Power Supply Plan

Grand Haven Board of Light & Power

Power Supply Plan
Project No. 109373

12/14/2018

BURNS & McDONNELL

December 14, 2018

Mr. Erik Booth, P.E.
Power Supply Manager
Grand Haven Board of Light & Power
1700 Eaton Drive
Grand Haven, MI 49417

Re: Power Supply Plan

Dear Mr. Booth:

The Grand Haven Board of Light & Power ("GHBLP") retained Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") to provide planning assistance for both short-term and long-term power supply needs while considering previous planning studies and efforts. GHBLP requested that Burns & McDonnell form a Power Supply Plan ("Study") to assess the options that may be available to GHBLP for providing reliable, low cost, and environmentally compliant power to its customers.

The report attached hereto provides the detailed evaluations conducted by Burns & McDonnell. GHBLP has completed a comprehensive evaluation of its power supply portfolio since 2012 to present. The analysis has been broad and deep evaluating existing generation, future options including both traditional and renewable resources, existing site utilization, local resources, and market power purchases. Based on the analysis herein, along with the previous efforts conducted by GHBLP, Burns & McDonnell offers the following recommendations for GHBLP to consider.

1. GHBLP should retire J.B. Sims Unit 3 on June 1, 2020.
2. Decommissioning and demolition studies should be pursued to permanently retire J.B. Sims Unit 3. These studies should be conducted under the assumption that the Sims site will be utilized as a brownfield location for a new generating asset.
3. In accordance with GHBLP's stated policy and the requests of the City's residents, GHBLP should initiate a Project Definition Report ("PDR") for preliminary engineering of a new reciprocating engine generating asset and snow melt system. If the cost of such an asset is consistent with the assumptions in this Study, GHBLP should make the investment. This configuration offers several attractive advantages:
    a. Reciprocating internal combustion engines are flexible across a wide range of load profiles, have responsive and prompt ramp rates, take advantage of low natural gas prices, and operate cleanly and efficiently.
    b. The capacity payments in the form of debt service will be retired over the life of the bonds rather than purchasing capacity externally which requires payments in perpetuity.
    c. Local generation serves as a hedge against potentially unfavorable market conditions, mitigating some of the risks of relying solely on the MISO market. Additionally, local generation in the form of reciprocating engines, allows

GHBLP to quickly add additional assets in the future if warranted by changing market conditions.

Burns & McDonnell appreciates the opportunity to assist GHBLP with this important endeavor. If you have any questions regarding the information presented within this Study, please contact me at 816-822-3459 or mborgstadt@burnsmcd.com.

Sincerely,

Mike Borgstadt, P.E.
Project Manager / Manager, Utility Consulting

MEB/meb

Enclosure: Power Supply Plan

Power Supply Plan

prepared for

Grand Haven Board of Light & Power
Power Supply Plan
Grand Haven, Michigan

Project No. 109373

12/14/2018

prepared by

Burns & McDonnell Michigan, Inc.
Detroit, Michigan

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
BES	Bulk Electric System
B&V	Black & Veatch
Burns & McDonnell	Burns & McDonnell Michigan, Inc.
CO_2	Carbon Dioxide
COD	Commercial Operation Date
City	City of Grand Haven
CPP	Clean Power Plan
DVC	Dynamic Voltage Control
EPA	Environmental Protection Agency
GHBLP	Grand Haven Board of Light & Power
GW	Gigawatt
GWh	Gigawatt-hour
IRP	Integrated Resource Plan
LMP	Locational Marginal Pricing
LCOE	Levelized Cost of Electricity
LSE	Load Serving Entity
MISO	Midcontinent Independent System Operator
MTEP	MISO Transmission Expansion Plan
MPPA	Michigan Public Power Agency
MW	Megawatt
NERC	North American Electric Reliability Council

Abbreviation	Term/Phrase/Name
NITS	Network Integration Transmission Service
NPV	Net Present Value
NYMEX	New York Mercantile Exchange
OEM	Original Equipment Manufacturer
PPA	Power Purchase Agreement
PCT	Programmable Communicating Thermostat
PDR	Project Definition Report
PTP	Point-To-Point
RTO	Regional Transmission Organization
RICE	Reciprocating Internal Combustion Engine
S&L	Sargent & Lundy
SCGT	Simple Cycle Gas Turbine
Sims	J.B. Sims Generating Station
Study	Power Supply Plan
UCAP	Unforced Capacity
U.S.	United States
ZRC	Zonal Resource Credits

STATEMENT OF LIMITATIONS

Certain aspects of this report were prepared under and shall only be available to parties that have executed, a Confidentiality Agreement with Grand Haven Board of Light & Power. Any entity in possession of or that reads or otherwise utilizes confidential information herein, is assumed to have executed or otherwise be responsible and obligated to comply with the contents of such Confidentiality Agreement. Any entity in possession of this document shall hold and protect its confidential contents contained herein in confidence and not share with others without prior written authorization from Grand Haven Board of Light & Power.

In preparation of this report, Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") has relied upon information provided by Grand Haven Board of Light & Power and other third-party sources. While there is no reason to believe that the information provided is inaccurate or incomplete in any material respect, Burns & McDonnell has not independently verified such information and cannot guarantee or warranty its accuracy or completeness.

Burns & McDonnell's estimates, analyses, and recommendations contained in this report are based on professional experience, qualifications, and judgment. Burns & McDonnell has no control over weather; cost and availability of labor, material, and equipment; labor productivity; energy or commodity pricing; demand or usage; population demographics; market conditions; changes in technology; and other economic or political factors affecting such estimates, analyses, and recommendations. Therefore, Burns & McDonnell makes no guarantee or warranty (actual, expressed, or implied) that actual results will not vary, perhaps significantly, from the estimates, analyses, and recommendations contained herein.

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1.0 EXECUTIVE SUMMARY

1.1 Introduction & Objective

Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") was retained by the Grand Haven Board of Light & Power ("GHBLP"), to provide planning assistance for both short-term and long-term power supply needs. GHBLP requested that Burns & McDonnell perform a Power Supply Plan ("Study") to assess the options that may be available to GHBLP for providing reliable, low cost, and environmentally compliant power to its customers.

The electric industry is experiencing significant changes due to economic and political influences that can affect decisions made by a utility for providing power to its customers. The primary objective of a power supply plan is to provide an economic evaluation of a utility's power supply portfolio over both short-term and long-term planning horizons, with a specific focus on short-term decisions that will position a utility for long-term success. Each utility will have unique issues that will drive its decision-making process.

GHBLP is arriving at a decision point with regards to power supply. The coal-fired J.B. Sims Unit 3 ("Sims") is reaching the end of its useful life and would require significant capital investment to retain and utilize. Power supply is abundant, affordable, and reliable in Grand Haven's location on the Midcontinent Independent System Operator ("MISO") network, making Sims far less competitive and economical. GHBLP has taken steps to find a solution to these new market conditions that is in line with its stated policies, mission statement, and strategic objectives.

A power supply plan consists of numerous components and is an exhaustive evaluation of a utility's existing and future power supply. This Study consisted of a comprehensive review of previously commissioned studies and a detailed economic evaluation of power supply options currently available to GHBLP.

The following provides a summary of the key findings of the Power Supply Plan.

1.2 Conclusions

Burns & McDonnell conducted several assessments within this study, evaluating the economic benefits of maintaining long-term coal-fired operation of J.B. Sims Unit 3 and GHBLP's level of interaction with the MISO energy market. Based on the analysis conducted herein, Burns & McDonnell provides the following conclusions for various aspects of the Study.

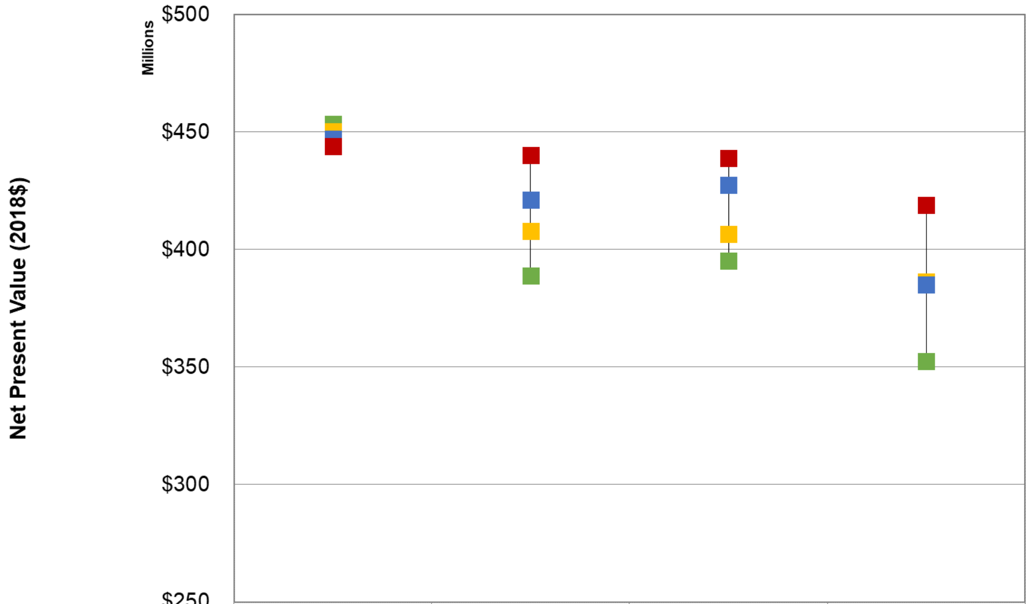
1. GHBLP initiated planning efforts in 2012 to identify potential alternatives to its aging power generation resources. S&L's IRP Study accurately concluded that J.B. Sims Unit 3 would not serve as a viable generating asset beyond its stated retirement date of 2022. Given the attractiveness of market supply and the projected decline of natural gas prices, the report recommended GHBLP retire J.B. Sims Unit 3 and increase its reliance on the MISO network to serve its load. To prepare for this outcome, the report advised GHBLP to take steps to prepare for and obtain MISO Network Integrated Transmission Service ("NITS") and commission further studies to explore local generation options.
2. Several studies were conducted by GHBLP from 2013 to 2018 as per S&L's recommendation. The subject matter of the studies included feasibility of a natural gas-fired plant, integrated resource planning efforts, internal policy discussions, economic modeling, plant condition assessments, and an assessment of the City's snowmelt system. Over the course of this timeframe, GHBLP stated its desire to transition to MISO NITS, maintain some form of local generation, and invest in a diverse and sustainable supply portfolio. In order to function in accordance with its mission statement and strategic plan, GHBLP recognized that J.B. Sims Unit 3 is not an effective or economic power supply asset and should be retired. Based off economic forecasts and siting studies, a natural gas-fired plant on the Sims site was identified as the most desirable local supply configuration.
3. Burns & McDonnell evaluated four power supply paths under four market scenarios consisting of various local supply options and variations in market interactions with MISO. These market interaction conditions were based on projected natural gas and capacity costs. The four supply paths and economic scenarios are shown in Table 1-1:

Table 1-1: Operating Scenarios and Power Supply Paths

	Scenario A Low Gas/High Capacity				Scenario B Low Gas/Low Capacity				Scenario C High Gas/High Capacity				Scenario D High Gas/Low Capacity			
Power Supply Path	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Power Supply No.	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
Power Supply Portfolio	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only

4. Each of the power supply paths were evaluated under the various scenarios to assess the total cost to provide wholesale power to meet GHBLP demand and energy requirements. The net present value of each path and scenario was determined and is presented in Figure 1-1.

