Supply Resource Analysis

OVERVIEW

Supply side resource analysis was conducted to determine the feasibility of modifying and continuing to operate the Lewis & Clark generating Station) (Lewis & Clark Station) located near Sidney, Montana, in compliance with EPA's Mercury and Air Toxics Standards (MATS) emission rule. The Lewis & Clark Station is located within the Bakken oil field development area and is an important generation resource that serves load and provides voltage support to the region. With the rapid growth of activity in the Bakken area, the Lewis & Clark Station is needed to maintain reliability in the area under both peak system conditions and various transmission outage conditions.

Montana-Dakota proposes to install a baghouse at the Lewis & Clark Station for particulate control to comply with the MATS Rule rather than convert the facility to natural gas-fired generation only or retire the plant. Please see Exhibit 1 for details on the Lewis & Clark Station project. Alternatives for the Lewis & Clark Station were included in the analysis to determine if it would be more cost-effective to retire the Lewis & Clark Station, convert the plant to natural gas-fired generation only, or install the controls required to allow continued operation of the plant.

Potential new resources consisting of both capacity resources (generation or external resources) and load modifying resources must be proven technology and be able to provide the same system reliability that Montana-Dakota's customers have come to expect over the years. The resource analysis integration process considers the possible new resources and integrates those resources into a single least-cost plan. The analysis also considered different future economic and social scenarios. The least-cost resource plan provides the basis for evaluating and determining the most cost-effective, long-term plan for future supply options but is not the sole criteria used in the development of Montana-Dakota's long-term resource plan. Other criteria used include but are not limited to: fuel diversity, technology, capital cost, environmental attributes, project timing, projected run-time, expansion capability, project construction schedule, and partnership requirements.

Montana-Dakota is a member of the Midcontinent Independent System Operators, Inc. (MISO) and is required to meet a planning reserve margin and a system coincident factor set forth by MISO. MISO assigns each resource an applicable zonal resource credit (ZRC), which is used in the modeling process described below.

Analysis Method and Model

The Electric Generation Expansion Analysis System (EGEAS) version 9.02, a computer model developed by the Electric Power Research Institute (EPRI), is used to perform the resource expansion analysis and develop the least-cost integrated resource expansion plan. The analysis was performed on various scenarios based on the load forecasts, availability of resources, and economic variables. Each of the scenarios constitutes a resource expansion plan unique to the assumptions used in that scenario. The resource expansion analysis minimizes the present worth, or the net present value (NPV), of the total revenue requirement over fifty years by using an algorithm called "dynamic programming." The dynamic programming utilized in EGEAS calculates each scenario one year at a time to satisfy the reliability constraints and to fulfill the forecasted energy and capacity requirements. This process identifies all possible states that satisfy the reliability requirements for each year. Finally, the annual results are combined to determine the least-cost plan.

The base year used in the resource expansion analysis was 2012 with the study period starting in 2013. Costs indicated in this report are in 2012 dollars, unless otherwise specified. The study for each scenario was analyzed over a 20-year period (2013-2032) in which new resources are added to meet the forecasted load growth and to compensate for unit retirements. To model the remaining life of capital investments installed during the study period, an additional 30 years, called the extension period, was added. During this extension period, loads stayed the same as the final year of the study period. All associated operational and fuel costs continue to be escalated at specified rates through the extension period.

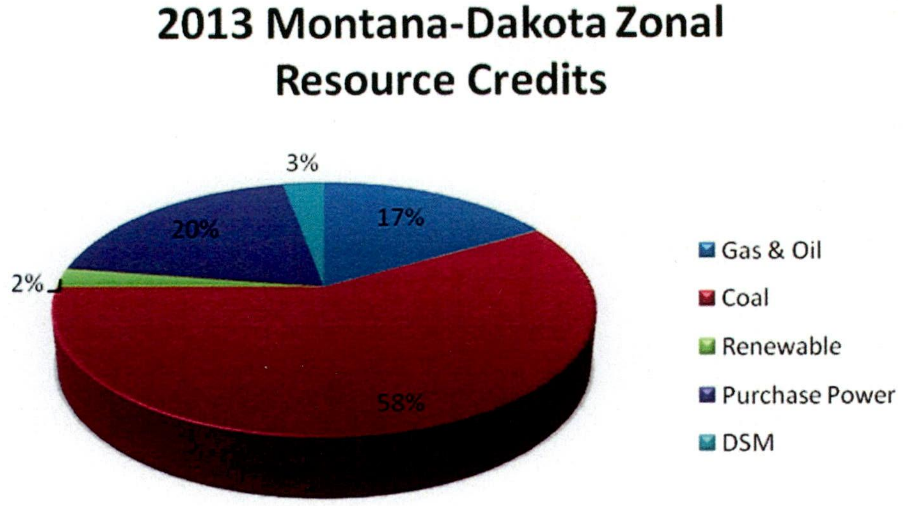
Montana-Dakota's existing generation portfolio includes coal, natural gas, diesel engines, waste heat and wind, along with a capacity purchase contract – the WE Energies contract for the 2012-2015 timeframe. The resource expansion analysis considered other potential available alternative resources to expand the generation portfolio to meet forecasted energy and capacity requirements. All resources were modeled with applicable zonal resource credit (ZRC) amounts, fixed and variable O&M costs, and fuel costs that are shown in Tables 2-1 through 2-5 below.

