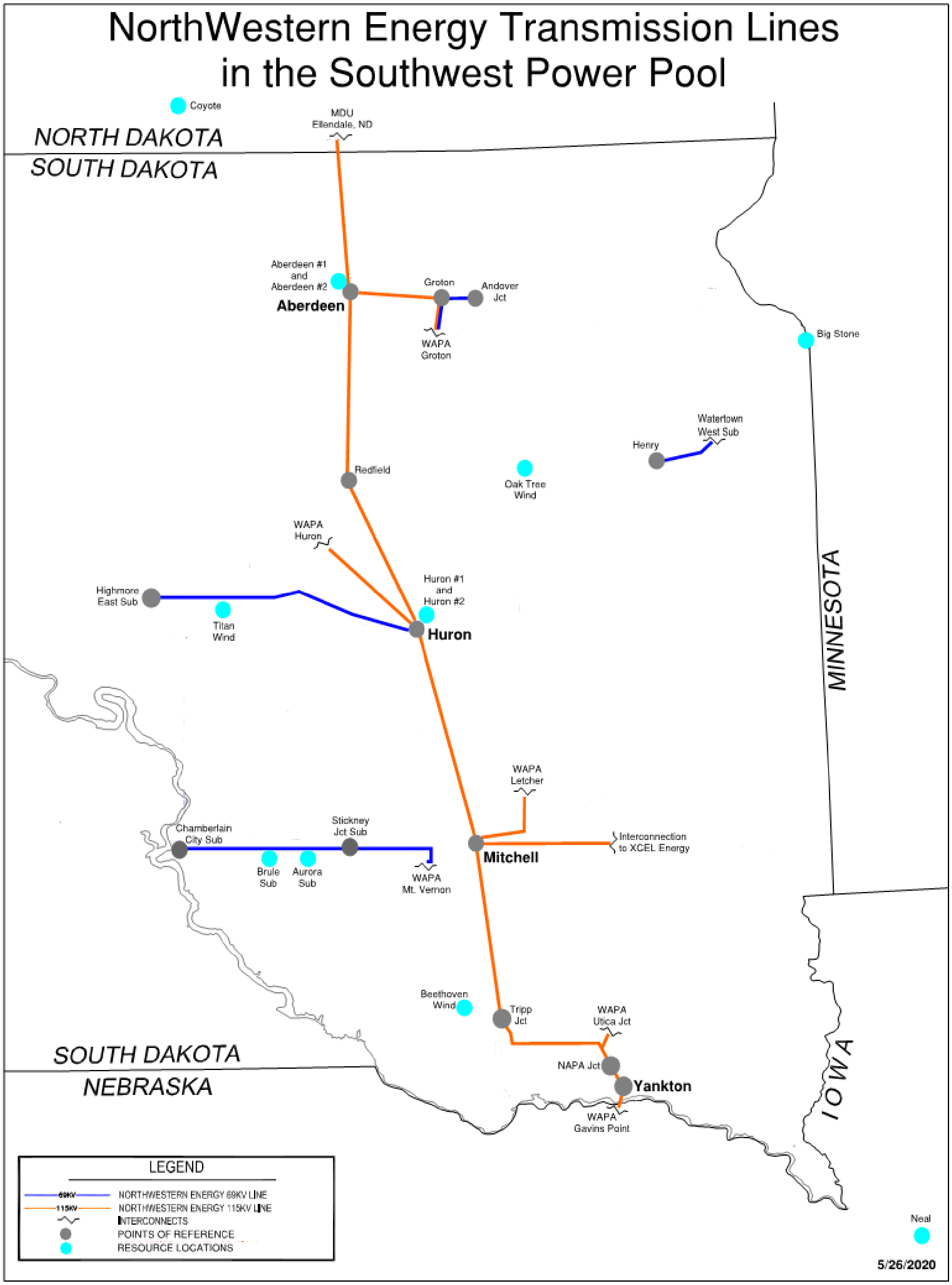
NorthWestern owns 1,273 miles of transmission facilities that play a vital role in moving the energy generated from our resources to our South Dakota customers. The backbone of our South Dakota system operates at 115 kV and runs from Ellendale, ND to Yankton, SD (north to south), on the east side of the state. These owned facilities, along with a number of transmission agreements, form a reliable transmission network to serve the energy needs of our 63,800 South Dakota electric customers.

TABLE 20 NORTHWESTERN ELECTRIC TRANSMISSION & DISTRIBUTION SYSTEM

Transmission System	
345 kV	25 miles
230 kV	18 miles
115 kV and lower	347 miles
69 kV and lower	847 miles
Total	**1,273 miles**
Distribution System	
Overhead	1,633 miles
Underground	659 miles
Total	**2,292 miles**
Total Substations	**128**

In South Dakota, NorthWestern is both a transmission customer and transmission-owning member of the SPP, located in Zone 19, a.k.a. the Upper Missouri Zone ("UMZ"). NorthWestern transferred functional control of its South Dakota electric transmission facilities to SPP on October 1, 2015, and updates the qualifying facilities under the SPP Tariff annually. As of April 1, 2020 over 95% of the South Dakota 115 kV line miles, and 62% of the 69 kV line miles, are under the SPP Tariff.

FIGURE 19 MAP OF SOUTH DAKOTA TRANSMISSION SYSTEM



While not a member of the Midcontinent Independent System Operator ("MISO"), NorthWestern does have transmission facilities located within the MISO footprint. Our ownership of these 230 kV and 345 kV generator lead lines out of Big Stone, Coyote and Neal, are part of transmission agreements that have been grandfathered in under the MISO Tariff, allowing the generation from these plants to be moved across the MISO footprint and onto the SPP network.

Interconnections with neighboring systems also play a vital role in the resilient South Dakota transmission system. NorthWestern has transmission agreements with WAPA, Montana-Dakota Utilities, Otter Tail Power, MidAmerican Energy, Xcel Energy's Northern States Power system, East River Electric Coop, Watertown Municipal Utilities and West Central Electric Coop. These agreements each provide different levels of service to benefit our South Dakota customers.

6.2. Areas of Concern

While the ‘backbone’ 115 kV system in South Dakota has proven to be a very efficient and reliable design for NorthWestern and our customers, we have identified potential vulnerabilities at the north and south ends of the system. In Yankton, on the south end, there are concerns about the long-term reliability of the transmission system because a significant portion of the Yankton load is served by a radial 115 kV line. Similar concerns have been identified on the north end, near Aberdeen.

Yankton

In the City of Yankton, a radial 115 kV line serves approximately 44% of the City’s load under system normal operating conditions. In the event that this radial 115 kV line is lost, the City’s 34.5 kV system becomes extremely stressed when trying to serve all load on the lower voltage system. During heavy loading seasons, load shedding to the east side of Yankton becomes a very real possibility if the radial 115 kV line is lost. NorthWestern is considering a few different solutions to address Yankton’s reliability need. One potential solution is the addition of localized generation on the east side of Yankton, while the second potential solution being a new interconnection to a WAPA 230 kV transmission line in close proximity to our Yankton East facility. Either of these potential solutions would solve this need on the south end of our transmission system.

Aberdeen

The City of Aberdeen has needs similar to Yankton, where certain transmission outage conditions have the potential to cause low voltage issues on the system. The reliability needs in Aberdeen were partially addressed in 2019 when NorthWestern constructed a section of new 115 kV line, which closed a loop of two existing radial 115 kV lines. One potential solution to the needs that remain in the area would be to install additional generation at our existing Aberdeen facilities. Additional generation, along with other potential solutions, will continue to be analyzed in the years ahead.

As previously mentioned, below is an excerpt from NorthWestern’s South Dakota Ten-Year Energy Facility Plan, outlining the investments the company is currently making to the transmission system in Aberdeen.

ARSD 20:10:21:07 Proposed Transmission Facilities (Electric)

NorthWestern plans to construct a 3.3-mile 115-kV transmission line in Aberdeen, South Dakota, in 2019, referred to as the Aberdeen Loop project. The construction of this line will create a closed loop of two existing radial 115-kV lines, and will solve local reliability needs in the Aberdeen area.

The second phase of this project, scheduled for construction in 2020, will be a rebuild of NorthWestern’s current A-Tap switchyard, located on the west side of Aberdeen. This construction will include new substation structures, breakers, and relay equipment to coordinate the looped 115-kV facility. The combined estimated cost of the two projects is approximately $10 million.

6.3. Long Term Transmission Plan

NorthWestern has been coordinating and planning with other systems in South Dakota since 1950, resulting in interconnections, interchange contracts, and the joint construction of facilities. This joint planning effort with neighboring utilities continues today, as NorthWestern is an active participant in the UMZ Coordination Group (“UMZCG”), which comprises entities with load and transmission facilities registered under SPP’s Zone 19.

Prior to SPP’s April 1, 2020 deadline, the UMZCG submitted local planning criteria for all of Zone 19, which will be used by SPP for all members of Zone 19 in SPP’s Integrated Transmission Planning (“ITP”) process for the 2021 planning year. The UMZCG worked together for more than 12 months developing the local planning criteria, and will now realize the benefits of all SPP qualifying transmission within the zone being studied under the same planning criteria.

NorthWestern Energy has 128 substations to reliably serve our 63,800 South Dakota electric customers.

NorthWestern also actively participates annually in SPP's regional ITP process, which analyzes reliability, economic, and policy needs within the region and along the seams of neighboring Regional Transmission Organizations ("RTO"). If the ITP process identifies transmission needs on any SPP Tariff facilities owned by NorthWestern, the RTO will work with NorthWestern on the best solution and issue NorthWestern a Notice To Construct ("NTC") the approved facilities. All new facilities constructed to address needs on Tariff facilities are eligible for zonal and/or regional cost allocation under the SPP Tariff.

Along with the previously mentioned regional and zonal planning processes, NorthWestern's Transmission Planning group has also recently developed an internal planning process as another layer of planning on the South Dakota system. Study work performed under this process establishes a South Dakota Local Area Plan ("SDLAP"), which like SPP's ITP process, is meant to identify the system needs and potential solutions from both reliability and economic perspectives. Once the study work is conducted and system needs are identified, the next step of the process involves gathering ideas of potential solutions from internal stakeholders. Ultimately in the end, the accepted solutions feed into NorthWestern's 5-year capital budget and build the long-range plan for the system. With the regional planning process tailored more towards SPP Tariff facilities and regional needs, the addition of this internal process provides assurances that local needs also get identified.