Figure 1-1: Net Present Value of Power Supply Costs



	Path 1 J.B. Sims Unit 3	Path 2 4x 9 MW Recips	Path 3 6x 9 MW Recips	Path 4 MISO Market
Low Gas/Low Capacity	$453,384,057	$388,717,345	$395,052,209	$352,347,011
Low Gas/High Capacity	$450,121,714	$407,701,944	$406,609,640	$386,185,943
High Gas/Low Capacity	$446,997,772	$421,107,982	$427,381,441	$384,942,027
High Gas/High Capacity	$443,735,429	$440,092,581	$438,938,872	$418,780,959

5. In all market scenarios, continued J.B. Sims Unit 3 Operation (Path 1) incurred higher revenue requirements compared to the other three paths. Path 1 is more competitive with the other Paths in the High Gas Scenario, as coal resources become more economical to dispatch to the MISO network.
6. Installation of reciprocating engines (Path 2 and Path 3) allows GHBLP to retain local generating capacity while also taking advantage of low MISO wholesale power prices for the bulk of its energy needs. Based on the dispatch model, these generators would operate as price and load balancing peaking units, functioning at a capacity factor of less than 5 percent in all economic scenarios. Due to low natural gas prices, efficient combined cycle resources, and substantial wind generation within the MISO system, wholesale energy from MISO is expected to be lower cost than generation from reciprocating engines. These assets would be added primarily as capacity and provide a call-option for energy. Whereas the capacity purchases from the market would not be entirely eliminated, debt service would replace capacity payments to others with the installation of the local generation capacity. Despite a larger capital investment, this supply configuration is much more economical than continued operation of J.B. Sims Unit 3 and slightly more expensive (5 to 10 percent greater depending on the scenario) than buying all capacity from the market.

7. Market Only Supply (Path 4) has the lowest revenue requirements in all economic scenarios. The low cost of this Path is a result of excess MISO network capacity and affordable wholesale energy prices. Given the economic conditions and future forecasts, it is less expensive for GHBLP to source all energy and capacity from the MISO network than to dispatch from a local on-system resource over the study period, given current cost projections of needed capacity and energy market transactions. The PROMOD hourly dispatch model did not identify any significant transmission issues (i.e. congestion) that would inhibit 100 percent supply import.
8. Although Path 4 is projected to be the most economical over the 20-year study period, it does leave GHBLP exposed to market forces outside of its control and will require GHBLP to purchase capacity resources from the market in perpetuity. Paths 2 and 3 mitigate a potential unfavorable shift in the market. The physical footprint of a reciprocating engine plant supports expansion in the event that additional on-system capacity is required or economical in the future.

1.3 Recommendations

Based on the results of this assessment presented herein, the feedback received from the public, and on the desire of the community to maintain local resources, Burns & McDonnell offers the following recommendations.

1. GHBLP should retire J.B. Sims Unit 3 on June 1, 2020
2. Decommissioning and demolition studies should be considered to determine the costs to permanently retire J.B. Sims Unit 3. These studies should be conducted under the assumption that the Sims site will be utilized as a brownfield location for a new generating asset.
3. MISO power supply is an attractive alternative to J.B. Sims Unit 3. GHBLP should continue efforts to obtain NITS in MISO to secure “firm” capacity and energy which is currently scheduled for June 2020..
4. In accordance with GHBLP’s stated policy and the requests of the City’s residents, GHBLP should initiate a Preliminary Design Review (“PDR”) for a new RICE generating asset. If the cost of such an asset is consistent with the assumptions in this Study, GHBLP should make the investment. The RICE configuration offers several attractive advantages:
   a. Reciprocating internal combustion engines are flexible across a wide range of load profiles, have responsive and prompt ramp rates, and take advantage of low natural gas prices.
   b. The capacity payments in the form of debt service will be retired over the life of the bonds rather than purchasing capacity externally which requires payments in perpetuity.
   c. Staffing and O&M requirements in Path 2 and Path 3 are significantly less than would be needed to operate a steam plant such as Sims.

   d. Local generation serves as a hedge against potentially unfavorable market conditions, mitigating some of the risks of 100 percent network supply.
   e. Although MISO transmission reliability has historically been excellent and will improve even more with NITS, a local generator could provide a potential contingency power supply in the event of a "loss of grid" scenario if natural gas supply to the facility also remains uninterrupted.
5. Should the community decide to pursue a local generating facility, combined heat and power functionality could be evaluated for snowmelt purposes. However, snowmelt for three city blocks should not be used to decide dispatching of power supply resources for 14,000 industrial, commercial, and residential customers. Based on the experience of Burns & McDonnell, a co-located, yet de-coupled, snow melt system will likely be the most effective and efficient option.
6. GHBLP should take action to procure capacity required after the retirement of J.B. Sims Unit 3 on June 1, 2020. Capacity could be procured through MPPA, through power purchase agreements, or the annual MISO Planning Resource Auction.
   a. Assuming GHBLP pursues Path 2 with the installation of a 36-MW local generating facility, the capacity should be procured to cover any interim period between June 1, 2020 and the estimated in-service date of the new generation facility.
   b. If GHBLP opts to rely only on the MISO market for capacity, longer-term contracts, if available, should be considered if cost competitive. GHBLP should consider issuing a Request for Proposals ("RFP") for capacity if the community pursues this option.
7. GHBLP should continue to evaluate participation in renewable generation projects through its membership in MPPA as opportunities arise. Participation in MPPA may provide additional economies of scale and may supplement and provide complementary generation to GHBLP's power supply portfolio.
8. GHBLP should continue to consider adding local solar resources through a small community solar project. Burns & McDonnell recommends that GHBLP should first determine a power supply plan with respect to the local, natural gas-fired resource and then evaluate local solar as part of that plan; a local solar project should not be a guiding factor in deciding a power supply path forward. The reciprocating engine plant is sized appropriately within Path 2 to provide GHBLP the ability to add additional renewables, or other power supply resources, to the portfolio to meet energy and capacity requirements.
9. As determined in the internal Sims Staffing Considerations, GHBLP should continue to reduce staffing level at the Sims plant through attrition and internal transfers.

10. After the completion of the PDR and other engineering studies, Burns & McDonnell recommends GHBLP begin conducting financial studies to support the debt financing of the power generation facility.

2.0 INTRODUCTION

2.1 About Grand Haven Board of Light and & Power

The Grand Haven Board of Light & Power retained Burns & McDonnell Michigan, Inc. to conduct a quantitative and qualitative analysis of its existing power supply configuration and possible alternatives moving forward. This analysis was requested as the existing coal-fired J.B. Sims Generating Station ("Sims") reaches the end of its useful life and will require significant capital investment to replace or repair. GHBLP is a municipal electric utility serving approximately 14,000 customers in the greater Grand Haven, Michigan area.

Numerous studies have been commissioned by GHBLP in anticipation of the possible retirement of the Sims plant. While no capital investment for new generation has yet been made, these studies have prompted GHBLP to take steps towards increased reliance on the wholesale market. With the recent retirement of debt service for the existing plant, GHBLP does have the financial ability and an opportunity to invest in a new power supply portfolio. A robust portfolio requires an assessment of current and future generation resources, market conditions, and demand.

2.1.1 Current Load and Generating Resources

GHBLP's local generating resources consist of J.B. Sims Unit 3 and the Grand Haven Diesel Plant, as well as the import of power through its Energy Supply Agreement with Michigan Public Power Agency ("MPPA"). The two generators have a cumulative verified test capacity of 77.4 MW: 70.4 MW for Sims; 7 MW for Diesel 1. In 2017, GHBLP saw an average demand of 35 MW and peak demand of 63 MW. Accounting for 10 percent reserves, GHBLP has excess capacity of 7.9 MW. Both units are self-dispatched by GHBLP.

GHBLP also maintains a portfolio of renewable power through three long-term MPPA partnerships. These resources include:

- MPPA Landfill Gas Project
  - Energy Developments and NANR: 16.26 percent of 15.5 MW (2.5 MW)
- MPPA Energy Services Project (Wind)
  - Exelon Generation: 7.31 percent of 31.2 MW (2.3 MW)
  - Next Era Pegasus Wind Project: 9.67 percent of 62.5 MW (6.0 MW) – currently awaiting construction
  - CMS Energy: 10 MW from project year 2020/2021 through 2029/2030

- MPPA Energy Services Projects (Solar)
    - 10.5 MW - currently awaiting construction

While some of the projects are awaiting construction, estimates of contributions from these assets were made by Burns & McDonnell to increase the accuracy of the dispatch models.