Current Resources

The existing generation portfolio is broken down into five groups: coal, natural gas/oil, renewable, demand-side management (DSM), and purchase power. Figure 2-1 shows Montana-Dakota's 2013 current generation mix by zonal resource credits. 58 percent of Montana-Dakota's ZRCs comes from coal generation, 17 percent from gas and oil-fired generation, 20 percent from purchased capacity, three percent from DSM, and two percent from renewable resources.

Figure 2-1

Montana-Dakota's Current Generation Mix by Zonal Resource Credits



Coal

Montana-Dakota currently owns five coal-fired units, two of which are jointly owned with other regional utilities. Coal currently accounts for 58 percent of the zonal resource credits on Montana-Dakota's system. Table 2-1 shows the capacity in MW established by the MISO Generator Verification Test Capability (GVTC) process, equivalent forced outage rate (XEFOR$_d$), number of zonal resource credits, and various costs for each coal-fired plant serving Montana-Dakota's customers.

Table 2-1

Montana-Dakota's Coal-Fired Units

Unit	GVTC (MW)	XEFOR$_d$	Zonal Resource Credit [1]	Fixed O&M ($/kW-year)	Variable O&M ($/MWh)	Fuel ($/MBTU)
Coyote[2]	107.0	4.74	101.7	23.86	2.47	1.45
Big Stone[3]	107.7	6.32	101.3	23.19	1.63	2.20
Heskett 1	28.2	5.37	20.8	57.55	7.36	1.81
Heskett 2	74.2	11.60	64.6	53.78	7.71	1.80
Lewis & Clark	52.3	0.47	52.1	52.01	3.02	1.44

1. Based on MISO 2013-14 Planning Year ICAP and XEFOR$_d$
2. Montana-Dakota's 22.7 percent ownership share
3. Montana-Dakota's 25 percent ownership share

Natural Gas and Diesel

Simple-cycle combustion turbines capable of firing natural gas or fuel oil, along with an internal combustion engine capable of firing diesel, are operated as peaking units and make up about 17 percent of Montana-Dakota's existing zonal resource credits. The capacity in MW established by the MISO Generator Verification Test Capability (GVTC) process, equivalent forced outage rate (XEFOR$_d$), number of zonal resource credits, and various costs for Montana-Dakota's existing combustion turbines and diesel generator are shown in Table 2-2.

Table 2-2

Montana-Dakota's Natural Gas Combustion Turbines and Diesel Generator

Unit	GVTC	$XEFOR_d$	Zonal Resource Credit[1]	Fixed O&M ($/kW/year)	Variable O&M ($/MWh)	Fuel ($/MBTU)
Glendive 1	34.7	7.43	33.8	5.57	2.00	3.70
Glendive 2	40.3	4.20	38.6	5.81	2.00	3.70
Miles City	23.0	9.63	20.8	10.13	2.00	3.70
Diesel 1	2.0	9.75	1.8	3.69	2.00	28.16
Diesel 2	2.1	9.75	1.8	3.69	2.00	28.16
Diesel 3	2.1	9.75	1.9	3.69	2.00	28.16

1. Based on MISO 2013-14 Planning Year ICAP and $XEFOR_d$

Renewable

In addition to coal, diesel, and natural gas, Montana-Dakota owns three renewable resources, as shown in Table 2-3. The renewable resources make up about two percent of Montana-Dakota's existing zonal resource credits.

Table 2-3

Montana-Dakota's Renewable Generation

Unit	Zonal Resource Credits[1]	Fixed O&M ($/kW/year)	Variable O&M ($/MWh)	Fuel ($/MBTU)
Diamond Willow I & II[1]	5.2	23.22	-31.85	-
Cedar Hills[1]	4.5	23.22	-31.85	-
Glen Ullin Station 6[2]	4.3	50.10	6.90	-

1. ZRC is based on MISO ELCC study. Variable O&M cost includes the Production Tax Credit, which is represented by a negative $/MWh cost value.
2. Based on MISO 2013-14 Planning Year ICAP and $XEFOR_d$

Purchased Power

In addition to generation resources that Montana-Dakota owns, the Company has entered into a purchased power contract, shown in Table 2-4, to meet the planning reserve margin requirements within MISO.

Table 2-4

Montana-Dakota's Purchase Power

Unit	Zonal Resource Credit[1]	Fixed O&M ($/kW/year)	Variable O&M ($/MWh)	Fuel ($/MBTU)
WE Energies Contract[1]	115-120	34.80	111.50	-

1. Expires after May 31, 2015

Demand Response

In addition to the supply side resources two different demand response programs were included in the model. The totals below reflect how much would be available in 2014.

- Montana-Dakota Interruptible loads – 13 MW
- Commercial DSM – 10 MW

MISO Energy Market

The MISO energy market provides a source of energy when prices are lower than Montana-Dakota's generating cost, or when energy is required due to planned maintenance or forced outages. The model included a 30 MW block of energy for off-peak and on-peak periods.