Through the local planning efforts, NorthWestern has been able to address the immediate near-term transmission issues by recently completing construction on transmission projects and by also placing new mobile generation units strategically throughout vulnerable areas on the South Dakota system. The multi-layered planning approach currently in place at NorthWestern provides a very valuable understanding of not only how our system stands today, but also where we need to focus our transmission investments in the years ahead.

7. NEW RESOURCE OPTIONS

Highlights

- NorthWestern evaluated a range of potential new generation resources to replace the aging units at Aberdeen and Yankton
- When evaluating resources, there are inherent tradeoffs between resources whose generation can be controlled or dispatched, and resources whose output is driven by the weather and thus not under the utility's control but which have no fuel costs.
- Small modular nuclear reactors may be a viable option in the foreseeable future.

7.1. Replacement Resources

When NorthWestern retires the aging generation at Aberdeen and Yankton, Northwestern will need approximately 40 MW of new resources to maintain the resource adequacy of its portfolio. This section describes the characteristics of a range of generation technologies that might fulfill these replacement needs.

7.2. Characteristics and Capacity Contribution

The resource technologies and configurations discussed in this chapter were selected because they represent the likely technologies available to cost-effectively replace the capacity from the resource retirements that NorthWestern must make due to its aging fleet.

NorthWestern engaged Aion Energy, LLC to develop estimates of the cost of potential resources that NorthWestern has analyzed in this IRP, including the costs of operating and maintaining the generators. The cost estimates do not include the costs of interconnecting the resource to the grid, infrastructure needed to connect to a fuel source (for a gas fired asset), or costs of land. These costs are resource- and location-specific and are not considered in the analyses presented here. Instead, these costs would be evaluated as part of a resource-specific evaluation when more detailed information is available. The costs associated with the new resources are detailed in Table 21 below. A comparison of the fixed and variable resource costs per MWh are found in the figures 20 and 21 below.

TABLE 21 NEW RESOURCE COST ESTIMATES

2020 SD Plan	Description	2020 Generation Scale	Storage Scale	Storage Duration	Storage	EPC Cost	TPC	Fixed O&M	Fixed Hourly Fee	Start Fee	Variable O&M	Total Variable	Accredited Capacity
		MW	MW	hours	MWh	$/kW	$/kW	$/kW-yr	$/hour	$/start	$/MWh	$/MWh	MW
SC - Frame CT	25 MW CT	25	-	-	-	$ 1,735	$ 1,908	$ 27.50	$ -	$ 3,000	$ 0.12	$ 6.97	25
SC - Frame CT	50 MW CT	50	-	-	-	$ 1,399	$ 1,539	$ 16.92	$ -	$ 5,000	$ 0.12	$ 5.83	50
SC - Aero CT	25 MW CT	25	-	-	-	$ 1,795	$ 2,011	$ 26.93	$ 130	$ -	$ 0.55	$ 5.75	25
SC - Aero CT	50 MW CT	50	-	-	-	$ 1,269	$ 1,421	$ 16.75	$ 176	$ -	$ 0.38	$ 3.90	50
SC - RICE *	18.6 MW RICE	18.6	-	-	-	$ 1,745	$ 1,955	$ 31.16	$ 134	$ -	$ 2.56	$ 11.88	18.6
SC - RICE	25 MW RICE	25	-	-	-	$ 1,596	$ 1,788	$ 27.32	$ 208	$ -	$ 2.37	$ 10.67	25
SC - RICE	55 MW RICE	55	-	-	-	$ 1,311	$ 1,468	$ 19.98	$ 349	$ -	$ 2.00	$ 8.35	25
Wind	150 MW Wind	150	-	-	-	$ 1,314	$ 1,445	$ 33.72	$ -	$ -	$ -	$ -	7.5
Wind	300 MW Wind	300	-	-	-	$ 1,226	$ 1,348	$ 29.68	$ -	$ -	$ -	$ -	15
Wind *	400 MW Wind	400	-	-	-	$ 1,167	$ 1,283	$ 26.99	$ -	$ -	$ -	$ -	20
Solar	45 MW PV	45	-	-	-	$ 1,249	$ 1,374	$ 21.76	$ -	$ -	$ -	$ -	4.5
Solar	90 MW PV	90	-	-	-	$ 1,207	$ 1,327	$ 20.30	$ -	$ -	$ -	$ -	9
Solar *	200 MW PV	200	-	-	-	$ 1,104	$ 1,212	$ 16.73	$ -	$ -	$ -	$ -	20
BESS *	22 MW/4-hr BESS	-	22	4	88	$ 1,393	$ 1,462	$ 33.19	$ -	$ -	$ 8.00	$ 8.00	20
BESS	25 MW/4-hr BESS	-	25	4	100	$ 1,493	$ 1,567	$ 33.97	$ -	$ -	$ 8.00	$ 8.00	23.3
BESS	50 MW/4-hr BESS	-	50	4	200	$ 1,393	$ 1,462	$ 33.19	$ -	$ -	$ 8.00	$ 8.00	46.5
Wind + BESS *	30 MW Wind + 20 MW/4-hr BESS	30	20	4	80	$ 2,571	$ 2,829	$ 67.24	$ -	$ -	$ 8.00	$ 8.00	1.5 wind + 18.5 storage
Wind + BESS	35 MW Wind + 25 MW/4-hr BESS	35	25	4	100	$ 2,547	$ 2,802	$ 66.41	$ -	$ -	$ 8.00	$ 8.00	1.75 wind + 23.3 storage
Wind + BESS	70 MW Wind + 50 MW/4-hr BESS	70	50	4	200	$ 2,376	$ 2,614	$ 60.61	$ -	$ -	$ 8.00	$ 8.00	3.5 wind + 46.5 storage
Solar + BESS *	36 MW PV + 18 MW/4-hr BESS	36	18	4	72	$ 1,837	$ 2,021	$ 38.18	$ -	$ -	$ 8.00	$ 8.00	3.6 solar + 16.4 storage
Solar + BESS	30 MW PV + 15 MW/4-hr BESS	30	15	4	60	$ 1,854	$ 2,040	$ 38.56	$ -	$ -	$ 8.00	$ 8.00	3 solar + 14 storage
Solar + BESS	60 MW PV + 30 MW/4-hr BESS	60	30	4	120	$ 1,768	$ 1,944	$ 36.67	$ -	$ -	$ 8.00	$ 8.00	6 solar + 27.9 storage

* Denotes configuration used in portfolio modeling analysis.

FIGURE 20 NEW RESOURCE EPC COST COMPARISON

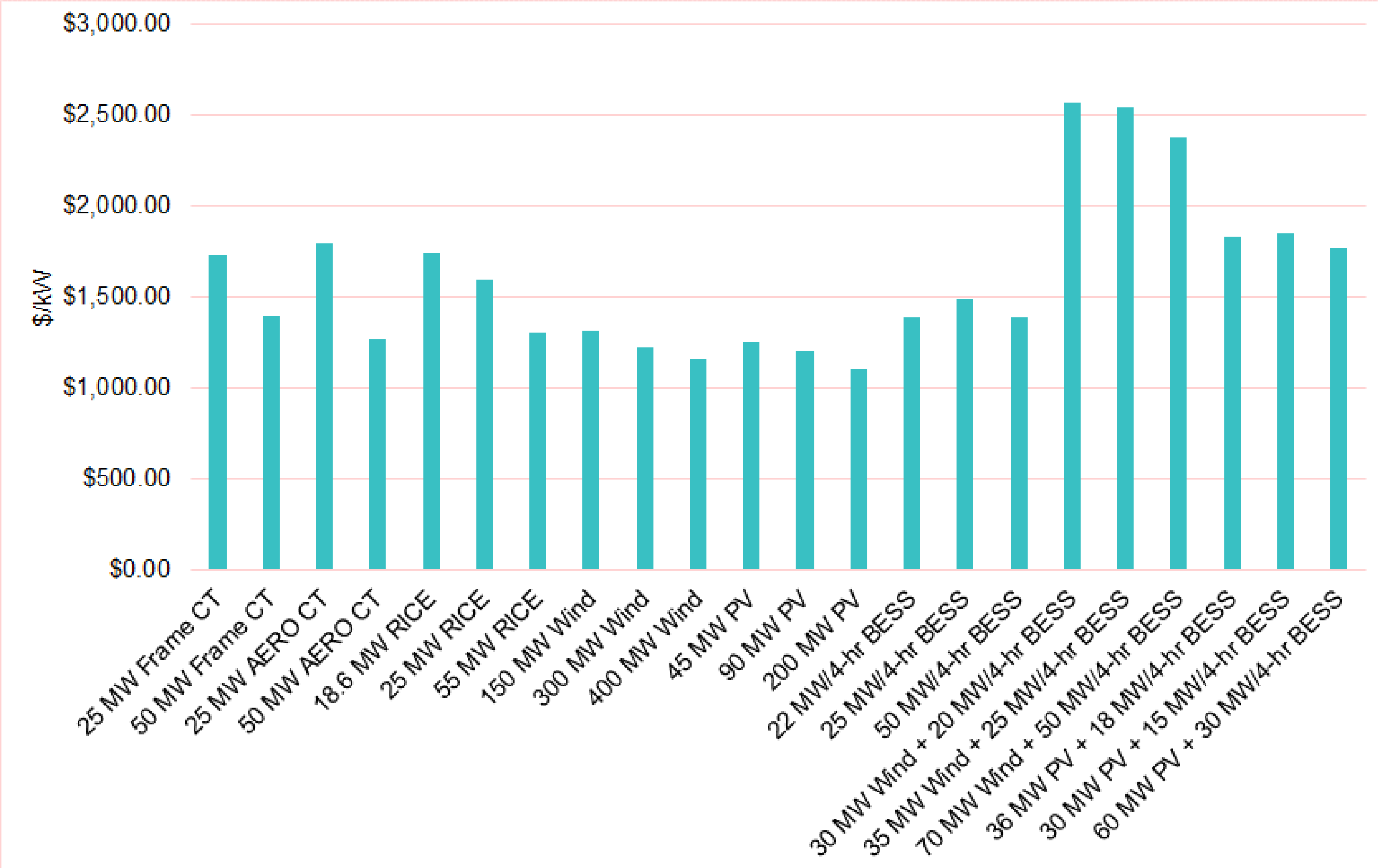
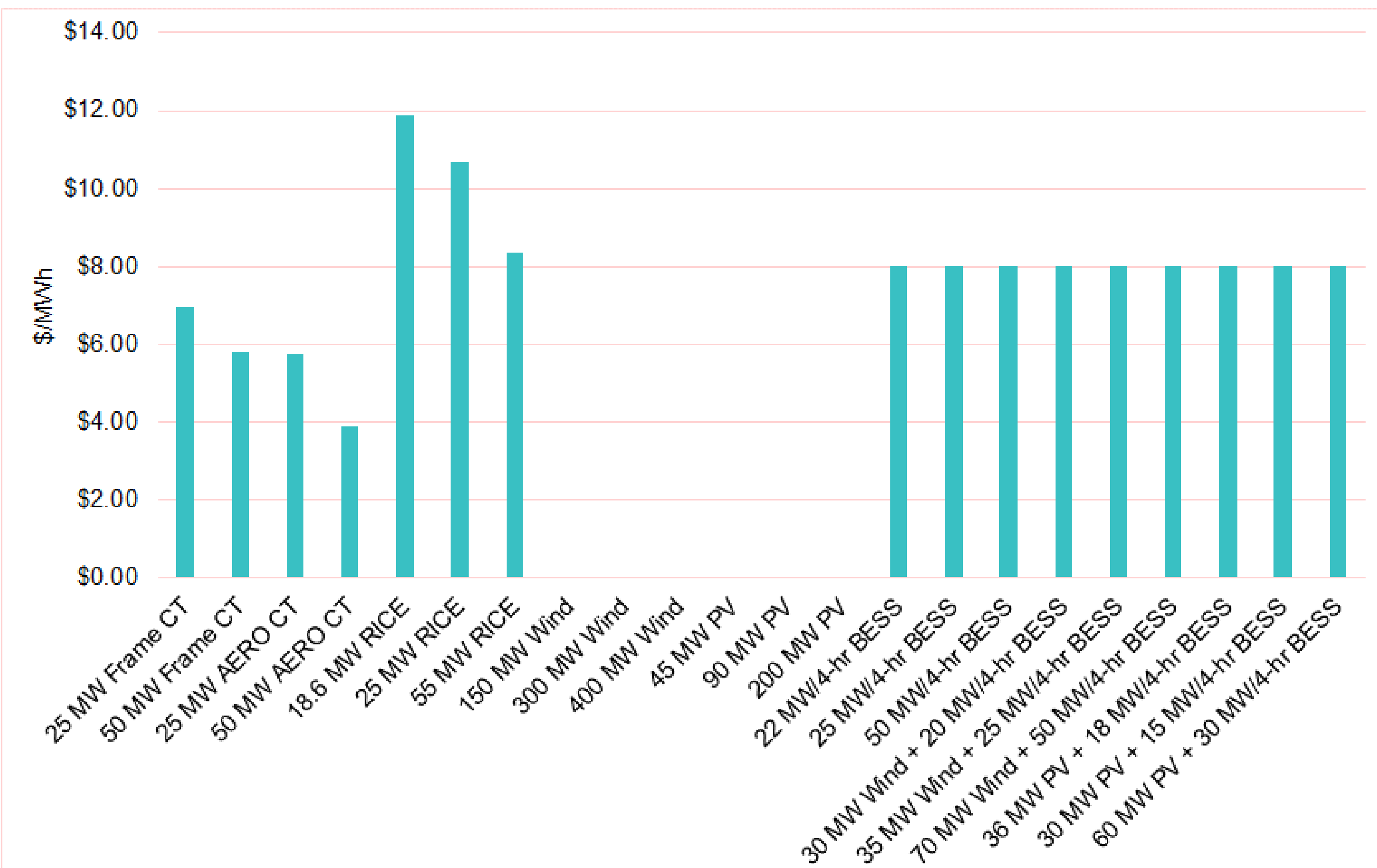