2.2 Study Objectives

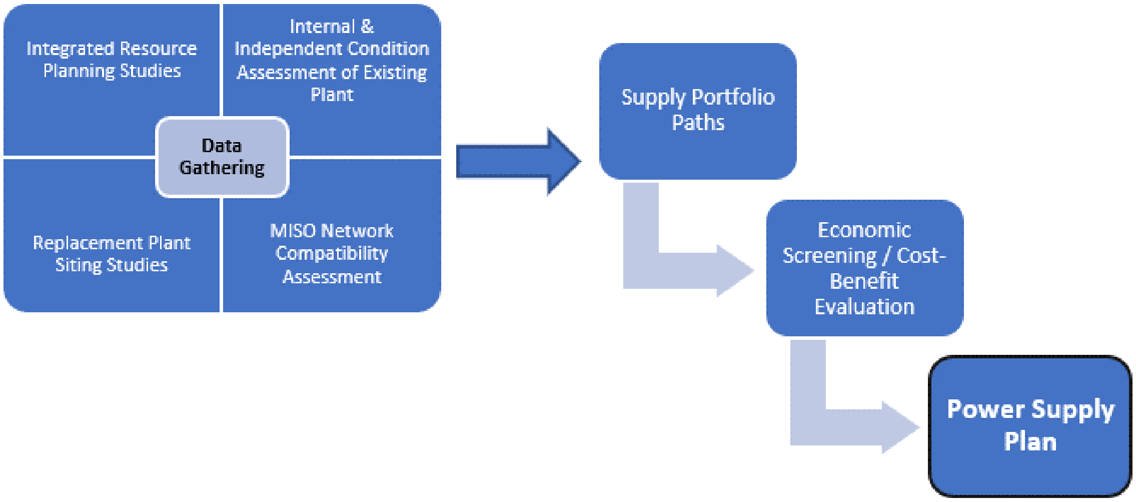
The primary objective of a power supply plan is to provide an economic evaluation of a utility's power supply portfolio over both short-term and long-term planning horizons, with a specific focus on short-term decisions that will position a utility for long-term success.

Each utility has unique issues that drive its decision-making process. Consistent with typical utility planning, the overall objectives of this Study included the following:

- Evaluate the condition of existing generating units, including expected or anticipated costs to maintain reliable operations into the future
- Provide recommended replacements, retirements, modifications, upgrades, and staffing levels for continued economic and reliable operation of on-system generating units
- Evaluate viable alternative generating technologies to replace GHBLP's existing generating units
- Compare the economics of continued use of the existing generating units to viable alternatives
- Recommend the preferred energy portfolio to supply GHBLP's electric customers over the next 20-years
- Provide a 20-year economic evaluation of alternative generation portfolios

To satisfy the Study objectives, Burns & McDonnell utilized the power supply plan process outlined in Figure 2-1. The efforts conducted to satisfy each step in this process are discussed in detail throughout the remainder of this report.

Figure 2-1: Power Supply Plan Process



Burns & McDonnell integrated historical data and analysis from GHBLP's previous planning efforts into our process of developing the City's Power Supply Plan. On this historical foundation, four different potential paths were identified based on the available assets, demands of the customer base, and planning goals of GHBLP. These paths were then modeled within potential economic scenarios to evaluate the most economical solution based on the best information available. Finally, modeling results were analyzed to provide final Power Supply Plan recommendations.

3.0 ELECTRIC POWER INDUSTRY REVIEW

The following provides a review of overall electric power industry trends, the MISO market, and GHBLP's current power supply.

3.1 Overall Electricity Industry Trends

The electricity industry continues to be impacted by numerous trends. The following provides a brief discussion of the overall trends that are impacting electric utilities and generators.

- Environmental regulations: Both federal and state environmental regulating agencies continue to pursue more stringent environmental regulations regarding emissions from power generating facilities, specifically coal-fired power plants, albeit federal stringency has eased or been reversed on some regulations under the current Environmental Protection Agency ("EPA") administration. Volatility in environmental regulatory policy raises concern regarding applicability of and compliance to existing environmental regulations.
- Clean Power Plan: One of the most controversial regulations from the EPA, the Clean Power Plan ("CPP"), targeted a reduction in carbon dioxide ("CO_2") emissions. This regulation was stayed (postponed indefinitely) by the United Sates ("U.S.") Supreme Court as appeals to the rule worked their way through the lower court system. Changes in EPA administration with the election of President Trump have rendered the CPP dormant and short-term federal CO_2 regulation significantly reduced. The question of long-term CO_2 regulation at the federal level remains unanswered and will be subject to future EPA leadership changes and political climates.
- Low natural gas prices: Natural gas prices remain low as production continues to outpace demand requirements. Industry futures, such as the New York Mercantile Exchange ("NYMEX"), feature relatively flat Henry Hub natural gas prices through 2020, then growing at an average of 2 percent through 2030.
- Continued renewable development: The use of wind and solar resources continues to increase. Many state and federal regulators continue to pursue increased renewable energy requirements. Technological advancements are expected to further lower prices of renewable energy, but the phaseout of federal renewable tax credits brings uncertainty regarding future pricing.
- Relatively low load growth: While much of the U.S. has seen economic growth since the economic recession in the 2008 and 2009 timeframe, the recovery of demand and energy has been much slower. Increased conservation programs have also contributed to lower load growth.

- Low wholesale market energy prices: The combination of low natural gas prices, increased renewable development, and relatively low load growth has kept wholesale market energy prices low compared to historical averages.
- Coal-fired retirements: With the combination of all the above factors, the investment in costly environmental compliance solutions at coal-fired power plants has reduced the overall economic benefit of coal-fired generation. Across the United States nearly 100 gigawatts ("GW") of coal-fired retirements have occurred, are pending, or have been announced; representing approximately 33 percent of the total coal fleet.
- Nuclear retirements: Similar factors driving coal-fired retirements are additionally placing pressure on nuclear power plants. Across the United States, approximately 5 GW of baseload nuclear plants have retired since 2013. An additional 22 GW of nuclear retirements are pending or have been announced; representing approximately 20 percent of the total nuclear fleet.
- Increased interest in "firm" natural gas pipeline capacity: A multitude of factors including coal-fired retirements, recent extreme winter weather, and increased dependence of natural gas for the electric industry have led to increased interest in firm capacity. If firm natural gas transport contracts are required for power generators, it could increase the cost of electrical production significantly.

3.2 Responsibilities of Electric Utilities

Electric utilities are responsible for providing low-cost, reliable, safe, and environmentally-compliant electric service to their customers (load). In order to accomplish this, utilities are responsible for meeting two requirements associated with load, demand and energy. Demand is the amount of electricity customers use at any one point in time and is typically measured with units of megawatts. The second portion of electric service is energy. Energy is a measure of how much electricity is used over time and is typically measured in units of gigawatt-hours ("GWh").

Electric utilities are responsible for maintaining enough generation (capacity) to meet forecasted demand. Capacity typically must be dispatchable to get accreditation toward utility capacity requirements. Renewable generation is typically intermittent and thus does not provide significant capacity. Electric utilities are also responsible for providing sufficient energy to meet customers' needs. Electrical energy can come from units owned by the utility, contracts, net metering, conservation, or the wholesale market.

3.2.1 North American Electric Reliability Council Requirements

The North American Electric Reliability Council ("NERC") was certified as the national Electric Reliability Organization as mandated by the Energy Policy Act of 2005. This designation allows NERC to develop and enforce compliance with mandatory electric reliability standards in the United States. Any electric utility operating within the United States must comply with reliability standards set by NERC.

Maintaining stable operation of the electric grid is one of NERC's top priorities, and thus has multiple requirements associated with grid stability. One of these requirements includes maintaining capacity in excess of forecasted peak load. These planning reserves ensure capacity is available if electric load is much higher than forecasted or if some generation resources are offline due to forced outage. An additional requirement is maintaining a set amount of operating reserves. Operating reserves are typically electric generators that can quickly react to fluctuations in electric demand or disturbances in the electric grid. Operating reserves provide the electric grid flexibility in real-time operation and serve to balance the supply and demand of electricity. These reserves are maintained by a balancing authority that is tasked with real-time operation of the electric grid.

Another area NERC regulates to maintain reliable operation of the electric grid is transmission planning for bulk electric systems. The threshold for compliance with these regulations is for transmission assets greater than 100 kV. NERC mandates analysis of a transmission operator's system under various operating conditions (contingencies). The contingencies represent various failures the electric grid may encounter in day-to-day operation. The number of contingencies the electric grid can withstand while maintaining electric service to customers is defined as its reliability standard. NERC regulation requires transmission operators to plan to an N-1 reliability standard. This means the electric grid must be able to withstand a single failure while maintaining electric service to customers. Transmission operators can plan to a higher standard of reliability, but NERC regulation only requires N-1 reliability.

NERC additionally requires transmission operators to have a system restoration plan approved by their reliability coordinator. The plan must cover how the transmission operator's system will restore service to an area when the bulk electric system ("BES") is shut down and the use of black start resources is required. The black start resource does not have to be located within the transmission operator's system but must be designated within the plan.

3.3 Midcontinent Independent System Operator

Founded in 2001, Midcontinent Independent System Operator is a regional transmission organization ("RTO") that oversees operation of the region's electricity grid, administers the region's wholesale electricity markets, and provides reliability planning for the region's bulk electricity system. Geographically, MISO is the largest RTO in existence. MISO is additionally in charge of monitoring the region's transmission network and developing transmission upgrade plans. MISO is a not-for-profit member-based organization that manages 65,000 miles of high voltage transmission, and 200,000 MW of power-generating resource across its footprint, which covers 15 U.S. states and one Canadian province.

GHBLP is in the process of obtaining full NITS in MISO. A recently completed System Impact Study identified the transmission system improvements necessary for GHBLP to obtain NITS. Currently, GHBLP uses a "point-to-point" ("PTP") transmission service from MISO. By using NITS, GHBLP will have access to "firm" energy and capacity from multiple network resources. This is priority for GHBLP, as all of its energy and capacity needs will be imported upon the retirement of J.B. Sims Unit 3, until another local resource can be constructed.

MISO members are required to have adequate capacity and reserves to meet their demand requirements. MISO currently requires utilities to use the Unforced Capacity ("UCAP") methodology to correspond with the utility's coincident peak of the overall MISO system. The UCAP methodology evaluates the unforced capacity against a utility's peak demand plus a reserve margin. The installed capacity of each generation resource is reduced to an unforced capacity value by factoring in the reliability of each unit. This methodology results in a lower reserve margin requirement, typically around 7 percent, compared to a methodology that utilizes the full installed capacity of each resource, typically around 12 percent. The UCAP method incentivizes power generators to operate their units more reliably, thus driving the UCAP capacity value closer to the installed capacity value.