Supply-Side Resource Alternatives Considered

Montana-Dakota analyzed the following supply-side alternatives that are described in more detail below:

- Simple cycle combustion turbine,
- Simple cycle internal combustion engines,
- Combined cycle combustion cycle,
- Coal,
- Wind (self-built),
- Solar,
- Wind (purchased energy),

- Landfill Gas,
- Biomass,
- Solid Waste,
- Geothermal and,
- Lewis & Clark Options.

Information regarding the resource alternatives available to Montana-Dakota is summarized in Table 2-5. The capital cost, fixed O&M cost, variable O&M cost, fuel cost, and other characteristics estimated for these resource alternatives were developed based on manufacturer's budgetary pricing, consulting engineer studies, Montana-Dakota's experience and expertise, and other available sources.

Simple Cycle Combustion Turbine

Simple-cycle combustion turbines (SCCT) are primarily built to serve peaking capacity needs and are usually used to supply a limited amount of energy because SCCTs are fueled by natural gas or fuel oil, which results in higher fuel cost than coal. The SCCT units are, however, lower in capital costs compared to other generating types and can be installed within a relatively short lead time (two to three years). Two basic types of SCCT exist: aeroderivative (Aero), and heavy-duty (Frame). Aero SCCT's are adapted from jet and turboshaft jet engines, and are usually lighter, smaller, and more thermally efficient than similar sized Frame units. However, they generally have a higher capital cost, more expensive maintenance costs, are more susceptible to reliability problems in cold weather operation, and have a maximum of 100 MW's generating capability in simple cycle form. Frame units are designed to drive stationary generation and process plant equipment. They are usually less expensive than Aero's, more robust, require less frequent inspection and maintenance intervals, and are available in up to 500 MW's in simple cycle form. Montana-Dakota has operating experience with four Frame units, and one Aero unit. Three options for the SCCT were analyzed in the resource expansion analysis: a 37.4 MW Aero unit, a 71.6 MW Frame unit, and an 87.4 MW Aero unit.

Simple Cycle Internal Combustion Engine

Simple-cycle internal combustion engines (ICE) are primarily built to serve peaking capacity needs and are usually used to supply a limited amount of energy because ICEs are fueled by natural gas or fuel oil, which results in higher fuel cost than coal. The ICE units require a relatively short lead time (two to three years) and are, however, lower in capital costs, normally more thermally efficient, and require lower fuel pressure compared to other SCCT's of similar power. Two ICE plants, utilizing two ICE's per plant, were analyzed in the resource expansion analysis: a 36.6 MW natural gas fired option, and a 33.3 MW dual fuel option that is designed to burn natural gas or fuel oil.

Combined Cycle Combustion Turbine

A conventional combined cycle combustion turbine (CCCT) burns natural gas or fuel oil in a SCCT. The hot exhaust gases from the SCCT pass through a heat recovery steam generator that produces steam for a steam turbine. CCCT's have one of the highest efficiencies of any new power plant, at more than 60%, and are usually used as a baseload unit. However, because they are fueled by natural gas or fuel oil, the units are higher-cost energy producers compared to coal-fired baseload units, which could limit their hours of operation. Three natural gas fired CCCTs were analyzed in the resource expansion analysis: a 47.5 MW Aero unit, a 129 MW Frame unit, and a 560 MW Frame unit.

Coal

Coal-fired power plants are primarily built to serve baseload power requirements. This type of generation is characterized as having a high capital cost with low operating and fuel costs, while providing a stable capacity and energy source. With low operating and fuel costs, baseload units produce large amounts of energy at a relatively low cost. However, as significant new federal regulations to reduce air emissions, including greenhouse gases are implemented coal-fired baseload generation is unlikely to be available as a new resource option for the foreseeable future. Two lignite coal-fired power plants, modeled in blocks of 30 MW, were included in the resource expansion analysis: a 168 MW circulating fluidized bed combustion (CFBC) boiler without CO_2 capture, and a 122 MW CFBC boiler with CO_2 capture.

Wind (Self-Built)

A wind energy resource is characterized as being a clean, renewable resource with low operating and maintenance costs. The main disadvantage of wind generation is that, because of the variability of wind, it cannot be relied on as a firm capacity resource. Unlike the thermal resources such as coal-fired units and combustion turbines, wind energy resources are allowed limited zonal resource credits (ZRC) by MISO. Therefore, the installation of additional wind generation on Montana-Dakota's system requires adding other capacity resources to meet the MISO planning reserve margin requirements.

This option represents Montana-Dakota's self-built wind generation. A $23/MWh (after tax) Production Tax Credit (PTC), which was modeled as a negative variable O&M cost, was assumed to be in effect for new wind generation installed before the end of 2014 as long as construction started at the end of 2013. Once the wind generation was selected as part of the least-cost plan, the tax credit would continue for ten years from its date of commercial operation. Table 2-5 shows four different options: 20 MW and 50 MW North Dakota options, and 20 MW and 50 MW Montana options. Wind resources installed before the end of 2014 includes the PTC, while wind resource options after 2014 do not include the tax credit.

Solar

Solar resources are characterized as renewable, high capital cost, low operation and maintenance cost energy sources. Like wind, solar is a variable output energy resource and must rely on other capacity resources to meet Montana-Dakota's MISO planning reserve margin requirements. Three types of 30 MW solar options were included in the resource expansion analysis: thermal, concentrated, and photovoltaic solar.