FIGURE 21 NEW RESOURCE VARIABLE COST COMPARISON



Crews work to rebuild a power line in Mitchell.

7.3. Dispatchable Resources

The 2020 plan considers four configurations of thermal resources. The most flexible of these is the simple cycle unit. A simple cycle is a single stage unit, meaning that it does not make use of the waste heat to generate power like a combined cycle unit does. Simple cycle CT plants are generally used as peaking plants during periods of high electric load or ancillary services demand due to their low capital cost, short construction schedule, rapid response (e.g. quick start capability), and ability to operate cost effectively at low capacity factors compared to other power generation alternatives. Dispatchable resources like RICE engines and batteries can provide ancillary services to the extent they can ramp up and ramp down in a 5-minute period.

The 2020 plan considers three types of SC units: Frame, Aeroderivative ("Aero") and Reciprocating Internal Combustion Engines ("RICE"). SC units can be fueled by a variety of fuels, but in this plan we focus on diesel or natural gas fired units. The configuration of each of the simple cycle units in this plan include an evaporative cooler (either air or fin –fan), and an SCR system/oxidation catalyst for emissions.

Simple Cycle (SC) Frame Combustion Turbine (CT)

This plan models a 25 MW and a 50 MW Frame CT plant. A frame unit is a more heavy- duty installation similar to a combined cycle, than compared with an aero unit. A frame unit typically produces a greater amount of thermal steam waste.

SC Aero CT

This plan models a 25 MW and a 50 MW Aero CT. When compared to industrial frame CTs of the same MW output, aero CTs are lighter weight, have a smaller size footprint, and are made of more advanced, lightweight materials, because the design is adopted from aerospace designs for use in power applications. Due to this, aeros can handle a greater number of starts and stops during their lifecycle. They also require a smaller footprint than other thermal options.

SC Reciprocal Internal Combustion Engine (RICE)

This plan models 25 MW and 50 MW SC RICE units. RICE units are internal combustion engines, and are larger version of an automobile engine. Similar to simple cycle CT plants, simple cycle RICE installations are used to supply peaking power and to operate in load following scenarios. RICE technology is favorable for peaking applications due to its wide range of operability and rapid response capability. Generally, in utility power generation applications, RICE technology is smaller in scale and has better efficiency as compared to simple cycle CT technology.

Battery Energy Storage Systems (BESS)

This plan models a 25 MW, 4-hr BESS and a 50 MW, 4-hr BESS. Utility-scale energy storage systems capacity are poised to continue to grow in the US.[14] BESS technology is useful in the following applications:

- meet normal demand
- help minimize peak demand
- smooth load variations due to renewables integration
- improve local grid resilience and availability
- Provide ancillary services.

BESS can be comprised of many technologies, but this plan models the most common, which is a 4-hour lithium-ion ("Li-ion") battery. Li-ion batteries utilize the exchange of lithium ions between electrodes to charge and discharge the battery. When the battery is in use (discharge) the charged electrons move from the anode to the cathode and in the process, energize the connected circuit. Electrons flow in the reverse direction during a charge cycle when energy is drawn from the grid. Li-ion batteries provide a high energy storage density which has resulted in adoption across the transportation, technology and power generation markets Due to its characteristics, Li-ion technology is well suited for fast-response applications like frequency regulation, frequency response, and short-term spinning reserve.

An important consideration of BESS is round trip energy efficiency, which is the amount of AC energy the system can deliver relative to the amount of AC energy used by the system during the preceding charge. Losses experienced in the charge/discharge cycle include those from the PCS (inverters), heating and ventilation, control system, and auxiliary systems. Li-ion technology experiences degradation both in terms of capacity and round-trip efficiency with time due to a variety of factors including number of full charge/discharge cycles and environmental exposure. Batteries are housed within shipping containers for protection against the elements. The containers house battery racks that hold individual battery cells. This allows for the replacement of individual components.

Small Modular Nuclear Reactor

There appears to be growing interest in using small modular nuclear reactors (SMRs) as sources of carbon-free reliable capacity. SMRs are effectively scaled-down, safer versions of a traditional nuclear plant. Each reactor module is comprised of a nuclear core and steam generator within a reactor vessel, which is enclosed within a containment vessel in a vertical orientation. The nuclear core is located at the base of the module with the steam generator located in the upper half of the module. Feed water enters and steam exits through the top of the vessel towards the steam turbine. The entire containment vessel sits within a water-filled pool that provides cooling and passive protection in a loss of power event.[15] https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf at page 212

The leading development of SMRs is by the Utah Associate Municipal Power Systems and NuScale Power, who are working in conjunction with the US Department of Energy to install twelve 60-MW SMRs on the Idaho National Laboratory Site in Idaho Falls sometime in the mid-2020s.[16]

This plan considers a nominal 600 MW installation of SMRs similar to the Idaho project mentioned above. NorthWestern has scaled the costs down to reflect an application closer in size to our likely resource needs.

FIGURE 22 EXAMPLE SMR[17]

NuScale Power Reactor Building

14 https://www.eia.gov/todayinenergy/detail.php?id=40072
15 https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf at page 212
16 https://www.energy.gov/ne/articles/nations-first-small-modular-reactor-plant-power-nuclear-research-idaho-national
17 Source: https://www.energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors