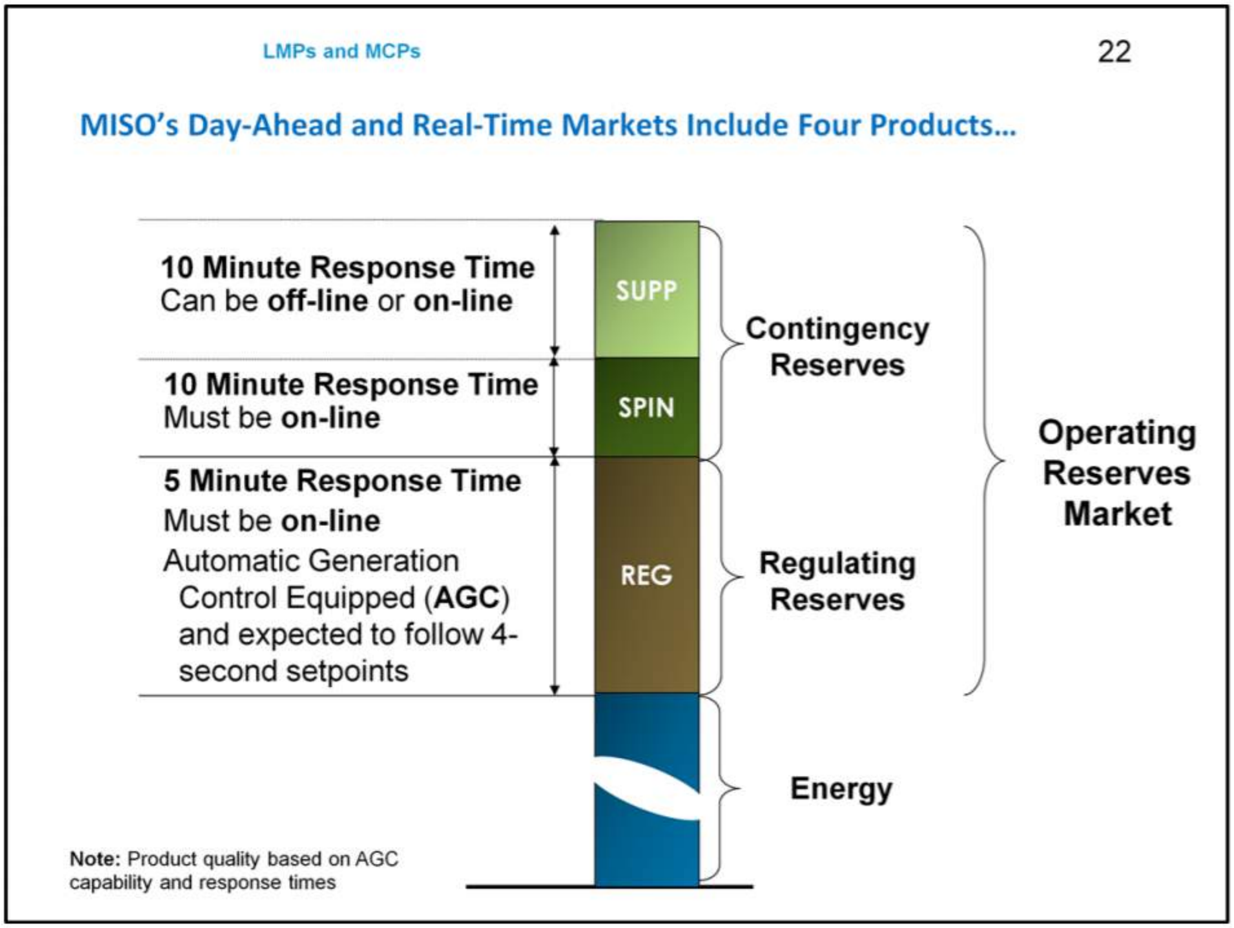
3.3.1 Wholesale Electricity Market

The MISO wholesale energy market contains sellers (producers) and buyers (loads) trading energy based on Locational Marginal Pricing ("LMP"). At distinct locations (commercial pricing nodes) within the MISO footprint, LMPs are set on a day-ahead and real-time basis to reflect projected and real-time the price of producing electricity, energy demand, and use and limits of the transmission system at that respective location for a specific period of time. Each LMP indicates the price of delivering electricity to meet the next megawatt of load at its respective location. Each generator is assigned a commercial pricing node and sells electricity to MISO at that node's LMP. Loads across MISO are also assigned to a commercial pricing node and buy energy from MISO at their respective load node's LMP.

The MISO Day-Ahead and Real-Time Markets include the ability for electric generators to bid ancillary services. This provides an additional avenue for electric generators to earn revenue. Figure 3-1 displays the different ancillary services available:

- Regulating Reserves
- Spinning Reserves
- Supplemental Reserves

Figure 3-1: MISO Ancillary Services



Source: "Intro to Markets" MISO Presentation

These services help maintain the stability of the electric grid, and as a balancing authority, NERC regulation requires MISO to maintain adequate amounts of ancillary services. While these services are required by NERC regulations, ancillary services represent only a small percent of total revenue within the MISO market. Additionally, only certain types of electric generators can bid ancillary services.

3.3.2 Resource Adequacy Requirement

Based on forecasted demand, MISO establishes a minimum threshold of committed generation resources to serve its load. Any asset owner represented in MISO that has a registered physical asset that is a load or an export interchange transaction is a load serving entity ("LSE"). MISO utilizes a variety of planning resources to provide adequate supply during peak load and generation outage conditions. Capacity resources are electrical generating units, or load reductions that can be dispatched to meet the remaining loads, known as demand response resources. Load modifying resources include behind-the-meter ("BTM") generation for use during emergencies and loads that can be directly controlled or interrupted to serve demand during emergencies. Energy efficiency resources are installed measures on retail customer facilities that permanently reduce energy usage. LSEs are required to secure supply for their anticipated peak demand plus a planning reserve margin through the acquisition of zonal resource credits ("ZRC"). ZRCs represent 1 MW of UCAP from a planning resource, and can be purchased via auction, bilateral contract, or self-scheduled by the LSE.

3.4 Power Supply Options

Electric utilities have the ability to acquire their capacity and energy from a variety of sources. Depending on economic, geographic, reliability, or ancillary factors, the best method to obtain capacity and energy is determined largely on a case-by-case basis. The following generally summarizes methods that are available for utilities to source capacity and energy to meet their load requirements:

- Market Purchases
  - Purchase energy and capacity directly from the MISO Market to serve load obligations
    - This is generally accomplished by the purchase of ZRCs for capacity through the Planning Resource Auction ("PRA") process
    - Purchase of energy on the Day-Ahead or Real-Time Markets in MISO
- On-System Resources
  - Build a new resource on-system to provide capacity for the MISO resource adequacy requirement
  - Energy from these resources serve as a hedge against wholesale energy prices, and transmission and congestion charges. Profits from generation can help offset other utility costs.
- Bi-lateral contract
  - Contract directly between a generator and LSE for firm capacity and/or energy. Otherwise known as a power purchase agreement.

  - Energy from these assets serve as a hedge against wholesale energy prices
- Financial contract
  - Participants buy or sell energy commodities at a future date and time
  - These contracts are purely a financial hedge and typically do not directly serve energy or capacity requirements

3.4.1 Market Purchases

With the widespread growth of RTOs, electric utilities are increasingly going to the market for capacity and energy needs. Lower wholesale energy market prices and a surplus of capacity from existing generation resources provide opportunities for utilities to lower their power supply costs compared to other resources, such as aging power plants or new resources. However, relying on market transactions may expose an electric utility to volatility in the market and does not provide the certainty of long-term contracts or ownership. The year-to-year availability of short-term capacity purchases is trending downward and remains heavily dependent on a multitude of factors such as load growth and power plant retirements. Increases in the number of baseload retirements, large buildouts of intermittent resources, or faster-than-expected load growth are factors that may negatively impact market transactions for capacity. As of the 2018 MISO Planning Resource Auction Report, a significant amount of dispatchable resources within the MISO footprint have excess capacity. On the network there is 139 GW of accredited capacity available to meet MISO's 136 GW of planning requirements, which includes both demand plus reserves.[1] This excess margin has been shrinking over the last two years, largely as a result of generator retirements.

3.4.2 On-System Resources

Historically, the traditional approach for a utility to meet a capacity need was through the addition of a generator on-system. This provides the benefit of having long-term security regarding the availability of the capacity. Additionally, transmission concerns are lessened with an on-system addition versus an off-system resource. Certain on-system additions can also meet the black start requirement designated by NERC and earn additional revenue from the MISO Ancillary Services Market.

3.4.3 Bilateral Contract

Bilateral contracts function similarly to market purchases but are for extended periods. These contracts involve a direct transaction of electricity between a seller (generator) and buyer (load). Contracts vary in length and can extend as long as the life of a unit. These contracts can also be an energy-only, capacity-

[1] MISO, https://cdn.misoenergy.org/20181003%20LOLEWG%202019%20Draft%20LOLE%20Report280984.pdf

only, or energy and capacity contracts. These contracts are a type of Power Purchase Agreement (“PPA”) and can serve as a hedge against volatility in the energy market.

3.4.4 Financial Contract

NYMEX defines a financial contract as “a legally binding obligation for the holder of the contract to buy or sell a particular commodity at a specific price and location at a specific date in the future.” In other words, the participants are buying and selling energy commodities at a future date and time. At the contract’s expiration date, the contract position is closed out financially compared to the current price at that time. No physical energy is scheduled or delivered with a financial contract, and therefore, these contracts do not serve to meet energy or capacity requirements. These contracts primarily provide more certainty regarding future energy expenses and can cap exposure to volatility in the energy market.

3.4.5 Types of Electric Generators

The following are examples of methods to generating electricity:

- Coal-fired power plant: Coal is burned in a boiler to heat water into steam and drive a steam turbine connected to a generator.
- Nuclear power plant: Heat from a nuclear reaction is used to heat water into steam and drive a steam turbine connected to a generator.
- Gas-fired power plant
  - Simple cycle gas turbine (“SCGT”): Natural gas is burned to drive a combustion turbine connected to a generator.
  - Combined cycle gas turbine (“CCGT”): Similar to a SCGT unit, natural gas is burned to spin a combustion turbine. However, waste heat is collected from the hot exhaust gasses to boil water into steam and drive a steam turbine generator to increase the overall efficiency of the power generation system.
  - Reciprocating Internal Combustion Engine (“RICE”): Natural gas, or fuel oil, is burned to drive a large reciprocating engine connected to a generator.
- Renewable generation
  - Solar photovoltaics: Solar energy is converted to electricity with the most common application using solar photovoltaic panels.
  - Wind turbines: Wind propels turbines connected to a generator to generate electricity.
  - Hydropower: Water propels turbines connected to a generator to generate electricity.