Wind (Purchased Energy)

The wind energy purchase option was modeled in two blocks of 25 MW that provide energy only with no eligible ZRCs. The wind options were included as a 2015 option in the model and scheduled to last for 30 years. The cost associated with the wind energy option is shown in Table 2-5.

Landfill Gas

Methane gas produced from landfill sites can be captured and used as an alternative fuel to produce electricity. Montana-Dakota modeled a 31.8 MW Frame SCCT burning landfill gas in its resource expansion analysis. A project of this size would require a location where there is a substantially sized landfill, which may not be representative of a landfill within Montana-Dakota's service territory.

Biomass

Similar in operation to a coal-fired power plant, a biomass-fired power plant burns a carbon-neutral organic based fuel instead of coal. The biomass option is considered a renewable resource with high capital and fuel costs as compared to coal and natural gas fired options. A 37.1 MW biomass option was included in the resource expansion analysis.

Solid Waste

Utilizing a boiler similar to what is used in a biomass-fired power plant, a solid waste power plant burns municipal solid waste as its fuel. A performance and cost analysis was completed for this unit for inclusion into the resource expansion model. However, after a considerable amount of research, an accurate estimate for fuel costs could not be obtained. Therefore, the solid waste option was not included as an alternative for the supply-side resource options.

Geothermal

Using the earth's high core temperature to heat a working fluid is used to turn a turbine and a generator. The working fluid is then cooled and returned to the earth's core for reheating of the working fluid. The geothermal option is considered a renewable resource with high capital and operating and maintenance costs as compared to coal and natural gas fired options. A geothermal plant is dispatchable and would receive ZRCs for resource adequacy purposes similar to a coal or gas-fired facility. A geothermal option was modeled in a 30 MW block in the resource expansion analysis.

Lewis & Clark Station Options

The Lewis & Clark Station Project and natural gas options were studied to compare the baghouse installation against other alternatives to determine if it would be more effective to retire the Lewis & Clark plant, convert the plant to natural gas-fired generation only, or install the baghouse required to allow continued operation of the plant. The analysis assumed the retirement of the Lewis & Clark plant at the end of 2014 with the new resource options available to the EGEAS model in 2015. The model assumed if the baghouse option was chosen the life of the plant would be five additional years from the time the baghouse was installed. The five year life is a conservative modeling approach and is used to show the value of continuing to run the Lewis & Clark Station on coal even under a limited remaining life scenario.

The natural gas-fired options for the Lewis & Clark Station were considered to have a twenty year life. For reliability purposes, Lewis & Clark natural gas-fired options in the EGEAS model were required to operate at their minimum generation level for four months, equal to a minimum ten percent capacity factor, every year through 2019 to support the Bakken area load. The costs associated with the Lewis & Clark options are shown in Table 2-5.

Table 2-5

Considered Resource Alternatives Available to Montana-Dakota

EGEAS Model Input Summary, 2013 $	Plant Size (MW, net)	ZRC	Capital Cost ($/kW)	Fixed O&M ($/kW-month)	Variable O&M ($/MWh)	Major Maintenance ($/kW-month)	Total Fixed O&M ($/kW-year)	Full Load Heat Rate (BTU/kWh)	Carbon Intensity (ton/GWh)	Fuel Cost ($/MBtu)
GE 7EA[1]	71.6	67.4	$759.13	$0.96	$2.70	$0.03	$17.47	11955	699	$3.70
GELMS100PB[1]	87.4	82.2	$976.15	$1.42	$4.45	$0.03	$21.98	9049	529	$3.70
GE LM6000PH[1]	37.4	34.8	$1,232.02	$2.06	$4.24	$0.03	$35.78	9943	584	$3.70
GE LM6000PH Sprint (CC 1X1)[1]	47.5	44.3	$1,479.03	$2.10	$4.65	$0.03	$33.95	8295	491	$3.70
GE 7EA (CC 1X1)[1]	129	122.4	$1,069.36	$1.05	$3.37	$0.03	$16.06	7611	447	$3.70
GE7FA.05 (CC 2X1)[1]	200	189.8	$827.57	$0.72	$3.81	$0.03	$11.00	6719	396	$3.70
SIEMENS SGT-900 LANDFILL GAS[2]	31.8	29.6	$1,165.81	$1.73	$2.70	$0.03	$21.12	13634	1178.5	$4.44
WARTSILA 18V50SG	36.6	34.0	$954.68	$0.71	$3.30	$0.87	$29.89	8368	461	$3.70
WARTSILA 18V50DF	33.3	30.9	$1,053.92	$0.71	$3.30	$0.92	$31.57	8467	465.5	$3.70
BIOMASS	37.1	30.8	$3,212.76	$9.16	$5.46	$0.03	$110.28	11218	1196.5	$6.56
PV SOLAR	30	7.5	$5,196.00	$1.52	$0.00	$0.00	$18.24	-	-	$0.00
CONC. SOLAR	30	9.0	$7,271.80	$4.29	$0.00	$0.00	$51.48	-	-	$0.00
THERMAL SOLAR	30	6.0	$5,126.00	$5.83	$0.00	$0.00	$69.96	-	-	$0.00
GEOTHERMAL	30	18.9	$2,746.00	$9.89	$10.53	$0.00	$118.68	-	-	$0.00
CFBC WITHOUT CO2 Capture	168	155.7	$3,520.07	$17.43	$11.78	$0.00	$209.16	9974	973	$1.45
CFBC WITH CO2 Capture[5]	122	113.1	$6,437.54	$23.92	$18.67	$0.00	$287.04	13781	124	$1.45
ND Wind[3]	20	4.0	$1,897.63	$3.27	$0.00	$0.00	$39.24	-	-	$0.00
ND Wind[3]	50	10.0	$1,885.16	$3.27	$0.00	$0.00	$39.24	-	-	$0.00
MT Wind[3]	20	4.0	$1,853.75	$3.27	$0.00	$0.00	$39.24	-	-	$0.00
MT Wind[3]	50	10.0	$1,836.10	$3.27	$0.00	$0.00	$39.24	-	-	$0.00
Wind Energy[4]	25	-	-	$0.00	$28.00	$0.00	$0.00	-	-	$0.00
Lewis & Clark Bag House[4,6]	52	51.8	$527.29	$5.02	$3.89	$0.00	$60.29	12700	1529	$1.44
Lewis & Clark Gas Option 1	52.3	52.1	$196.45	$3.88	$1.45	$0.00	$46.51	12412	1000	$3.70
Lewis & Clark Gas Option 2	52.3	52.1	$22.49	$5.99	$1.45	$0.00	$71.88	12412	1000	$3.70
Lewis & Clark Gas Option 3	52.3	52.1	$298.28	$3.88	$1.45	$0.00	$46.51	12412	1000	$3.70