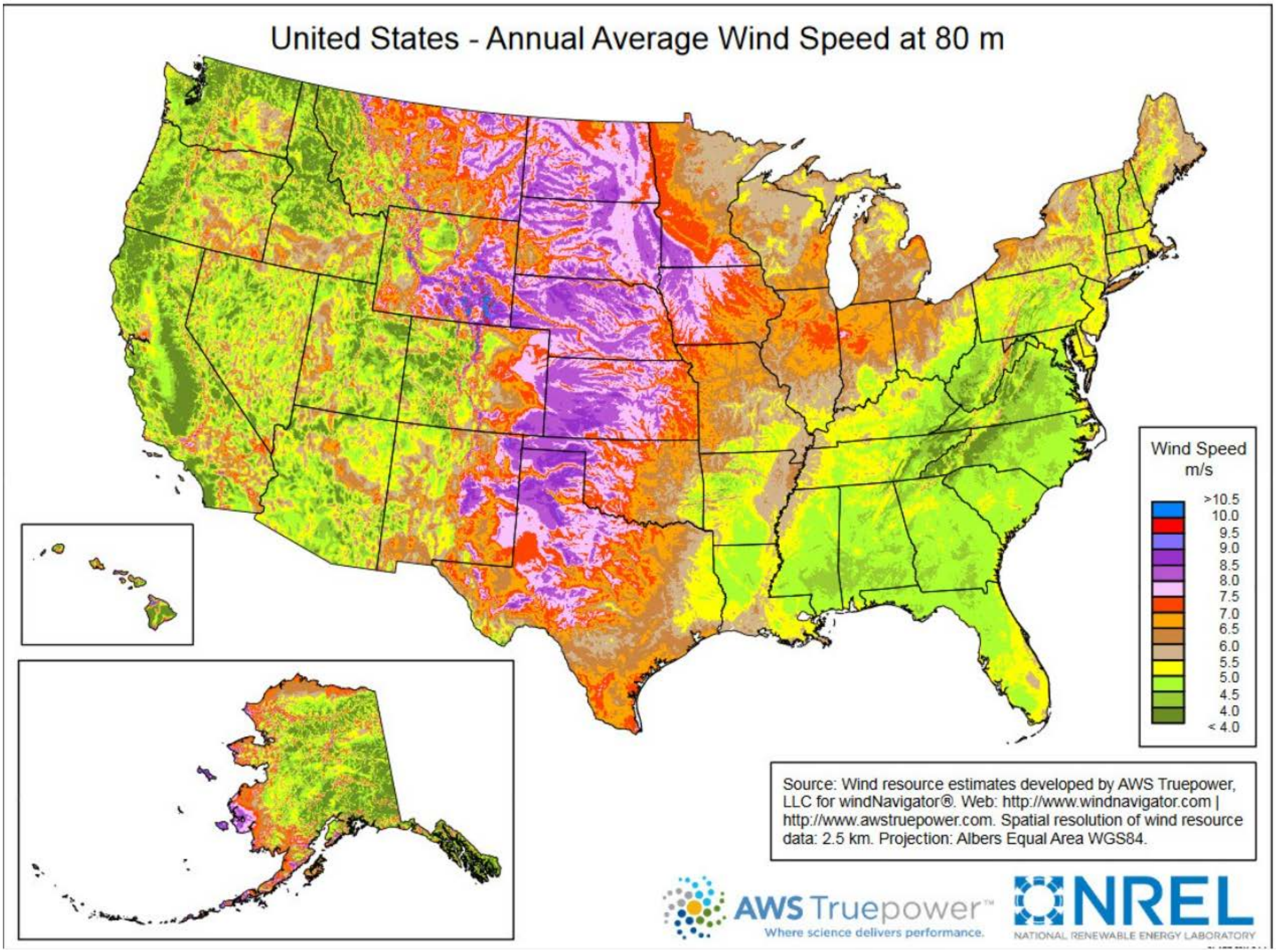
7.4. Weather-Driven Resource Technologies

Wind

This plan evaluates 150- and 300-MW wind projects to meet the equivalent 25- or 50-MW capacity need identified in this plan. This plan also considers a 35-MW wind plus 25-MW, 4-hour BESS, and a 70-MW wind plus 50-MW 4-hr BESS. These hybrid resources generate electricity using wind and stores the excess generation to be dispatched as needed to serve load or provide ancillary services.

As discussed in the chapter on SPP, installation of wind generation in the US has grown considerably in recent years and is expected to continue. Generally, the costs of building new wind resources are decreasing and the size of wind farms is increasing, even though production tax credits (PTCs) are expiring. The PTC period began for projects installed in 2016, and the benefit has reduced over time. The last effective year is 2020. Wind project construction must commence by December 31, 2020 to receive PTCs. Wind turbines can be designed for sizes between1.5 – 5 MWs. Capacity is based on blade length. Longer blades require a taller turbine installation. The wind availability in much of South Dakota is favorable.

FIGURE 23 ANNUAL AVERAGE WIND SPEED



Solar

This plan evaluates 45- and 90-MW solar photovoltaic (PV) installations to meet the equivalent 25- or 50-MW capacity need identified in this plan. Solar PV technology uses photovoltaic cell (“PV”) arrays to convert light from the sun directly into electricity. PV cells are made of different semiconductor materials and come in many sizes, shapes, and ratings. Solar cells produce direct current (“DC”) electricity and require a DC to alternating current (“AC”) converter to allow for grid connected installations. Solar PV arrays are mounted on structures that can either tilt the PV array at a fixed angle or incorporate tracking mechanisms that automatically move the panels to follow the sun across the sky. The fixed angle is determined by local latitude, orientation of the structure, and electrical load requirements. Tracking systems provide more energy production. Single-axis trackers are designed to track the sun from east to west and dual axis trackers allow for modules to remain pointed directly at the sun throughout the day.

This plan also considers a 30-MW solar PV plus 25-MW, 4-hour BESS, and a 60-MW solar PV plus 4-hr BESS. The cost of solar PV plus battery installation continues to drop. Both BESS and Solar PV technologies share similar factors that drive this cost reduction. Batteries can be either AC- or DC-coupled to the solar array. DC-coupled systems connect the battery directly to the solar array via DC wiring. The resource evaluated in this plan assumes an AC-coupled system, which is more prevalent in recent projects. AC-coupled systems offer higher efficiency when used in power AC applications, but they also have slightly lower efficiencies when charging the battery. The most common application for AC-coupled system is peak shaving, or energy arbitrage, where there is a limit on the power allowed into the grid and the peak of the solar generation is stored in a battery to be sold during the highest demand peaks for optimal profit.

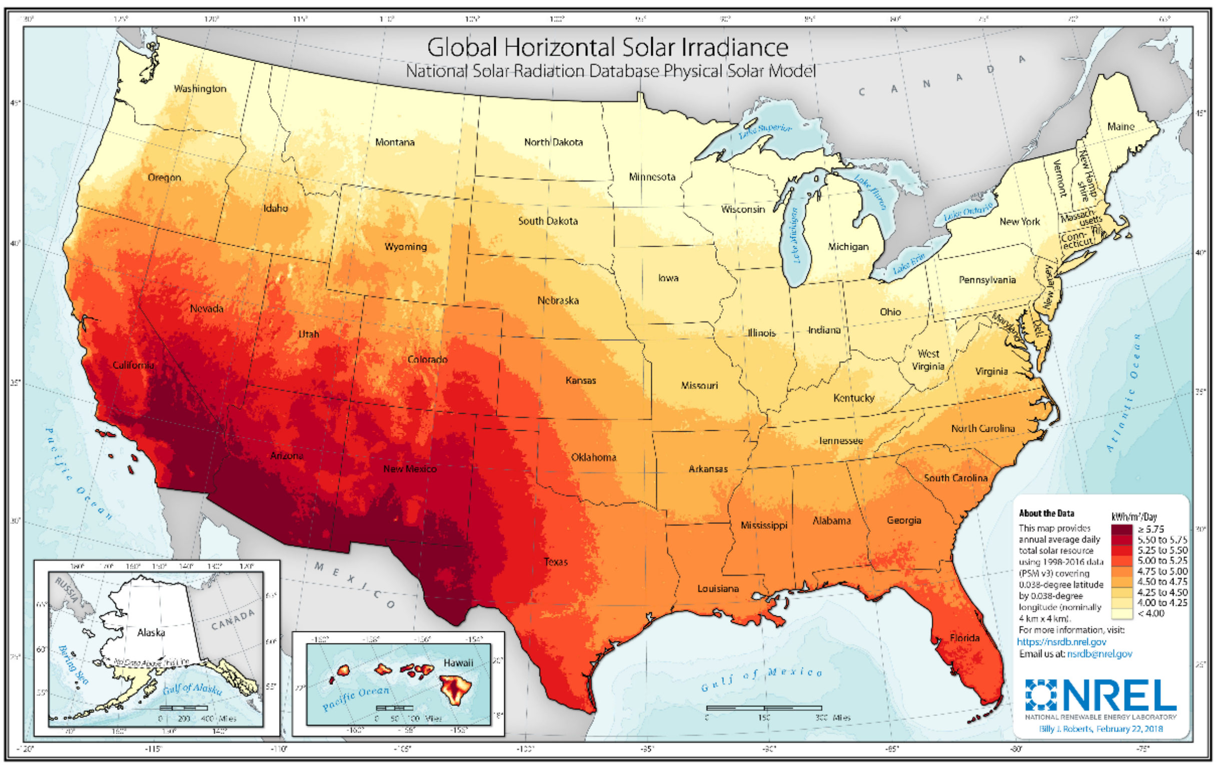
The Federal Investment Tax Credit ("ITC") provides a tax credit for the investment cost of solar systems and has been instrumental in supporting the growth of solar energy in the US. A summary of the Federal ITC phase down is provided in the table below.

TABLE 22 FEDERAL SOLAR ITC PHASE DOWN

Year Construction Begins	2020	2021	2022	Future
ITC %	26%	22%	10%	10%

The land area required for this application is assumed to be between 400 to 700 acres to support the capacity. The major components of a PV system include the PV modules/arrays, DC to AC converters/inverters, and mounting structures. An average capacity factor range for a solar power facility is typically in the range of 10 to 30 percent, with annual averages around 25 percent depending upon solar resources within the region. The estimated average annual capacity factor for the South Dakota site was estimated using NREL's PVSyst program, and determined to be 24.10%.

FIGURE 24 SOLAR IRRADIANCE



8. PORTFOLIO MODELING AND ANALYSIS

Highlights

- NorthWestern analyzed a variety of resources and portfolio configurations that will accomplish the goal of maintaining reliable energy supply through retirement and replacement of certain assets.
- Portfolios were compared based on the net present value (NPV) of their revenue requirements to identify which resources can meet customers' needs at the least cost and risk.
- The modeling results suggest that the replacement portfolio consisting of approximately 40 MW of RICE units has the lowest cost of the replacement options analyzed. These results are based on generic proxy resources and are thus suggestive, but any actual resource decisions would only be made following a rigorous analysis of resource-specific information.

8.1. Modeling Overview

This chapter describes how NorthWestern analyzes the expected costs of using different resource portfolios to meet our customers' future energy needs. NorthWestern uses Ascend Analytics' PowerSimm™ modeling software to simulate future system conditions at an hourly level—including weather, loads, renewable generation, and market prices of electricity and natural gas and their impact on economic operation of dispatchable resources. This approach allows NorthWestern to evaluate the net present value (NPV) of costs and risks associated with alternative resource portfolios across a range of future conditions.

Portfolio modeling begins with the simulation of future conditions for weather, load, and market prices for electricity and natural gas. The simulated weather conditions drive the simulations of load as well as the generation associated with renewable assets. Dispatchable resources are then optimally dispatched according to simulated market prices and the marginal cost of production for each generation asset (which are partially dependent on the simulated price of their fuel).