- Energy Storage
  - Compressed air energy storage: Air is compressed into storage, typically a large underground cavern, when wholesale electricity prices are inexpensive and later released to generate electricity when wholesale electricity prices are relatively higher.
  - Battery storage: batteries are charged when wholesale electricity prices are inexpensive and discharged when wholesale electricity prices are relatively higher.
  - Pumped-Storage Hydropower: Water is pumped into an upper storage reservoir when wholesale energy prices are inexpensive and later released to generate electricity when wholesale energy prices are relatively higher.

Each of these types of power generation technologies have unique characteristics when supplying capacity and energy. Resources that can be dispatched on demand are typically given full capacity recognition. Renewable resources, specifically wind and solar generation, are intermittent resources and cannot be dispatched. Due to this constraint, RTOs only recognize a percentage of wind and solar generation capacity, as they may not be able to dispatch these resources during peak load periods.

3.4.6 Demand-side Management and Energy Efficiency

Demand response programs are intended to reduce system or sub-system load during peak demand hours. These programs require control and communications technology along with ongoing administration and management from the utility. Example demand response programs include:

- Programmable communicating thermostats (“PCT”)
- Dynamic rates such as time-of-use rates, critical peak pricing, peak time rebates, etc.
- Voluntary customer load reduction/shifting in response to utility request
- Interruptible rates
- Dynamic voltage control (“DVC”)
- Energy storage (batteries, compressed air, pumped hydro, etc.)

Energy efficiency programs involve a reduction in overall energy consumption, typically through the installation of more efficient appliances and devices. These programs typically involve a one-time expense from the utility, in the form of a rebate or other incentives. Possible energy efficiency programs include:

- Lighting replacements or fixture upgrades
- Electric water heater upgrades to more efficient units

- Refrigerator and freezer upgrades to more efficient units
- Heating and cooling (air conditioning) upgrades to more efficient units
- Large motors and irrigation pumps upgrades to more efficient units
- Home energy audits – additional insulation/weatherization
- Garage refrigerator removal program

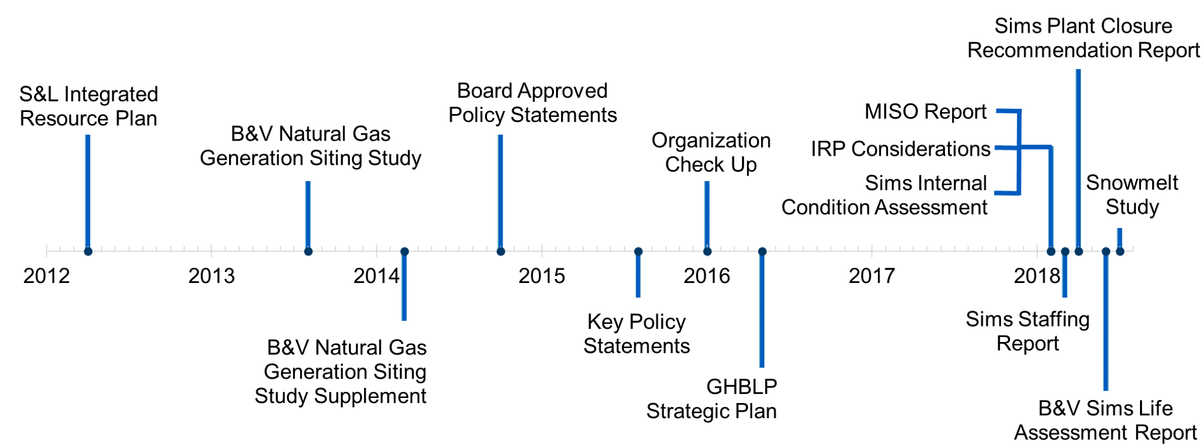
4.0 PRIOR STUDY REVIEW & PATH DEVELOPMENT

The following provides a summary of GHBLP's historical planning efforts and power supply paths evaluated in this Study. While there is no reason to believe that the information provided from previous efforts is inaccurate or incomplete in any material respect, Burns & McDonnell has not independently verified conclusions and recommendations made in the following section, nor does Burns & McDonnell opine as to the accuracy of these third-party analyses.

4.1 Historical Document Review

Burns & McDonnell completed a comprehensive review of previous data and studies initiated by GHBLP as part of its Power Supply Planning efforts. All figures were pulled directly from their respective source documents. Beginning in 2012, GHBLP began gathering information to address the need to replace its aging power supply resources. The following provides a high-level summary of these historical documents, the qualitative and quantitative content of which was aggregated into this Study. Figure 4-1 depicts a timeline of GHBLP's resource planning efforts from 2012 to present.

Figure 4-1: Study Timeline



4.1.1 Sargent & Lundy ("S&L") Integrated Resource Plan (April 2012)

The goal of this Integrated Resource Plan ("IRP") was to provide GHBLP with a strategy to meet the increasing demands of its customers as well as plan for necessary equipment expenditures and capital investments for existing resources. The IRP included a load forecast, environmental assessment, evaluation of transmission congestion and costs, evaluation of capacity and energy needs, and energy and capacity supply strategies.

The IRP concluded that the capacity of the J.B. Sims Unit 3/Diesel 1 configuration exceeded the peak demand for GHBLP's customers and would continue to do so until 2022 in the baseline case. The IRP found that repairs, improvements, and modifications required to continue operation of Sims and bring it in to regulatory compliance would have higher revenue requirements than replacing the unit. Subsequently, S&L recommended retirement of J.B. Sims Unit 3 and Diesel Unit 1 in 2020. Given the economic inefficiency of GHBLP's existing generation model, eight different long-term power supply portfolio options were evaluated in ten different potential economic scenarios. Alternatives were evaluated on the bases of net plant capacity, fuel type, capacity factor, and costs levelized over the period 2011-2036. While not offering a definitive recommendation, the two most economical alternative power supply portfolios from the model were:

- Purchase of ownership shares in a portfolio of natural gas and/or nuclear generation
- Installation of a natural gas plant(s) locally coupled with wholesale market purchases

The option with the lowest projected revenue requirements was a self-build option that included a 20 percent/80 percent mix between a simple cycle combustion turbine and wholesale market purchases respectively.

The IRP's projection of the economic infeasibility of investing in improvements to Sims was proven correct by subsequent studies. The economic forecasts of the plan were correct in predicting that both natural gas and market energy/capacity prices would fall in the proceeding decade, but they significantly underestimated the magnitude of the price reduction, and thus the attractiveness of the market. Finally, in anticipation of increased reliance on wholesale purchases, the IRP recommended GHBLP conduct a study of their transmission system with transmission planning software to facilitate the import of supply.

4.1.2 Black & Veatch Natural Gas Generation Siting Study (April 2013)

Black & Veatch ("B&V") evaluated potential locations for a natural gas power plant to replace Sims. Ten candidate sites were scored on the criteria of land use, site ecology, socioeconomics, air quality, site development, transportation, natural gas supply, transmission lines, and water resources. In addition to the site selection, a fixed and variable O&M cost analysis was performed for three different generation configurations:

- LMS100 SCGT (100 MW)
- LMS6000 SCGT (45 MW)
- 2x1 LMS6000 CCGT (120 MW)

Several greenfield sites were evaluated, but a brownfield conversion of the Sims site to a SCGT configuration was the most attractive option based on the study's scoring system.

A supplement to the study was conducted in 2014 to investigate the feasibility of a 100 percent natural gas-fired configuration of the existing Sims boiler. Although this "repower" took advantage of the Sims location and the existing balance of plant equipment, software analysis concluded that this configuration would result in significant heat transfer depressions to the main steam and reheat steam cycles, resulting in a 4.6 MW reduction in power generation at full load. The supplement to the B&V Siting Study included the technical details of the software analysis.

4.1.3 Key Policy Statement (October 2014)

This document was a list of GHBLP policies for 2015. It stated that GHBLP was open to a new generation configuration, ownership structure, or portfolio of supply types, but expressed its desire to maintain at least 50 percent of its generating capacity locally. GHBLP stated the intention to reduce reliance on coal and transition to alternative sources of fuel, specifically natural gas or nuclear.

4.1.4 Key Policy Statement (August 2015)

This document laid the groundwork for GHBLP's strategic plan to source its power supply. It stated that new policies needed to account for the following conditions: aging of current generation assets (Sims), moderation of natural gas prices, evolving emission restrictions, and pressure to use renewable resources. It established that GHBLP's priority is to avoid "overbuilding" or market speculation in order to meet customer needs in a reliable and cost-effective manner. A policy for the following year was outlined:

- Continue to operate Sims in an optimal manner as established by the GHBLP Energy Risk Management Policy
- Continue to evaluate alternative generation options
- Complete transmission and interconnection studies to prepare for increased reliance on wholesale imports
- Continue to evaluate renewable projects to meet any emerging standards, or if they present competitive alternatives to other projects

4.1.5 Organization Check Up (January 2016)

A quality review of utility operations was conducted in October 2015 in order to provide recommendations for best practices and improvements. The review identified areas needing improvement including power supply and transmission and distribution.

The primary concern with GHBLP's power supply was the Sims plant was not a viable option to supply GHBLP's customers in the future. Increased costs associated with the asset's age and regulatory environment present challenges to continued plant operation. The plant was originally designed as a baseload generator requiring it to sell energy to the market in addition to meeting Grand Haven's electrical demand. However, Sims has been unable to function as a base load unit in recent years as wholesale sales transactions have become uneconomic. As such, Sims has been acting instead as primarily a local, "load following" resource. As the Sims unit is oversized relative to GHBLP load requirements, utilization to meet low, local load requirements combined with lower wholesale sales have rendered Sims an uneconomical option for supplying GHBLP power supply. Lower loading and utilization rates of units designed for baseload operation drive the efficiency of these units down.

As the 2012 S&L IRP suggested, relying on the MISO market is a more economical option than continued operation of Sims. Increased reliance on market imports heightens the importance of a reliable transmission and distribution network. GHBLP's transmission network consists of a looped 69kV system with three substations. The review recommended replacement of the substation transformers, switchgears, and breakers. At the time of the study, GHBLP had two transmission delivery points, but transmission capacity was deemed insufficient to receive 100 percent of GHBLP peak load without Sims online. The review recommended capital transmission investments and subscribing to full network transmission service to prepare for the eventual retirement of the Sims plant.