*No transmission or system upgrades included in any of the cost estimates.

1. No pipeline costs included.

2. Fuel costs will be set at a 20% premium over natural gas prices. The size of this unit would require a large city, and may not be representative of a unit built in MDU's service area.

3 Included an option with a negative variable O&M to represent production tax credits (PTC) for wind through 2014.

4 The O&M costs are in 2015 dollars.

5 CO2 Sequestration costs are not included in this cost estimate

6. The capital cost includes AFUDC

Unit Retirements

Montana-Dakota is modeling the hypothetical retirement of Heskett 1 at the end of 2019. The retirement is assumed under the premise that additional EPA rules may be developed around 2020 that would require the Heskett 1 plant to install new emission controls or shutdown. However, at this time there is no actual plan to retire Heskett 1.

Additionally, Montana-Dakota's wind projects (Diamond Willow and Cedar Hills) are assumed to be retired in the model after a 20 year operating life. This would require the model to replace the wind projects within the initial 20 year study period.

Summaries of Results

Thirteen planning scenarios, which include the base case with the Lewis & Clark Station retired in 2015, three gas conversion options for the Lewis & Clark Station and a case including the Lewis & Clark Station retrofit determined to be the optimal case were produced. Eleven sensitivity runs with the optimal resource case, were considered. The least-cost resource plan and associated net present value (NPV) of the total revenue requirement for each scenario are shown in Table 3-1.

Table 3-1: Least-Cost Resource Expansion Plans for the Studied Scenarios

	Lewis and Clark Resource Options					All Sensitivity Cases run with Optimal Resource Case							
	Base Case: Lewis & Clark retire 2014	Lewis & Clark Gas Option 1	Lewis & Clark Gas Option 2	Lewis & Clark Gas Option 3	Optimal Case Lewis & Clark Retrofit	Low Gas price	High Gas Price	Low Growth	High Growth	$30 Carbon Tax	$50 Carbon Tax	High CT and IC Costs	Current MISO RA
2013							WIND50			WIND20	WIND50		
2014													
2015	4-WSCT, 2-WIND_PPA	LCNG1, 2-WIND_PPA, 2-WSCT	LCNG2, 2-WIND_PPA, 2-WSCT	LCNG3, 2-WIND_PPA, 2-WSCT	LCBH,2-WIND_PPA, 2-WSCT	LCBH,2-WIND_PPA,2-WSCT	LCBH,2-WIND_PPA,2-WSCT	2-WIND_PPA	LCBH,2-WIND_PPA,2-WSCT	LCBH,2-WIND_PPA, 2-WSCT	LCBH,2-WIND_PPA, 2-WSCT	LCBH, 2-WIND_PPA, 2-WSCT	LCBH,2-WIND_PP
2016							WSCT		WSCT				
2017		CT72	CT72	CT72	WSCT	WSCT		WSCT	CT72			WSCT	WSCT
2018							WIND20			WSCT	WSCT		
2019	CT72						WIND50						
2020					CC-200	CC-200	CC-200		CC-200	CC-200	CC-200	CC-200	CC-200
2021													
2022		CC-129	CC-129	CC-129									
2023													
2024	CC-129								CC-129				
2025									CT72				
2026								WSCT					
2027									CC-129				
2028		WSCT	WSCT	WSCT					CT72				
2029	WSCT												
2030									CC-129				
2031		WSCT	WSCT	WSCT			WIND20		CT72				
2032	WIND20				WIND20	WIND20	WIND50		WSCT			WIND20	
NPV[1]	$3,639.70	$3,643.13	$3,648.09	$3,656.01	$3,525.11	$3,263.55	$4,144.76	$2,417.28	$5,229.43	$4,457.98	$5,061.77	$3,599.27	$3,412.59