For each portfolio, 100 simulations are run, with each simulation representing an alternative combination of weather, prices, loads, and renewable generation, thereby producing 100 unique calculations of costs and revenues. Revenues are a function of the amount of electricity produced and market prices. Market purchases are a function of market prices and the amount of load that must be served. The expected value of portfolio costs is calculated as the mean across the results from the 100 simulations. Utilizing a large number of simulations ensures that inherent uncertainty in outcomes associated with planning in the dynamic energy environment is considered. It also allows for the calculation of a risk premium for each portfolio that is added to costs, resulting in a risk-adjusted NPV, effectively penalizing riskier portfolios relative to less risky ones.[18]

Once portfolio costs are obtained from the simulations, they are combined with fixed and capital costs to produce total portfolio costs reflecting the regulated utility model as governed by the South Dakota Public Utilities Commission (PUC). Key data inputs upon which simulation of future conditions are based are described further below.

8.2. Modeling Inputs

The simulation of the future market and load conditions that determine the dispatch of resources in the model are defined by historical data for weather, customer loads, electricity and gas prices, and renewable generation. In addition to historical data, the model utilizes forecasts of power prices, natural gas prices, and loads. Key variables in the model vary across an underlying statistical distribution, defined by historical input data and correlation with other key variables. The role of each of these components in modeling and portfolio evaluation is described below. Price forecasting methods are described in Chapter 2.

In stochastic modeling of NorthWestern's system, generation assets are optimally dispatched to the simulated market price of power. As discussed in Chapter 2, power prices are expected to decline slightly over time, before leveling off and eventually increasing slightly after 2030. Declining electricity market prices are expected because the SPP has seen significant wind additions since 2009 (Figure 7), a trend that is expected to continue into the future. As the marginal unit increasingly becomes wind, with zero marginal costs of operation, average market prices are pushed downward.

Along with the increase in renewable generation in SPP, the frequency of negative day-ahead prices has increased

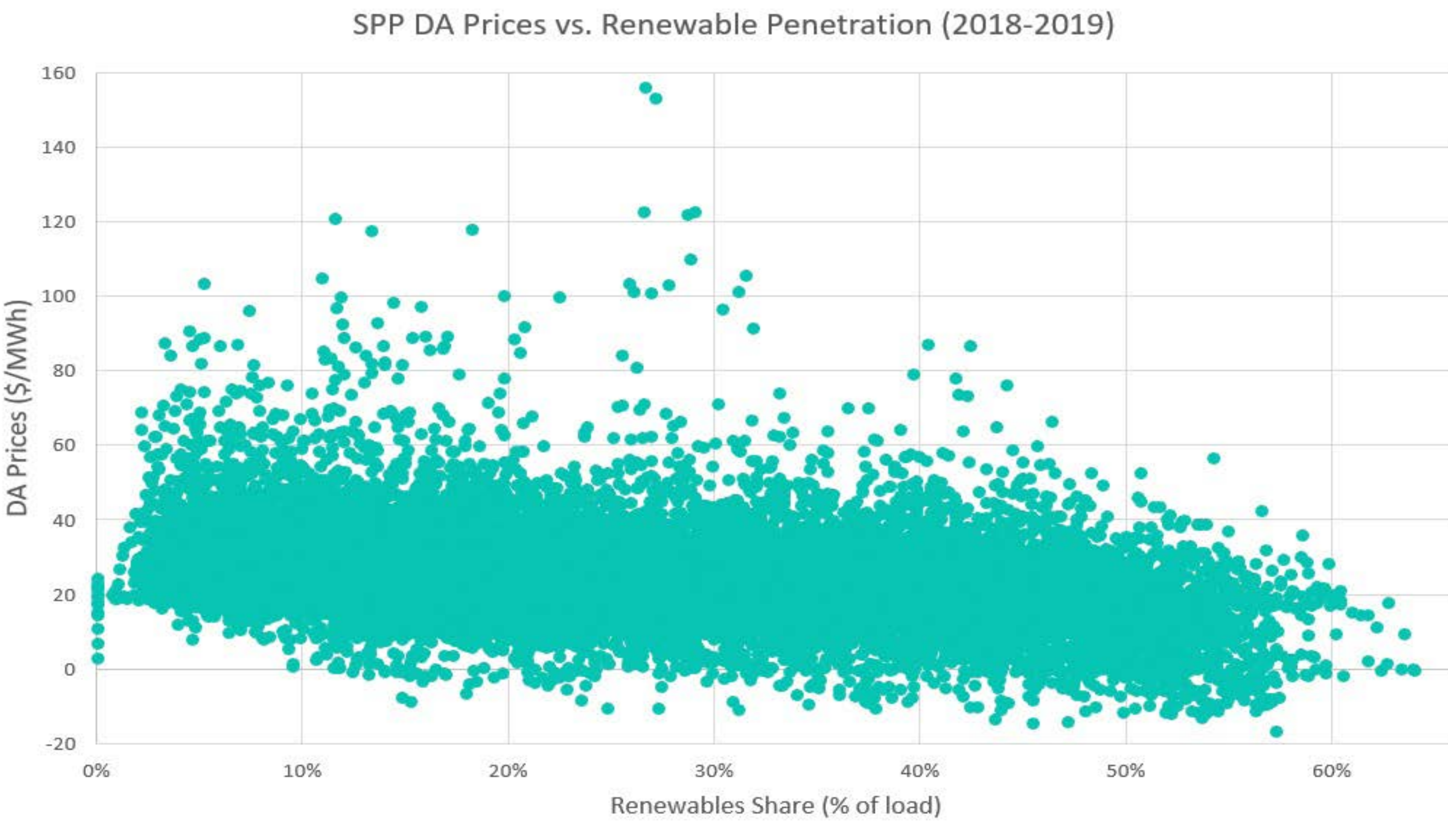
18 The uncertainty reflected in the estimated economic values and costs for different portfolios can be compared by estimating the likelihood that future conditions may result in a portfolio being extremely costly. Therefore, a portfolio's risk premium is the difference between (a) the probability-weighted average of the estimated costs for each portfolio above the median cost and (b) the median cost. Combining cost and risk into one value allows for a simple comparison of costs and risks associated with portfolio scenarios.

(Figure 25). When wind generation exceeds approximately 50% of load, prices are very frequently negative. Likely due in part due to the incentive created by the Production Tax Credit (PTC) for wind generators to run even when prices are negative. With more wind additions, and increasingly more solar in the interconnection queue, the observed trend of low or negative prices is expected to increase. Increased renewable generation could potentially lead to increased volatility in power prices, although growth in battery storage would likely mitigate this.

The price of natural gas is a key variable determining the cost of dispatching thermal units and is forecast in the short term using forward price curves for gas prices at Ventura through 2021. Past 2021, natural gas prices are escalated using the nominal gas price projection, as reported by the EIA. Figure 13 in Chapter 3 shows that NorthWestern expects natural gas prices to increase at a moderate rate through time.

Customer load does not influence the dispatch of NorthWestern's resources in SD, because they are economically dispatched based on price alone. However, load influences portfolio NPV by determining how much power must be purchased from the market. Load is forecast to grow at an average rate of .71% annually over the ten year planning horizon (Table 3).

FIGURE 25 DAY-AHEAD PRICES V WIND GENERATION IN SPP (2018 - 2019) (SOURCE: ASCEND ANALYTICS)



8.3. Portfolios

The "Current" portfolio represents NorthWestern's resource portfolio as it exists currently with no planned retirements or additions (Table 23). Alternative portfolios were developed to consider the effects of retirement and replacement of certain assets in the current portfolio with a variety of candidate resources (Table 24). The "Replacement" portfolios consider retirement and replacement of Aberdeen 1 and Yankton at the end of 2024. A variety of replacement resources are considered in the "Replacement" portfolios. In the Current portfolio and all Replacement portfolios, capital investment in environmental upgrades to the Coyote plant are made beginning in 2028.

TABLE 23 CURRENT PORTFOLIO ASSETS

Assets	Fuel Type	Nameplate (MW)	Note
Aberdeen 1 (AGS1)	Diesel	28.8	Replacement candidate
Aberdeen 2 (AGS2)	NG/Diesel	82.2	
Aurora	Wind	20	
Beethoven	Wind	80	
Big Stone	Coal	111	
Brule	Wind	20	
Clark	Diesel	2.8	Replacement candidate
Coyote	Coal	42.7	Under analysis for emissions compliance. Replacement candidate
Faulkton	Diesel	2.8	Replacement candidate
Huron	NG	60	New 60MW unit will replace Huron 1 & 2 - end of 2021
Mobile Units	Diesel	11.8	8 x 1MW units 1 x 2MW unit 1 x 1.8 MW unit
Neal	Coal	56	
Oak Tree	Wind	19.5	
Titan	Wind	25	
Yankton (YGS1, YGS2, YGS4)	NG/Diesel	7.1	Replacement candidate. 6.5MW from YGS3 not included.

TABLE 24 RESOURCE PLAN PORTFOLIOS

Portfolio	Aberdeen 1 Replacment	Yankton Replacement
Replacement #1	19MW RICE	19MW RICE
Replacement #2	19MW RICE	22MW Battery
Replacement #3	19MW RICE	400MW Wind
Replacement #4	19MW RICE	30MW Wind + 20MW Battery Hybrid
Replacement #5	19MW RICE	200MW Solar
Replacement #6	19MW RICE	36MW Solar + 18MW Battery Hybrid
Replacement #7	22MW Battery	22MW Battery
Replacement #8	22MW Battery	400MW Wind
Replacement #9	22MW Battery	30MW Wind + 20MW Battery Hybrid
Replacement #10	22MW Battery	200MW Solar
Replacement #11	22MW Battery	36MW Solar + 18MW Battery Hybrid

Resources considered as replacement assets include RICE, battery, wind, solar, wind + battery, and solar + battery. Replacement resources modeled for Aberdeen are limited to RICEs and batteries due to expected needs to meet voltage requirements at this location, while all options are considered for Yankton. Costs for replacement resources are shown in Table 21. Configurations of replacement resources for Aberdeen 1 and Yankton were determined by necessary nameplate size of the replacement to achieve capacity contribution equivalents to those of the assets being replaced (Table 25). The configuration ratios for renewable-battery hybrids were configured in accordance with the SPP's recent capacity accreditation studies (Table 21). All portfolios are analyzed under the same price and load forecasts, as described in the previous section.