GHBLP's distribution network consists of primarily overhead 13.2 kV (80 percent) and 2.4 kV (20 percent) lines. GHBLP had an internal distribution assessment underway at the time of the study, but this review suggested that GHBLP had insufficient resources to satisfactorily accomplish said assessment. This review recommended GHBLP implement a comprehensive vegetation management program, invest in replacement of 2.4 kV lines, implementation of a better tracking system for voltage loss on distribution lines, and implementation of an automated reliability tracking system.

The review found that retirement of debt associated with Sims in 2016 provides GHBLP with an estimated $8M/year for debt service payments. The increased availability of capital permits investment in generation assets, but the review recommended capital investment in the transmission and distribution systems to improve reliability and facilitate increased network supply imports.

4.1.6 GHBLP Strategic Plan (May 2016)

This plan was produced to address the challenges and opportunities associated with a changing industry environment in fiscal years 2017-2021. The Strategic Plan is the product of a Board-initiated process to revise and reiterate the mission statement and core values of the organization, examine the market and customer base, analyze the organization's strengths and weakness, identify potential opportunities and threats, and specify strategic areas of focus moving forward.

Locally controlled generation, a skilled workforce, excess capacity, freedom from debt, transmission tariff savings through local generation, a beneficial coal contract, and a focus on value creation for the community were identified as organizational strengths. Weaknesses were identified as aging infrastructure and technology, lack of supply diversity, carbon-intensive nature of generation, aging workforce, inadequate cash reserves, and higher retail rates in comparison to neighboring utilities.

Finally, the plan sought to identify six strategic areas of focus, and develop goals and outcomes within each area:

- Financial Management: Ensure long-term financial resources, rate stability, and customer value
- Customer/Community Engagement: Prioritize market research and community engagement to gain better understanding of customer expectations
- Transmission & Distribution: Modernize the system to support future load growth and supply diversity
- Power Supply: Transition to a more sustainable, economical, and diversified power supply
- Workforce: Attract and retain a qualified, competent, and professional workforce
- Business Practices & Processes: Promote efficient, effective, and sustainable utility operations

4.1.7 IRP Considerations (February 2018)

The IRP Considerations document was an internal GHBLP report outlining a plan for the future disposition of resources to replace the power supply losses associated with Sims and Diesel 1 closures. Considering renewable projects with MPPA, GHBLP would still need to replace 82 percent of its energy needs beginning in 2020 (projected Sims closure date). The primary IRP considerations were diversification and future adaptability and flexibility.

Supply diversification was deemed necessary to mitigate financial and physical risk through "multiplicity" of projects and/or wholesale transactions. GHBLP stated its desire to eventually move to a portfolio of natural gas and renewable generation in the long-term. A diverse use of new technologies could include a combination of gas generation (combined cycle, simple cycle, reciprocating units), storage technologies, and renewables. In the interim, a "buyer's market" for wholesale power would alleviate supply deficits until implementation of physical generation assets.

The report deemed financial diversification as desirable to minimize cost of capital, utilize economies of scale through partnerships, and take advantage of tax exemptions. The report found participating in local or joint municipal ownerships provides access to low-cost (tax-free) municipal bonds, and joint ownership minimizes risk and increases bond ratings. Private partnerships could also be developed through MPPA. With an increased reliance on the market, partnerships with commodity market experts would be beneficial.

One of GHBLP's concerns was overdiversification, in that GHBLP would not take advantage of economies of scale. Specifically, GHBLP does not serve a high enough load to operate J.B. Sims Unit 3 at intermediate or base load capacities economically: GHBLP peak load is ~70 MW; average load, ~35 MW, 15 percent of which is already covered by existing contracts.

Ultimately, GHBLP's goal is to be in a position to capitalize on future opportunities as they arise. One possible way to achieve this is to avoid overcommitment to a single resource. GHBLP is currently in this situation: customers are "stuck" with a base load facility when market supply is much more economical. However, GHBLP should not hedge 100 percent with market supplies, which would make it difficult for GHBLP to invest in potential new opportunities.

The report concluded with a Staff recommendation to close Sims on June 1, 2020. In the interim, the plant's operational schedule should be revised to optimize the plant's usage economically. Construction of the necessary 69 kV transmission improvements should be completed to facilitate acceptance as a network MISO user. Work should continue with MPPA to evaluate potential jointly-owned supply projects. The "Hedge Plan" and Risk Management Policy should be reviewed and revised to optimize future market trading. Finally, GHBLP Staff recommended continued efforts to evaluate a local replacement for Sims, noting that a potentially cost-effective alternative was a ~30 MW natural gas-fired "peaking" plant.

4.1.8 Sims Internal Condition Assessment (February 2018)

The Sims Internal Condition Assessment detailed the overall condition of the Sims plant in order to maintain reliability of system performance over the plant's remaining service life. The 2012 IRP indicated that additional information was necessary to determine the true costs of life extension for Sims Unit 3. The information was collected over the following hears and compiled in a 2018 internal condition assessment. The internal assessment confirmed S&L IRP's assertion and was stopped when the cost of life extension and maintenance of Sims exceeded any benefits of life extension and was determined to be higher than the cost of a natural gas peaking generator coupled with wholesale market purchases. The report recommended avoiding capital expenditures on the Sims plant, reducing position in coal markets, preparing a staff succession plan, and working with the MPPA to develop a reduced run-time plan for Sims.

4.1.9 MISO Transmission System Impact Study

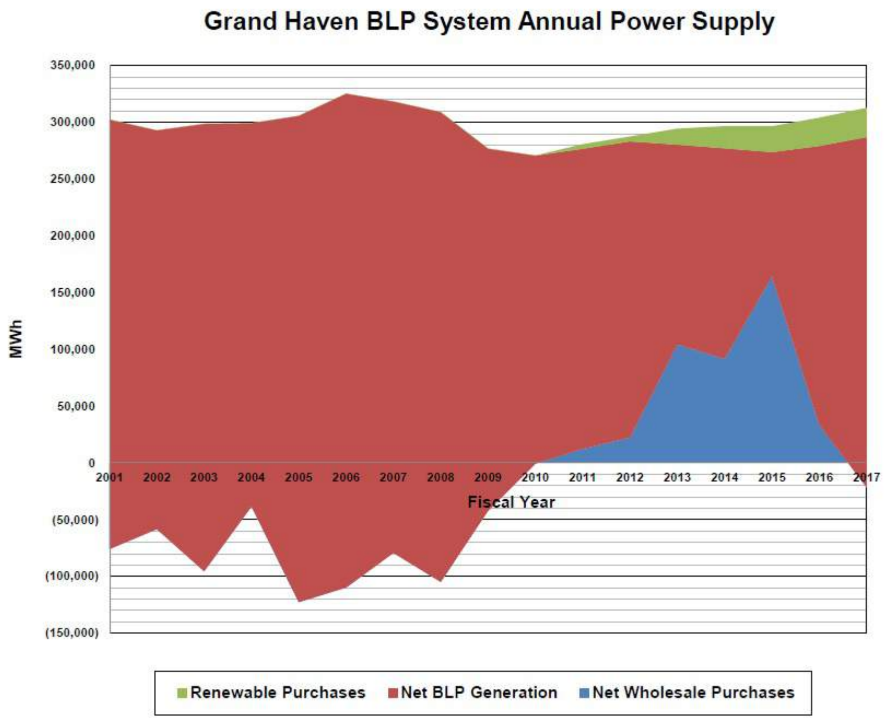
At GHBLP's request, MISO completed a study to determine the regional system impacts of providing GHBLP NITS service. Upon the study's completion, GHBLP filed application for NITS to begin June 1, 2020 and its application was conditionally accepted contingent on completion of necessary system improvements identified in MISO's study. MISO manages the transmission network and sets adequacy requirements daily, resulting in reliability of over 99.99 percent. Geographically speaking, GHBLP is ideally positioned to import power from the market. Western Ottawa County has a significant surplus of generation capacity, and GHBLP is located in an area where the transmission network can supply power to loads with high levels of reliability. Because the GHBLP is located in such an advantageous area within MISO, increased on-system generation capability will not increase reliability, but increased transmission and distribution capability will. Improvements are underway on 12.6 miles of 69 kV transmission lines with an anticipated completion date of 2019 to increase system reliability

4.1.10 Board Approved Sims Power Plant Closure Report (April 2018)

On April 24th, 2018, the Board of Light and Power recommended that planning begin for the June 1, 2020 closure of the Sims power plant based on the following facts:

1. Sims power supply to GHBLP is no longer economical
    a. Figure 4-2 includes a chart of GHBLP's Annual Power Supply from 2001 through 2017. Since 2005, decreasing margin and volume from wholesale energy sales has led to reduced utilization of Sims. The loss of wholesale energy revenue, along with the loss of capacity payments from MPPA, required GHBLP to increase retail energy revenue to recover Sims' increasing operating expenses. These impacts have moved GHBLP from being at the Michigan state average for retail revenue per MWh (during 2001 through 2004) to 17 percent above the state average and 30 percent above peer utilities in 2015.

Figure 4-2: GHBLP Annual Power Supply



Source: Approved Sims Closure Report

   b. Although designed as a baseload facility, Sims has been operating at less than half of the plant's demonstrated net capacity since 2010
   c. The plant's economic efficiency continues to decline, and capital investments required to complete necessary improvements are cost prohibitive
2. Sims operation does not impact GHBLP customer reliability
   a. There is no evidence of any relationship between forced outages at Sims and customer outages. From 2010-2014 Sims was not operating 38 percent of the time, and there were no instances of failures in the transmission system.
   b. Grand Haven is located in a portion of the MISO network (Western Ottawa County) which has substantial excess generation resources (2,700 MW of capacity; 500-600 MW collective peak load)
3. A 70 MW coal plant is not the ideal resource for GHBLP's load (Average of approximately 35 MW).
   a. Generally, baseload (high utilization/high capacity factor) facilities are larger, more efficient, and able to achieve economies of scale; Sims is not operated in this fashion.

   b. Having a "dominant" baseload facility does not allow for diversification, as was mentioned previously with regards to GHBLP's inability to take advantage of favorable market conditions in 2010.
4. Sims cannot operate beyond 2020 safely, reliably, economically, efficiently, and effectively without incurring substantial additional expense.
   a. Over $15M in needed repairs have been identified, but this does not necessarily represent the totality.
   b. Taking on debt for a continued operation contains risk: life expectancy cannot be reliably estimated and amortized.
   c. In July 2016, a new rate structure took effect (after end of debt service) following a cost of service study. Rates were deemed adequate to fully-fund a 5-year capital investment program focused on transmission and distribution projects. The report found any Sims repairs would require a significant rate increase. For example, $18M in capital spending for Sims would require a 16.4 percent rate surcharge on all customer classes over a three-year period. A rate increase of this size would negatively impact GHBLP customers.
5. Ancillary benefits of continued Sims operation cannot be justified.
   a. Layoffs will not be an issue based on planned restructuring and employee retirement schedules.
   b. The city's snowmelt system can be operated more economically with a natural gas configuration. This is supported by two independent engineer evaluations
   c. Existing harbor traffic, in the absence of coal delivery traffic, will be sufficient to justify continued federal funding for dredging services.
6. Closure of Sims is consistent with public opinion.
   a. Surveys show popular support for plant closure in favor of cleaner energy.
   b. "Key" commercial and industrial customers do not support Sims operation if costs are higher than alternatives.
7. Closure of Sims will result in substantial savings in regulatory compliance costs.
8. GHBLP can only complete its mission if Sims is retired.
   a. "Meet the community's expectations for quality local electric utility services that returns value to our customers and the community as a whole."