1 - NPV in millions of dollars
LCBH - Lewis & Clark baghouse (~$27.4 million)
WSCT - 36.6MW Wartsila18V50SG Combustion Turbine(~$955/kW or $33.2 million)
LCNG1 - Lewis & Clark fueled by natural gas(~$10.3 million)Option1-Bear Paw plant
LCNG2 - Lewis & Clark fueled by natural gas(~$1.2 million capital and $1.3 million annual reservation)Option2-Modify WBI Charbonneau station
LCNG3 - Lewis & Clark fueled by natural gas(~$15.6 million)Option3-Direct build to Northern Border
WIND PPA - 25MW blocks
CC-200 - 200MW of a potential partnership of a 560MW GE7FA.05(Combined Cycle 2x1) ($828/kW or $165.5 million)
CT72 - 71.6MW GE 7EA Combustion Turbine (~759/kW or $54.4 million)
CC-129 - 129MW Combined Cycle with GE 7EA(incremental increase of~$648/kW or ~$83.6 million)
WIND50 – 50 MW of self-built wind
WIND20 - 20 MW of self-built wind

Optimal Resource Plan Results

The Optimal Resource plan consists of the following resource additions for 2015-2020:

- Install the Lewis & Clark Station baghouse in 2015;
- Contract for 50-100 MW of wind energy in 2015 (to be determined based upon results of the Company's 2013 Request for Proposals);
- Install two Internal Combustion Engines (two 36.6 MW Wartsila 18V50SG) for a total of 73.2 MW in 2015;
- Install an additional Internal Combustion Engine (36.6 MW Wartsila 18V50SG) in 2017; and
- Assuming the retirement of Heskett 1 and the Lewis & Clark Station at the end of 2019, consider options to partner for 200 MW from a Combined Cycle unit (560MW GE7FA.05 Combined Cycle 2x1) in 2020.

For the later years, a 20 MW self-built wind farm was selected to be installed in 2032. The NPV of the Optimal Resource Case over the 50-year study period equates to $3,525.11 million in 2012 dollars, as shown in Table 3-1.

The "Base Case: Lewis & Clark Station retire 2014" assumed that nothing was done to meet the MATS requirement for the Lewis & Clark station and the plant was then retired at the end of 2014 and had to be replaced with new resources in 2015. The NPV of the revenue requirement, over the 50 year study period, is 3.15 percent lower (approximately $115 million) under the Optimal Case, including the installation of the pollution control equipment at the Lewis & Clark station, than the Base Case that assumed retirement of the Lewis & Clark Station.

Sensitivity Analysis

The eleven sensitivity scenarios consist of various assumptions regarding carbon taxes, low and high natural gas prices, low and high load growth, current MISO

Resource Adequacy, higher capital costs for combustion turbines, and the Lewis & Clark Station gas options.

Carbon Tax

With the potential of a future carbon penalty applied to fossil fuel units and MISO energy purchases, an assumed carbon tax was applied to every ton of carbon dioxide (CO_2) emitted from Montana-Dakota's existing coal-fired units and natural gas-fired SCCTs, energy purchases from the MISO market, and new generating units added to the resource plan starting in 2020. While no carbon tax was modeled in the Optimal Resource case, consistent with N.D.C.C. §49-02-23, Montana-Dakota modeled a carbon tax of $30 and $50 per ton in the sensitivity analysis. For both the $30 and $50 per ton scenarios, the resource plans selected remained similar to the Optimal Resource case, which includes the Lewis & Clark baghouse, with the only difference being the selection of 20 MW of self-built wind in 2013 in the $30 per ton and 50 MW of self-built wind in the $50 per ton scenario. At $30 per ton the NPV increased by 26.5 percent above the Optimal Resource case, and at $50 per ton the NPV increased by 43.6 percent over the Optimal Resource case. Montana-Dakota recognizes the amount and applicability of any carbon allowance price or tax has not been established, but this analysis was conducted to provide information regarding possible impacts to customers and to identify potential changes in the Company's future generation resource mix as part of the least-cost plan in the event a carbon tax was implemented.

High and Low Gas Price

Prices for natural gas supplies as delivered to Montana-Dakota's existing turbines, future combustion turbines, and future combined cycle plants were developed in-house for use in the resource expansion analysis based on Montana-Dakota's view of the long-term outlook of natural gas pricing. For the Optimal Resource case, natural gas was priced for delivery at $3.51/MBTU for 2013, and increased to $4.33/MBTU in 2017. After 2017, natural gas prices were escalated by three percent annually. Considering the historical fluctuations of natural gas prices, there is a need to consider what impact both higher and lower gas prices would have on the Optimal Resource case. Therefore, high and low gas price scenarios were also developed, whereby the gas price used in the Optimal Resource case was increased by $3/MBTU and decreased by $1/MBTU from the Optimal Resource case, respectively. The high and low gas price cases were escalated by three percent annually after 2017. The results of the high natural gas price case were similar to the Optimal Resource case, which includes the Lewis and Clark baghouse, with the exception of the addition of more self-built wind totaling 190 MW over the 20 year planning period. The NPV of the revenue requirement in this scenario increased 17.58 percent over the Optimal Resource case. The results of low natural gas price scenario were the same as the Optimal Resource case. This case decreased the NPV of the revenue requirement by 7.42 percent from the Optimal Resource case.