TABLE 25 CAPACITY CONTRIBUTION OF REPLACEMENT RESOURCES

Resource Type	Capacity Credit	Source/Rational
RICE	100%	Replace dispatchable thermal with similar
Wind	5%	SPP Default NPC
Solar	10%	SPP Default NPC
4 Hr li-ion battery	93%	SPP Storage ELCC first 25MW

8.4. Portfolio Results

These following results contribute valuable insights to guide NorthWestern's planning, but are based on generic resource cost estimates and do not represent specific projects for which costs will vary on a case-by-case basis. NorthWestern's resource procurement strategy will rely on a competitive solicitation of proposals, also known as Requests for Proposals (RFP), which will utilize the same modeling framework used in the analysis to evaluate opportunities.

Portfolios are evaluated according to net present value (NPV) of costs over a ten year planning horizon.[19] NPV is a function of fixed costs and capital costs of existing and new resources, variable costs, market sales and purchases of energy, risk premium value, and a sub-hourly credit that reflects the potential to capture additional market revenues associated with flexible resources. Future costs and revenues are discounted using NorthWestern's weighted average cost of capital (WACC) of 7.24%. Preferred portfolios minimize costs and risk, while allowing NorthWestern to accomplish planning needs. It should be noted that some costs accrue beyond the 10 year time-frame of this analysis and are therefore unaccounted for in this comparison. For example, in the case of the Coyote environmental upgrades, which take place in the final three years of the analysis, a substantial portion of capital costs will be unrepresented.

The 10-year NPVs of the replacement portfolios modeled are shown in Figure 26, with costs categorized as: a) existing fixed costs, b) new resource revenue requirement, c) variable and market costs, and d) risk premium. Variable and market costs are displayed with additional detail in Figure 27. The NPVs of the replacement portfolios range from a low of $792 million (Portfolio #1, with two 19 MW RICE units), to a high of $978 million (Portfolio #8, which adds one 22MW battery unit and a 400MW stand-alone wind facility). Portfolio #7, which adds two battery units, and Portfolio #2, which adds one RICE and one battery, are not far off from the least cost portfolio, with both having NPVs around $796 million. This suggests battery storage is likely to be very competitive in a solicitation process. The capital costs associated with building a wind facility that is large enough to replace the accredited capacity of the retiring thermal units appear to be prohibitively expensive in this comparison.

19 Portfolio NPV does not reflect any potential value associated with the sale of ancillary services to the SPP markets for Regulation Up, Regulation Down, Spinning Reserve, and Supplemental Reserve. The ability of RICE and battery assets to provide these service could affect their value in ways that are not accounted for in our NPV comparison. Resource costs provided in Table 21 do not reflect operations for ancillary services.

FIGURE 26. 10-YEAR NPV COMPARISON OF CURRENT AND REPLACEMENT PORTFOLIOS

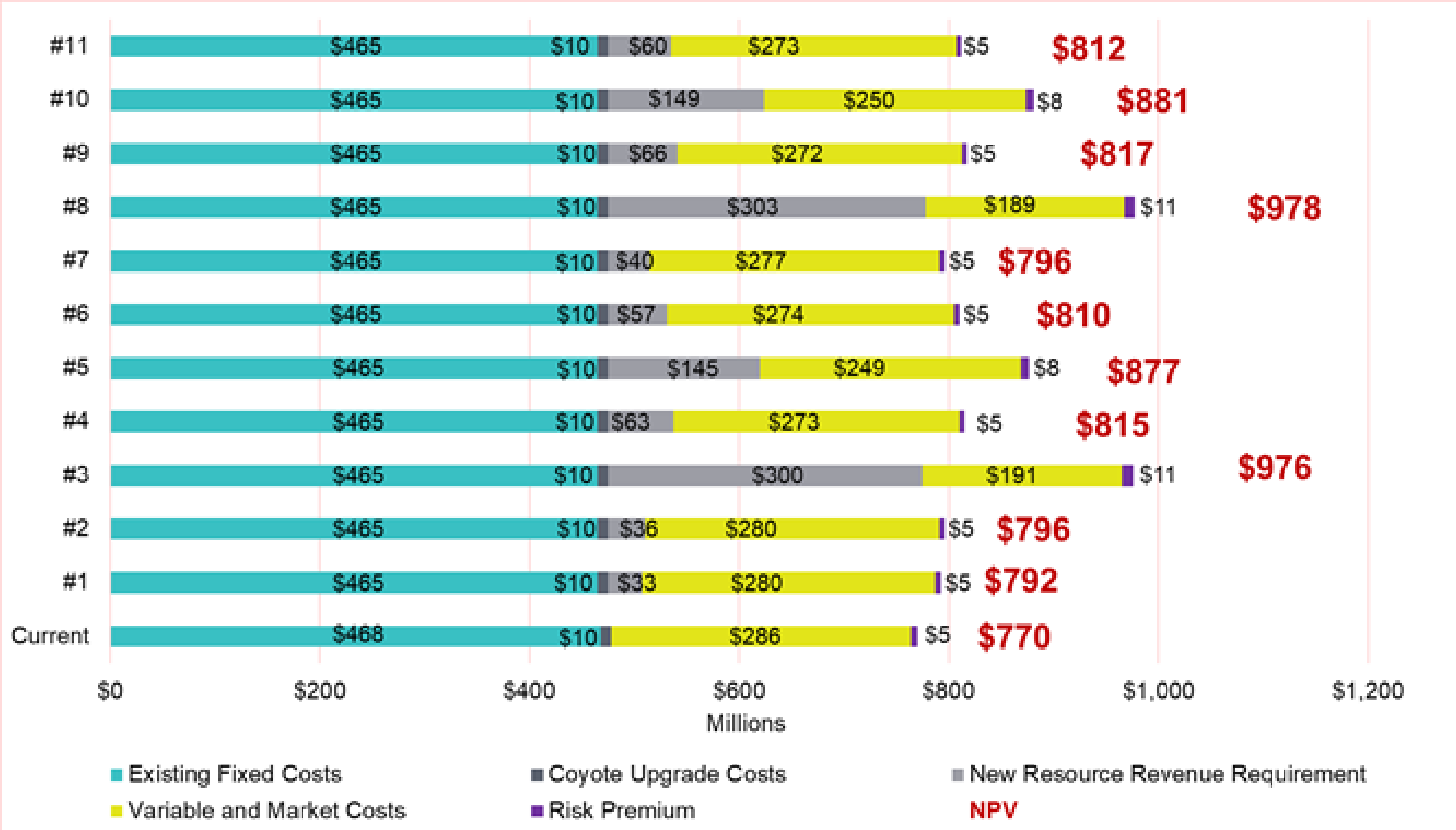


FIGURE 27 VARIABLE, MARKET, CONTRACT AND FLEX CREDIT CURRENT AND REPLACEMENT SCENARIOS

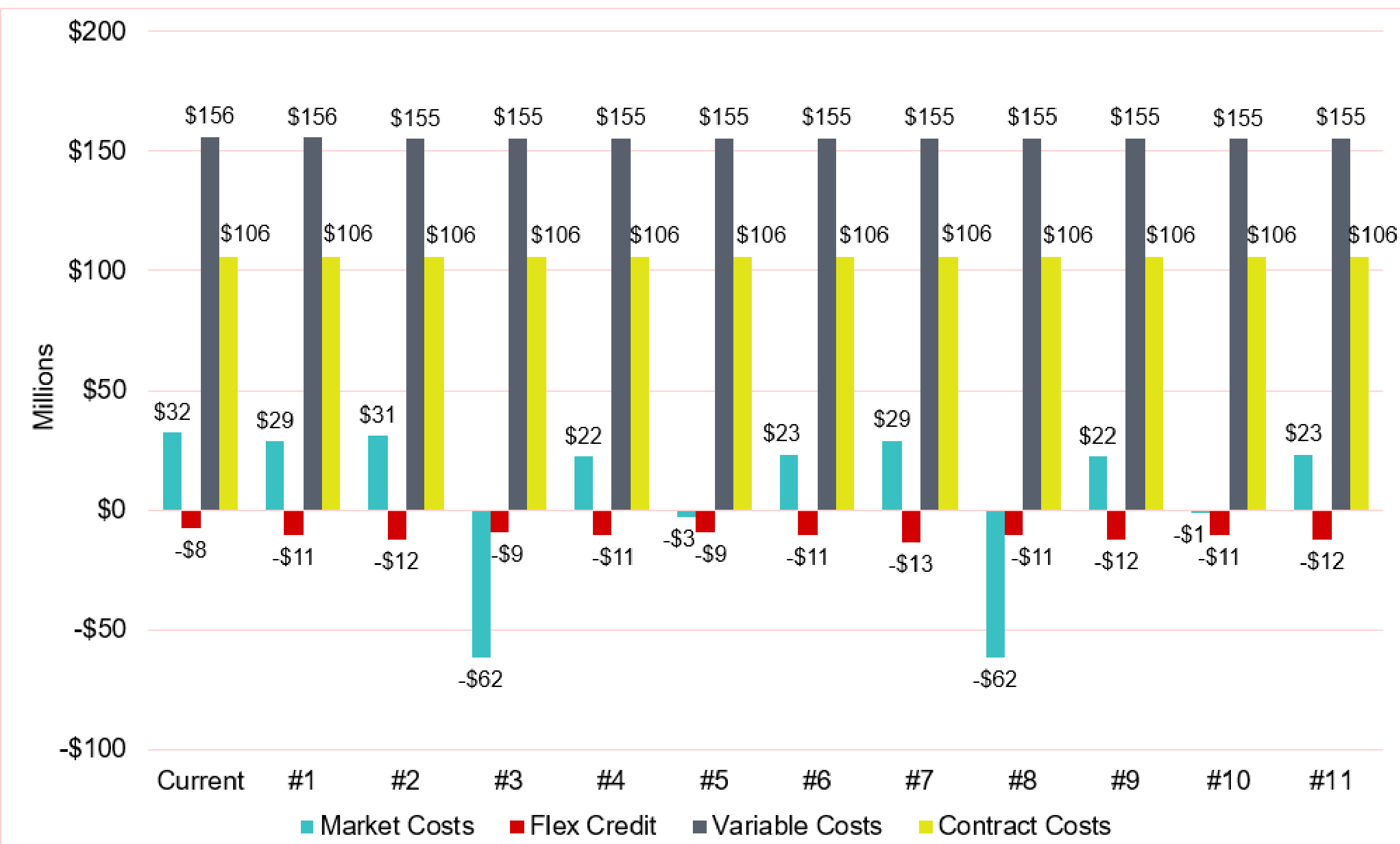
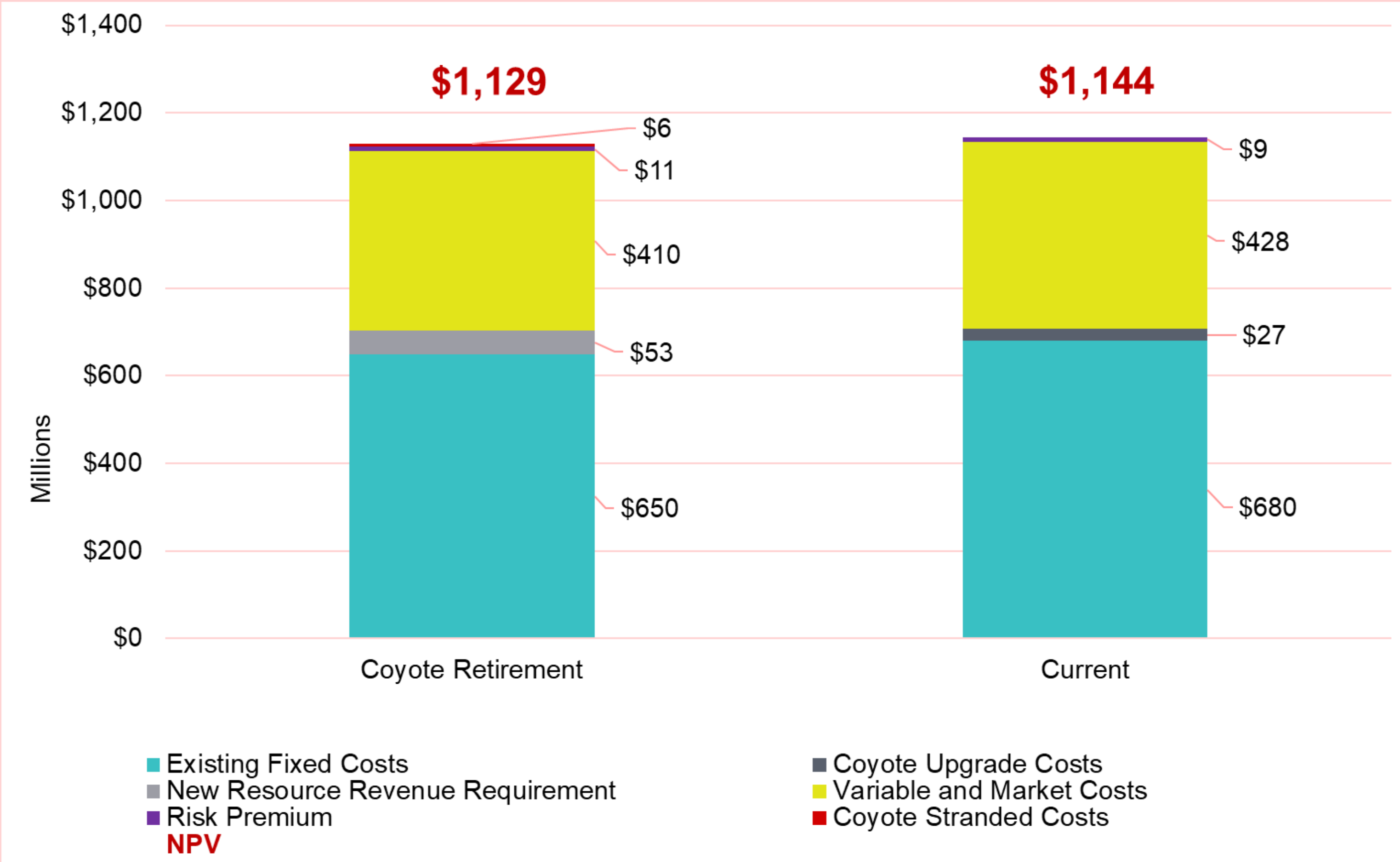