4.1.11 B&V Independent Sims Life Assessment Report (June 2018)

An independent comprehensive condition assessment of the Sims plant was conducted by B&V. Findings from this assessment were then used to produce an action schedule and expense forecast for the maintaining continued operation of Sims. The forecasted expenses are dispersed over a five-year schedule, then ambiguously thereafter. The Life Assessment Report estimated a cost of $35M required for safe and reliable continued operation. A timeline of estimated capital expenditures is shown in Figure 4-3:

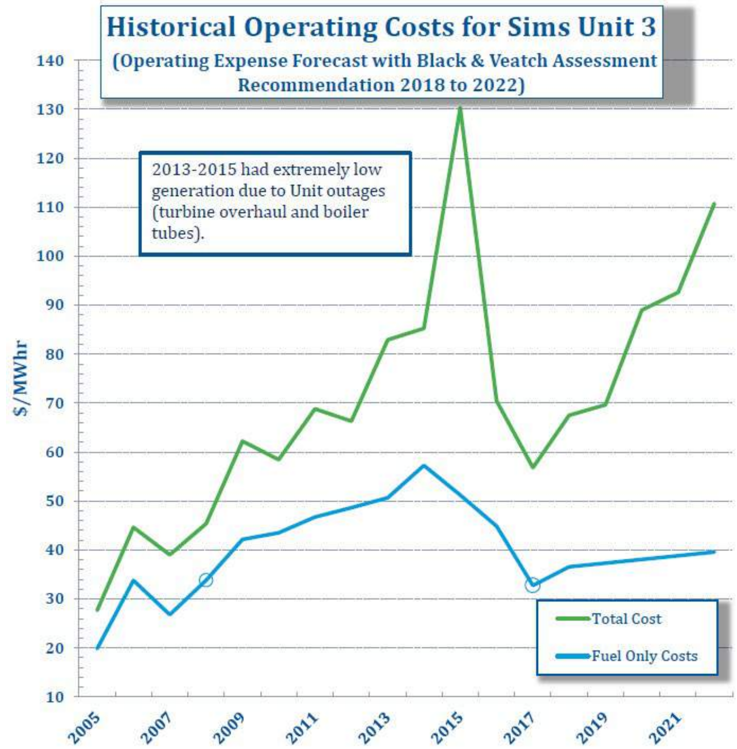
Figure 4-3: Projected Expense Schedule

ACTION SCHEDULE	FORECASTED EXPENSE, $M
< 6 Months	1.9
< 12 Months	2.5
> 24 Months < 5yrs	8.8
Next Major Outage	7.9
5+ Year Plan	13.9
TOTAL	**35.0**

Source: B&V Life Assessment Report

The report provided an itemized list of all required maintenance, repairs, replacements, and additions with their respective cost estimates. Unfortunately, the potential life extension for these investments cannot be accurately estimated, therefore it is difficult to estimate an amortization schedule. The report recommended expenditures of $4.4M to keep the unit operating safely on its current cycling schedule until closure in June 2020. Based on the 2016-2017 capacity factor of 43 percent, Figure 4-4 shows the change in operating expense over the next 5 years. Capital expenditure required to continue operation of Sims results in increasingly expensive energy, resulting in a feedback cycle diminishing the ability of the unit to cover its operational expenses.

Figure 4-4: Historical and Future O&M Costs



Source: B&V Life Assessment Report

Based on financial implications of these findings, the Life Assessment Report identified several considerations and recommendations:

- Pursue either a combination of local generation and market purchases, or purely market supply
  - Either option will take advantage of lower staffing requirements
- The estimated average cost to operate Sims over the next 5 years is $85/MWh; average day ahead LMP for the node was $31.14/MWh in 2017
- Conduct production cost modeling, load forecasts, demand forecasts, market forecasts to determine the ideal configuration for power supply
- Begin project development to include site selection, utility supply agreements, preliminary engineering, permit acquisition, equipment procurement, and contracting approaches
- Conduct a decommissioning study

4.1.12 Snowmelt Studies (May/July 2018)

An independent study was conducted to determine the amount of energy required to heat the snow in the snowmelt system and the amount of energy required to pump heated water through the system. These calculations were completed using the existing auxiliary boiler configuration. Although the energy costs for the pumps would likely be similar, energy costs for heating would be dependent on the new generator configuration and was outside the scope of this study. Figure 4-5 provides the energy requirements for melting snow and Figure 4-6 provides energy requirements to pump heated water throughout the snowmelt system.

Figure 4-5: Melting Energy Requirements

YEAR	HEAT TO SNOW MELT (MBTU)	83% EFFICIENCY BOILER, COAL			90% EFFICIENCY BOILER, NG		
		FUEL HEAT REQUIRED (MBTU)	ENERGY PRICE ($/MBTU)	ENERGY CHARGE ($)	FUEL HEAT REQUIRED (MBTU)	ENERGY PRICE ($/MBTU)	ENERGY CHARGE ($)
2015-2016	7,643	9,207.83	3.67	33,804	8,492	5.55	47,129
2016-2017	6,096	7,344.29	2.93	21,519	6,773	5.55	37,591
2017-2018	11,554	13,920.30	2.83	39,394	12,838	5.55	71,249
Average	8,431	10,157.47	3.14	31,572	9,367	5.55	51,989

Figure 4-6: Pumping Energy Requirements

YEAR	ENERGY USE (KWH)	ENERGY PRICE ($/KWH)	ENERGY CHARGE ($)
2015-2016	100,941	0.0832	8,398
2016-2017	70,936	0.0900	6,384
2017-2018	88,683	0.0900	7,981
Average	86,853	0.088	7,588

Source: B&V Sims 3 Snowmelt Analysis

A subsequent study explored the possibilities associated with adapting the snowmelt system to "decoupled" alternate energy source. Under the current 126,000 square foot system, the system requires about 11 MMBtu/hr of heat and 1,100 gallons per minute ("GPM") of heated water circulation. The existing snowmelt system is coupled with the Sims plant using heat recovered from the boiler.

The proposed new system would require natural gas-fired boilers and electric pumps. The costs associated with the new system are largely dependent on its location. The estimated cost of a new boiler system is $1.1M. This includes boilers, pumps, miscellaneous hydronic equipment, piping, electrical, controls, and heating & ventilation equipment. The remaining costs associated with its installation are largely dependent on location. Total installation costs range from $1.45M-$2.5M. Operational costs of the unit are dependent on natural gas prices. According to the study, the most economical location for the system is in an existing building downtown near the transmission mains; the most expensive site may be on the existing Sims site on Harbor Island, if a new stand-alone control building must be built.

4.1.13 Staffing Considerations (March/June 2018)

Two internal reports were produced to examine the impact of a new power supply configuration on staffing requirements. The normal staffing level for Sims is 39 employees: 28 union employees (16 operations, 11 maintenance, 1 electrician) and 11 general employees (7 management, 2 instrumentation & control technicians, 1 chemical laboratory technician, 1 secretary). Full staffing level incurs an annual cost of $4,318,854 between wages and benefits. At the time of this study, Sims was understaffed at 30 personnel due to recent retirements and staff turnover. Regardless of the power supply path GHBLP takes, it its projected that by June 2020 staff will be reduced to 10-15 people. This reduced number is estimated based on retirement schedules and internal transfers.

In the event that Sims remains in operation, GHBLP will need to recruit, train, and retain new employees to reach the full staffing level of 39 personnel. These same employees could be terminated in the near future if (and when) Sims reaches the end of its useful life. In the event that Sims is retired, and a new, smaller plant is installed, it is estimated that staffing requirements will be reduced to 10-15 personnel primarily through attrition. In the retirement scenario, June 2020 staffing costs are estimated at $1.6M—a savings of $2.7M annually.

4.1.14 Conclusion

Upon review, Burns & McDonnell agrees that conclusions and recommendations in the historical documents were consistent with industry trends and standards at their time of completion. Although the 2012 IRP Study did not accurately predict fuel prices, its recommendation to retire Sims was—and still is to an even greater degree—sound.

The Sims plant should be retired on an economic basis. Based on recent historical and projected market conditions, the most economically advantageous configuration would be reliance on wholesale market supply. With the transmission improvements currently underway, the MISO network should be able to support this quantity of supply import and recent system operations concur with this conclusion. There is a case to maintain local generation to diversify the energy portfolio (risk mitigation) and provide a contingency supply in the event of a “loss of grid” event. There is also a public desire to maintain some form of local generation, although not at the cost of higher rates. The supply portfolio will balance economic considerations with desires of the Grand Haven community.