Current MISO Resource Adequacy (RA)

This sensitivity scenario considered the continuation of current 80.6 percent coincident factor that Montana-Dakota has within MISO's resource adequacy for the 2013-14 planning year. The sensitivity scenario requires a lower capacity need, however the energy needs do not change. The selected least-cost plan for this scenario was different from the Optimal Resource case, still includes the Lewis& Clark baghouse, with two fewer internal combustion engines needed and no self-built wind in 2032. The results of this scenario indicate a decrease of 3.19 percent in the NPV of the revenue requirement over the Optimal Resource case.

Low Growth

This scenario was used to evaluate the load growth potential at less than the Optimal Resource case with an average growth rate of 0.5 percent per year during the 20-year forecast. The basis for this assumption came from Montana-Dakota's historical growth rate during 1985-1993. The results of this scenario indicate that there is less future capacity and energy needed, resulting in the following resource additions: no Lewis & Clark Station baghouse in 2015, two internal combustion engines (2017 and 2026), and 50 MW of wind energy in 2015. This scenario is very unlikely based on forecasted growth levels in the Bakken and surrounding areas.

High Growth

A high-growth scenario evaluated the effects of a continued long-term average load growth rate of 4.4 percent per year starting in 2015. The basis for 4.4 percent per year assumption came from Montana-Dakota's historical growth rate during 1977-1985. For 2013-2014, the forecasted growth for the 50/50 forecast was used as the growth rate in those two years as it was greater than the 4.4 percent per year. The results of this scenario indicate the need for the following resources over the Optimal Resource case: a total of one more internal combustion engine (two 18.3 MW Wartsila 18V50SG) over the study period and four SCCT (71.6 MW GE 7EA) of which three would be converted to CCCT (129 MW GE 7EA (1x1)).

High Combustion Turbine and Internal Combustion Engines Costs

Historically the costs of materials associated with the construction of generation have increased at a rate higher than general inflation both in the United States and the rest of the world. The Optimal Resource case reflects the present price forecasted costs for all generation options, but for purposes of risk analysis, Montana-Dakota considered the impact of higher installed costs for new generation (i.e., combustion turbines and internal combustion engines) on the resource plan. This sensitivity scenario included a 20 percent increase in capital costs for future combustion turbines and internal combustion engines to determine the sensitivity of the optimal resource case to increases in combustion turbine and internal combustion engine costs. The Optimal Resource case stays the same and the results of this sensitivity case indicate an increase of 2.1 percent in the NPV of the revenue requirement over the optimal resource case.

Lewis & Clark Natural Gas Options

In all three Lewis & Clark natural gas options, the Lewis & Clark unit had to be forced into the model as none of the Lewis & Clark natural gas options were least-cost as compared to the Lewis and Clark baghouse option. The least-cost of the three gas options was Option 1, which included the construction of a natural gas pipeline to a nearby natural gas processing plant. This resulted in an increase of 3.3 percent or $118.02 million in NPV of the revenue requirement over the Optimal Resource case. All three options had the same resource plan which differed from the Optimal Resource plan. They consisted of two more 18.3 MW Wartsila 18V50SG units over the study period, no self-built wind added in 2032, and a 129 MW CCCT (GE 7EA (1x1)) unit in 2022.

Summary of Results

Figures 4-1, 4-2, and 4-3 show a comparison of the resource mix that Montana-Dakota has available to serve its customers' needs in 2013, as compared to the Optimal Resource case plan in 2015 and 2020.