FIGURE 28 20-YEAR NPV OF CURRENT AND COYOTE RETIREMENT PORTFOLIOS



In addition to the replacement portfolios considered above, the potential remediation of Coyote was evaluated against a scenario of retiring it and replacing it with RICE units, which were found to be the least cost option when evaluating replacements for the generation at Aberdeen 1 and Yankton. The Coyote Retirement portfolio considers the retirement and replacement of Coyote with a 47MW RICE resource at the end of 2027, with no retirement of Aberdeen 1 and Yankton. This is compared to the Current Portfolio, in which an investment is made in environmental upgrades at Coyote starting in 2028. The Coyote retirement portfolio has an NPV of $1.129 billion, which is slightly less than the $1.144 billion NPV of the Current portfolio (Figure 28). Because a substantial portion of costs will accrue beyond a 10-year time horizon in these two scenarios, they are compared over a 20-year time horizon, and are therefore not directly comparable to the results for Replacement Portfolios or 10-year analysis of the Current Portfolio presented in Figures 26 and 27.

As discussed in Chapter 4, the future of Coyote and the investments potentially necessary to achieve the required reductions in emissions will depend on the decisions of the joint owners. Each owner will have to determine whether they will continue investing in the plant or not. If an owner decides not to support the investment necessary for continued operation of the plant, the possibility of NorthWestern taking on an increased ownership share would most likely not be economic, and would depend on a detailed evaluation of the specific costs and requirements when they become known.

9. ENVIRONMENTAL RESPONSIBILITIES

Highlights

- NorthWestern Energy is committed to environmental stewardship in all aspects of its business.
- The emissions at Huron will improve significantly when the new unit there comes online.
- Federal changes to the Affordable Clean Energy laws will impact air quality regulation in South Dakota.

9.1. Introductory Statement - Environmental Trends that Influence the 2020 Plan

NorthWestern Energy provides affordable, reliable and safe energy services while responsibly managing the natural resources under our stewardship. We support using renewable resources when consistent with the needs of the portfolio and our commitment to ensure our customers always get the energy they need in all weather conditions. Our commitment to environmental stewardship and compliance affects all facets of our business, including our resource procurement planning. We prepare an annual publication called “Environmental Stewardship: Our Commitment in Action” which is available on our website[20]. We encourage those interested to review this publication.

NorthWestern’s Statement of Environmental Policy

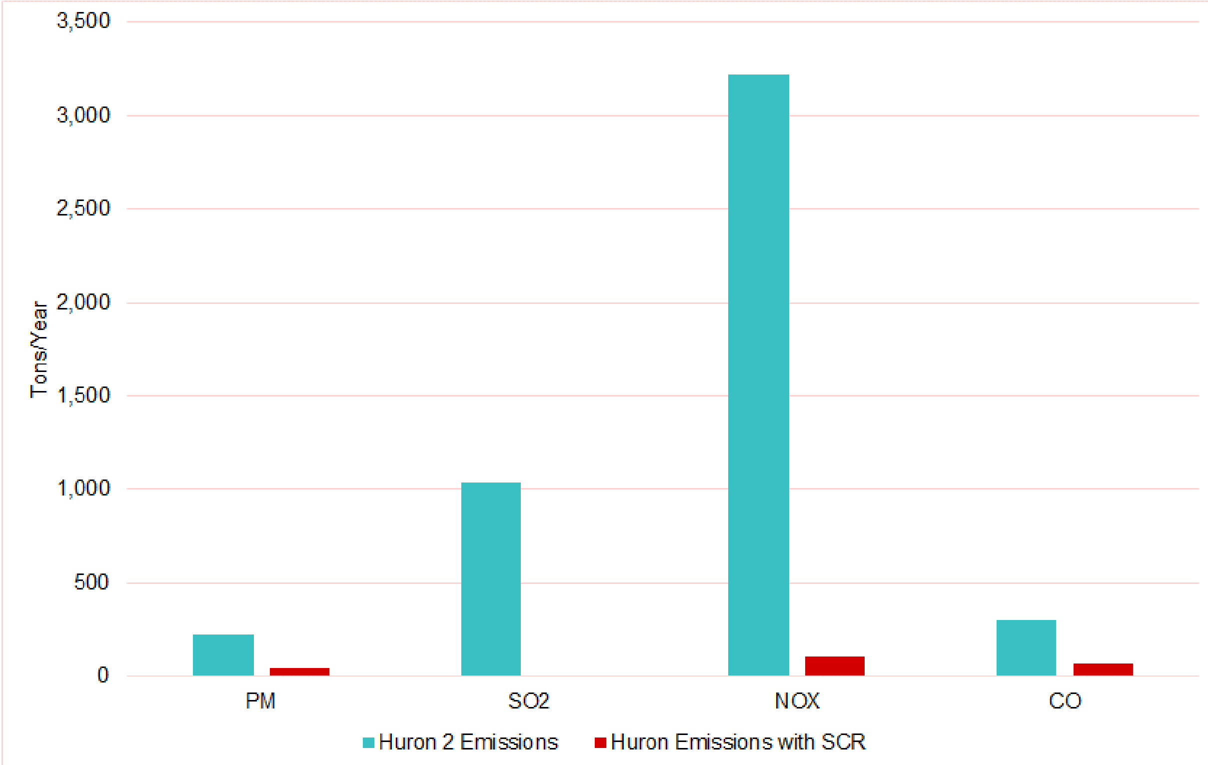
> NorthWestern Energy’s policy is to provide cost-effective, reliable and stably-priced energy while being good stewards of the natural resources and complying with environmental regulations. We apply the following environmental principles in our day-to-day business:
>
> Our business practices reflect a respect for, and a commitment to, sustainability and the long term quality of the environment.
>
> One of our priorities is being good stewards of natural and cultural resources at our hydroelectric projects.
>
> We comply with the spirit as well as the letter of environmental laws and regulations.
>
> Environmental issues and impacts are an integral part of our planning, operating and maintenance decisions.
>
> We promote our customers’ efforts to conserve energy.
>
> We support providing energy through non-carbon emitting and renewable resources when consistent with our statutory requirement to provide cost effective energy.
>
> We strive to minimize the generation of wastes and promote the reuse and/or recycling of materials.
>
> We seek to continuously improve our environmental compliance and stewardship.
>
> We embrace a team culture where positive environmental stewardship and compliance are encouraged, mentored and rewarded.
>
> Our contractors and consultants must comply with this policy when working for or representing NorthWestern Energy.

Improvements in Plant Emissions – Huron

The RICE installation at the Huron plant will significantly reduce the air emissions compared to the emissions of the previous installed unit. The Caterpillar RICE engine is equipped with a Selective Catalytic Reductions system (SCR) that further reduces air emissions output and improves quality. The emissions difference between the prior installation at Huron and the new installation is captured below.

20 Go to http://www.northwesternenergy.com/environment/our-environment and click on the link to the Environmental Stewardship Report.

FIGURE 29 HURON POTENTIAL TO EMIT ("PTE")



9.2. Regulation of Greenhouse Gas (GHG) Emissions

Regulations covering GHG emissions from new and existing electric generating units demonstrate the impact the Clean Air Act can have on the planning process. Coal-fired generation plants are under particular scrutiny due to their level of GHG emissions.

New Source Performance Standards ("NSPS")

On October 23, 2015, the final standards of performance to limit GHG emissions from new, modified, and reconstructed fossil fuel generating units and from newly constructed and reconstructed stationary combustion turbines were published in the Federal Register ("FR"). The standards reflect the degree of emission limitations that the U.S. Environmental Protection Agency ("EPA") believes are achievable through the application of its designated "best systems of emission reduction" ("BSER"). Parties are currently challenging this regulation. EPA's carbon dioxide ("CO2") emissions limit for fossil fuel-fired electric utility steam generating units precludes the construction of any new base load coal-fired plants because the BSER includes carbon capture and storage systems which are not yet ready for commercial use. New base load natural gas combined cycle and simple cycle combustion turbines are also required to meet a CO2 emissions standard. Non-base load simple cycle combustion turbines are required to meet a heat input-based standard. New reciprocating engines would not be affected by the NSPS. NorthWestern's analyses in this plan factored in consideration of the NSPS for combustion turbines.

Existing Source Performance Standards – Affordable Clean Energy Rule

On August 21, 2018, EPA proposed the Affordable Clean Energy rule (ACE) which established emission guidelines to be used by States to develop plans to address GHG emissions from existing coal-fired electric generating units. EPA released the final version of ACE on June 19, 2019; it was published in the Federal Register on July 8, 2019 with an effective date of September 6, 2019.

EPA determined the BSER for existing coal-fired power plants to be heat rate efficiency improvements (HRI) based on a range of "candidate technologies" that can be applied inside the fence-line. States are to establish a unit-specific performance standard in the form of an allowable emission rate (i.e., lbs of CO2 per MWh-gross generation) by evaluating the HRI technologies while also considering remaining useful plant life, reasonableness of cost, prior installation/application of efficiency improvement technologies and other factors. States have three years from the date the final rule was published in the FR to submit a plan to EPA. If a State does not submit a plan or a submitted plan is not acceptable, EPA has two years to develop a federal plan. Compliance will generally begin two years following the date State plans are due (assuming EPA doesn't need to develop a federal plan) and if a compliance schedule extends past July of 2024, the State's plan must include enforceable incremental standards of performance.

On April 17, 2020 a series of opening briefs challenging the ACE rule were filed in the U.S. Court of Appeals for the District of Columbia Circuit (consolidated litigation known as American Lung Association, et al. v. EPA, et al.). It is unclear how these challenges or any future litigation relating to the ACE rule or other GHG regulations will impact our resources.

NorthWestern cannot predict whether or how ACE will be applied to the jointly owned coal plants used to serve our South Dakota customers. No additional costs were modeled in this Plan for potential requirements associated with the ACE rule. We will continue monitoring the status of the ACE rule and state plans and update our assessment if there are any final decisions prior to preparation of our next SD Plan.

Carbon Costs

Estimated potential future costs associated with the regulation of CO2 emissions from thermal power plants represent one of the risks that NorthWestern considered in its modeling analysis. In the 2014 Plan, NorthWestern accounted for the potential costs resulting from CO2 reduction regulation by including a cost for carbon. The 2016 and 2018 Plans did not assign a cost to carbon emissions, but noted that carbon is included in the market prices produced by the EIA in its Annual Energy Outlook for the SPP North Reference case. The 2020 Plan treats carbon costs in the same manner as the 2016 and 2018 Plans.

9.3. Regional Haze

The Regional Haze Rule addresses visibility impairment in Class I areas. Class I areas include national parks and wilderness areas. Facilities built between 1962 and 1977, with emissions in specified quantities that contribute to visibility impairment in Class I areas, are required to install best available retrofit technology (“BART”) to control emissions.

Big Stone Plant (“Big Stone”)

Big Stone has been online since 1975 and was BART-eligible. Air dispersion modeling for Big Stone indicated the plant contributed to visibility impairment at Class 1 areas in South Dakota, North Dakota, Michigan and Minnesota. Therefore, Big Stone was required to install and operate BART that was determined by the South Dakota Department of Environment and Natural Resources (“DENR”) to be selective catalytic reduction in conjunction with separated over-fire air for control of nitrogen oxides (“NOX”), a scrubber for reducing sulfur dioxide (“SO2“), and a bag-house to control particulate matter. The air quality control system comprised of this equipment was commissioned on December 29, 2015 and is fully operational. Since Big Stone was required to install and operate BART, it is not anticipated that further requirements relative to Regional Haze compliance will be required in the future.

Coyote Station (“Coyote”)

Coyote has been online since 1981 and was not BART-eligible. Although the unit was not BART-eligible, the North Dakota Regional Haze State Implementation Plan (“SIP”) required Coyote to reduce NOX emissions by July 2018. To satisfy the SIP, separated over-fire air equipment was installed during a spring 2016 planned maintenance outage. As detailed elsewhere in this plan, we anticipate Coyote will be required to participate in future reasonable progress evaluations and the plant operator has submitted a “four factor” analysis to the North Dakota Department of Environmental Quality (ND DEQ). This analysis will be used by the ND DEQ to identify possible 2028 control strategies. The next Regional Haze SIP containing ND DEQ’s recommended 2028 control strategies is required to be submitted to EPA by July 31, 2021. The impacts of this are discussed in Chapter 4.

Neal Unit 4

In Iowa, no source specific or unit specific emissions limits or compliance schedules were developed for the regional haze SIP. Iowa relied on the Cross-State Air Pollution Rule to enact BART. Future impacts to Neal 4 resulting from the Regional Haze Rule are not anticipated at this time.

Regional Haze SIP Revisions

States are required to revise their regional haze implementation plans and submit them to EPA by July 31, 2018 and every 10 years thereafter. However, on April 25, 2016, EPA signed a proposed rule to delay the July 31, 2018 revision date until July 31, 2021.

Mercury and Air Toxics Rule (“MATS”)

MATS became effective April 16, 2012, requiring new and existing coal-fired facilities to achieve emissions standards for mercury, acid gases, and other hazardous pollutants. Existing sources were required to comply with the new standards by April 16, 2015.

The Meridian Bridge in Yankton.

All of the jointly owned coal-fired power plants in our portfolio –Big Stone, Coyote, and Neal 4 – are currently in compliance with the MATS rule. Therefore, we assume subsequent SIPs will contain no additional requirements for material upgrades to any of the plants.

Coal Combustion Residuals ("CCR")

"The Disposal of Coal Combustion Residuals from Electric Generating Utilities" was published in the FR on April 17, 2015. These regulations set forth requirements for the disposal of CCR as non-hazardous waste under the solid waste provisions in subtitle D of the Resource Conservation and Recovery Act. The rule establishes requirements for new and existing CCR landfills and surface impoundments. The requirements also cover groundwater protection, operating criteria, record keeping and notification, and public information posting.

Big Stone

Big Stone operates a dry landfill disposal site that is already regulated, permitted, and inspected by DENR. Big Stone installed a new bottom ash handling system in 2018 that eliminated the need to sluice boiler slag to a surface impoundment. Big Stone conducted the required background groundwater monitoring program for the impoundment and completed clean closure by removal of all coal combustion residuals. Following the closure by removal activities, groundwater samples were collected and analyzed that confirmed the surface impoundment closure project was appropriately completed.

Coyote

Coyote operates a dry landfill disposal site that is already regulated, permitted and inspected by the North Dakota Department of Environmental Quality. Coyote installed a new bottom ash handling system in 2019 that eliminated the need to sluice boiler slag to a series of three surface impoundments. Similar to Big Stone, Coyote conducted the required background groundwater monitoring programs for the impoundments, completed clean closure by removal of all coal combustion residuals at the impoundments, and collected post-removal groundwater samples to verify closure of all three impoundments was completed.

Neal Unit 4 ("Neal 4")

The CCR disposal area at Neal 4 is undergoing a compliant closure.

NorthWestern follows the U.S. Fish and Wildlife Service's Land-Based Wind Energy Guidelines, which are voluntary guidelines for addressing wildlife conservation concerns.

9.4. Other Environmental Considerations

Renewable Energy Certificates ("RECS")

RECs are created for each MWh of energy produced by certain registered generators. RECs are used for compliance with state Renewable Portfolio Standard ("RPS") requirements. They are also purchased by corporate parties that are seeking to meet corporate and social environmental goals using certified renewable energy. The REC-eligible facilities in SD are Rolling Thunder and Beethoven. Because RECs are used to meet various statutory and environmental compliance goals, it is necessary to use a third party to validate production data. The South Dakota RECS are registered in the MidWest Renewable Energy Tracking System ("MRETS[21])" system for tracking and validation purposes. South Dakota does not have a Renewable Portfolio Standard, although it did have a Renewable Energy Objective ("REO") set at 10% by 2015. While this REO requirement is no longer in place, NorthWestern provides updates on our generation mix as requested by the SD PUC.

Wind Generation

In siting the 80 MW Beethoven Wind Farm, the developer and now NorthWestern as the owner/operator, follow the U.S. Fish and Wildlife Service's ("USFWS") Land-Based Wind Energy Guidelines, which are voluntary guidelines for addressing wildlife conservation concerns. The Bird and Bat Conservation Strategy for the project is being implemented. Post-construction monitoring to determine impacts of operations on birds and bats has been completed. Results of the monitoring indicate that additional material mitigation at our wholly owned wind facility is not needed.

The USFWS has regulatory authority to administer the following regulations that could affect siting or operating a wind farm in South Dakota: the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, the Endangered Species Act as amended, the National Wildlife Refuge System Improvement Act of 1997, and the National Environmental Policy Act. New wind generation in South Dakota will be subject to the aforementioned regulations.

9.5. Summary

NorthWestern's planning process will continue to be impacted by environmental and wildlife regulations, as well as legislation that will affect current and future thermal and renewable generation resources. Providing reliable, cost-effective energy in an environmentally safe manner remains one of NorthWestern's commitments. We will continue to comply with environmental statutes and guidelines while fulfilling our responsibility to our customers.

21 M-RETS® validates the environmental attributes of energy to serve as a trusted centralized gateway to environmental markets (from MRETS website, accessed 5/18/2020)