Figure 4-1

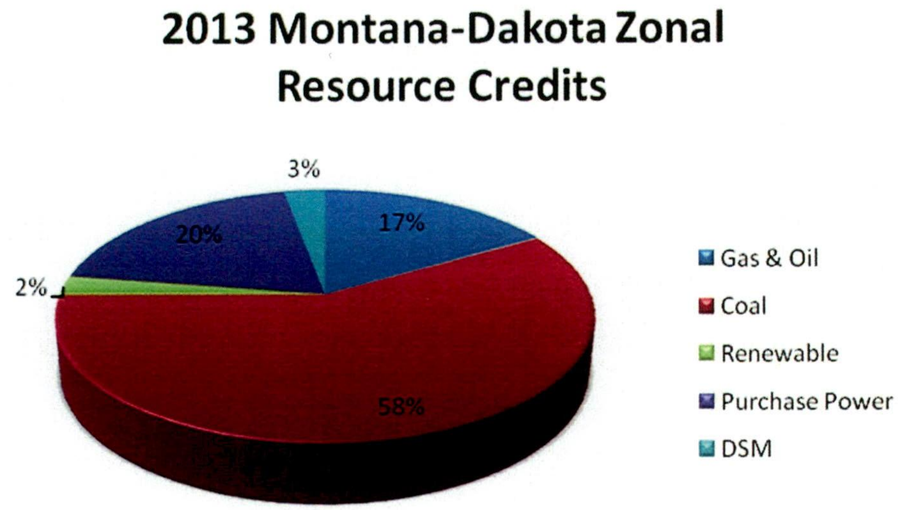


Figure 4-2

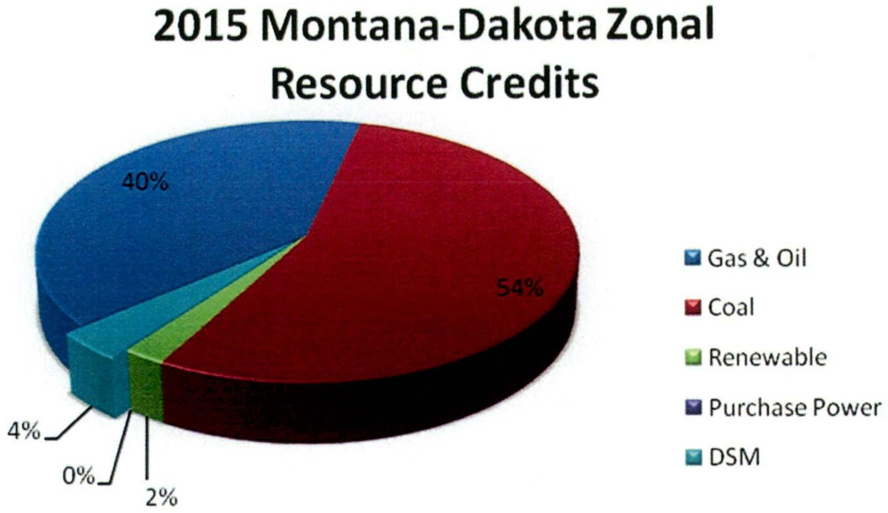
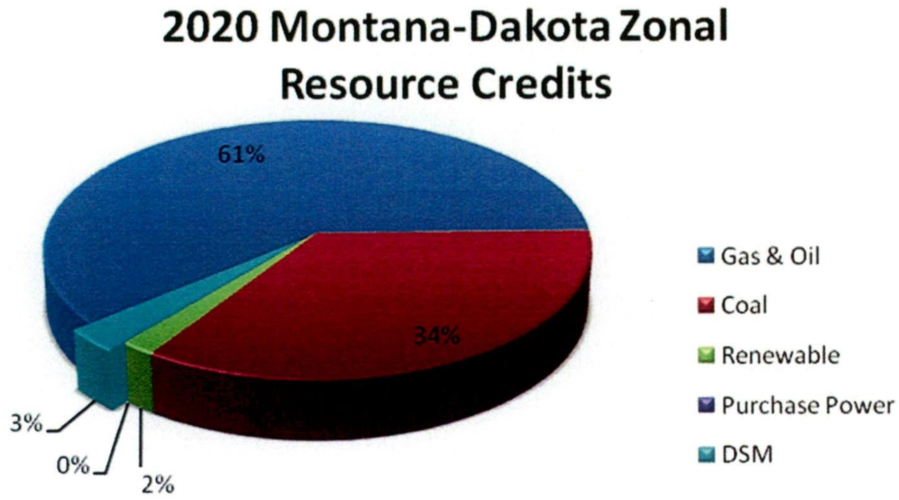


Figure 4-3



As shown in Figures 4-1, 4-2 and 4-3, in 2013 approximately 17 percent of Montana-Dakota's resource capacity is supplied by natural gas and oil-fired combustion turbines and internal combustion engines while in 2015 and 2020, based on the optimal resource plan, approximately 40 percent and 61 percent respectively of the Company's resource capacity would be provided by natural gas and oil-fired combustion turbines and internal combustion engines. The resource additions were selected to replace the current purchased capacity agreements and meet the Company's growing energy requirements on peak.

The sensitivity scenarios show that the largest variations in the NPV of supply plans relate to potential carbon tax legislation and high load growth scenarios. With a $30 per ton carbon tax, the resource plan remains similar to the Optimal Resource case, which includes the Lewis & Clark baghouse, with the exception of 20 MW self-built wind in 2013, but the NPV increased by 26.5 percent. The same can be seen with $50 per ton carbon tax – the NPV increases, but the resource plan remains the same except for a 50 MW self-built wind in 2013.

Conclusions

Based on the results of the supply-side and integration analysis, the resource plan including the Lewis & Clark retrofit represents the Optimal Resource case. The following resources are selected as the least-cost options in meeting the forecasted capacity and energy requirements until 2020:

- Install the Lewis & Clark baghouse Project in 2015
- Contract for 50-100 MW of wind energy in 2015 (To be determined based upon results of the Company's 2013 Request for Proposals);
- Install 109.8 MW of internal combustion engines (73.2 MW in 2015 and 36.6 MW) in 2017. (At this time Montana-Dakota would seek to purchase capacity through the MISO Capacity Auction or a bi-lateral agreement to meet this resource addition); and
- Look at options to partner in the construction of a large CCCT in 2020 with an ownership of 200 MW.

References

MISO Business Practice Manual-11-r11 Resource Adequacy. (October 1, 2012)

EGEAS User's Guide Version 9.02. New York, New York: Stone & Webster Management Consultants, Inc., June 1999.

Midwest ISO Planning Year 2013 LOLE Study Report. (November 1, 2012)