4.2 Power Supply Paths

Given the context of the above studies, Burns & McDonnell has identified four potential paths GHBLP could follow to provide reliable and economical power supply to its customers:

1. Path 1: J.B. Sims Unit 3 Operation. GHBLP could continue to operate the Sims plant on its modified run-time schedule. Per the June 2018 Life Assessment Report, significant financial investment would be required to continue to operate the plant safely and reliably. As previously mentioned, minimum costs to continue safe operations through June 2020 are estimated at $4.4M; costs to continue operation past June 2020 are estimated at $35M. As of April 2018, Sims operation is limited by two, eight-week outages in the Spring and Fall, and there would be additional outages to facilitate required repairs. Previous studies estimated the cost of energy in the J.B. Sims 3 Operation scenario at approximately $42/MWh, 50 percent higher than the 2017 average LMP at the unit's node.
2. Path 2: 4x9 MW RICE plant. This configuration would take advantage of favorable wholesale market conditions for the bulk of GHBLP's supply needs. Local generation saves money on capacity costs and can earn revenue from the wholesale market. The RICE plant provides flexible, fast responding generation to provide power during times of peak load on the MISO network. Installation of such a plant would potentially require more capital investment than would be required to maintain Sims operation, but would benefit from low natural gas prices, reduced staffing requirements, and reduced O&M costs. This configuration would allow for future expansion and provide GHBLP flexibility to pursue future opportunities as they arise.
3. Path 3: 6x9 MW RICE plant. This configuration could serve as a possible future expansion of the 4x9 MW generator. More generation capability serves as a hedge against unfavorable market conditions and could potentially deliver more revenue through wholesale market sales. If this path is installed, the 54 MW configuration does take advantage of greater economies of scale, as installed costs per kWh of RICE facilities generally decrease as plant capacity increases. The return on investment of this path increases if network capacity costs substantially increase.
4. Path 4: Market Only. GHBLP could forego local power supply generation and rely purely on wholesale market purchases. Given the current market conditions, this is the most economical path. Taking into account GHBLP's recent transmission system investments, this supply strategy is feasible given the historical reliability of the MISO network. Being fully reliant on market supply, however, is not in line with GHBLP's stated desire to maintain some form of local generation and a diverse supply portfolio.

5.0 ASSUMPTIONS & FORECASTS

Burns & McDonnell and GHBLP developed numerous assumptions and forecasts to utilize within this assessment. The following section provides a summary of the key assumptions utilized within this study. A workbook containing the assumptions used in this Study is included in Appendix A.

5.1 General Assumptions

- General inflation/escalation rate: 2.5 percent
- Discount rate: 4 percent
- Interest rate: 4 percent
- Debt: 100 percent
- Debt term: 20 years
- Study period: 2019 to 2038 (20 years)

5.2 Load Forecast

GHBLP engages in load and energy data collection on an ongoing basis. Short-term electricity forecasts are developed for budgeting purposes. Off-system sales, energy requirements, and peak demand forecasts are developed for system capacity planning. The purpose of this forecast is to the assess the short-term and long-term energy requirements of GHBLP.

Figure 5-1 presents GHBLP's historical load along with the load forecast for peak demand (MW). Figure 5-2 presents the historical and forecasted annual energy requirements (GWh) utilized in this Study. Historical retail sales per household was the primary variable in determining the forecast model. The peak demand forecast and annual energy forecast project an increase in demand and energy consumption at an average growth rate of 0.4 percent. Load factors were assumed to remain constant throughout the study period, at approximately 55.6 percent.

The forecasted values for any given year will not necessarily be the actual value that will be experienced in that year. However, on average the load is expected to generally agree with the forecast. As with all forecasts, this load forecast should be monitored and revised if future events cause actual loads to be significantly different than expected levels.

Figure 5-1: Historical and Forecasted Peak Demand

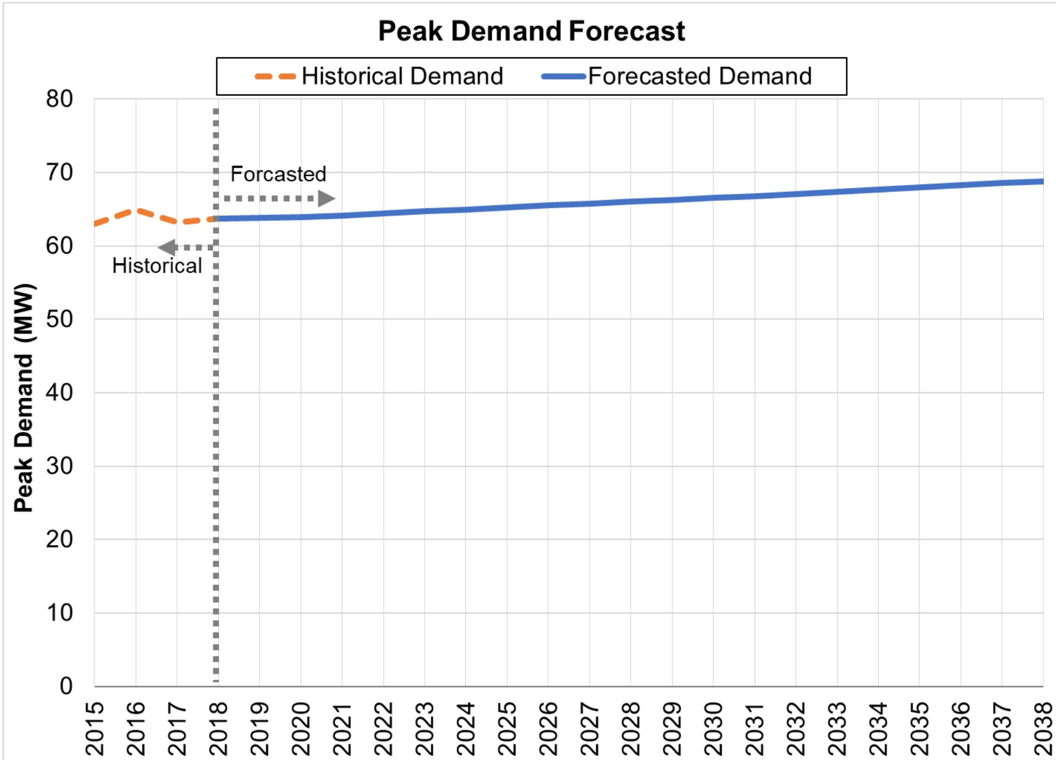
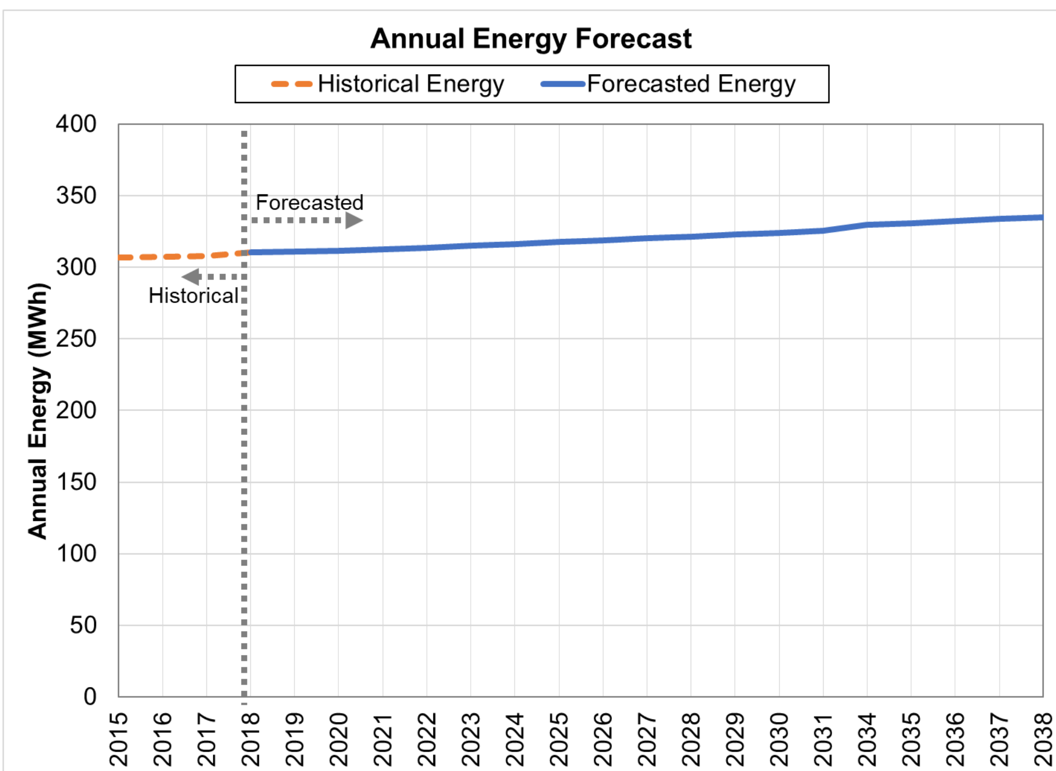


Figure 5-2: Annual Energy Forecast



5.2.1 Balance of Load and Resources

A balance of loads and resources ("BLR") provides an analysis of a utility's ability to serve its load plus reserve requirements over the planning horizon. The BLR identifies the time frame in which additional resources will be necessary to avoid a capacity deficit situation under normal operating conditions.

GHBLP is a behind the meter generator within the Midwest Independent System Operator (MISO) footprint. While not currently utilizing NITS in MISO, this Study was completed with the assumption that GHBLP will gain full NITS as currently planned. Additionally, GHBLP has and will continue to participate as a MISO member through its membership in MPPA. MISO members are required to have adequate capacity and reserves to meet their demand requirements. MISO currently requires utilities to use the UCAP methodology to correspond with the utility's coincident peak of the overall MISO system. It is expected MPPA will require GHBLP to follow MISO planning requirements.

The UCAP methodology evaluates the unforced capacity against a utility's peak demand plus a reserve margin. The installed capacity of each generation resource is reduced to an unforced capacity value by factoring in the reliability of each unit. This methodology results in a lower reserve margin requirement, typically around 7 percent, compared to a methodology that utilizes the full installed capacity of each resource, typically around 12 percent. The UCAP method incentivizes electric generators to operate their units more reliably, thus driving the UCAP capacity value closer to the installed capacity value.

For the purposes of this assessment, it was assumed that GHBLP would maintain a planning reserve margin of 7.8 percent, which is consistent with current MISO requirements. Figure 5-3 contains a BLR based on the load forecast and GHBLP's current supply portfolio (Path 1). With J.B. Sims Unit 3 operational, GHBLP maintains the majority of their requirements on-system. Figure 5-4, Figure 5-5 and Figure 5-6 display the balance of load and resources for the 4x9 MW RICE (Path 2), 6x9 MW RICE (Path 3), and Market Only (Path 4) paths. Path 2, Path 3, and Path 4 feature increased reliance on market capacity to meet reserve requirements. Increased reliance on market capacity exposes GHBLP to unfavorable changes in market conditions.

Figure 5-3: Path 1 (Sims Operational) BLR

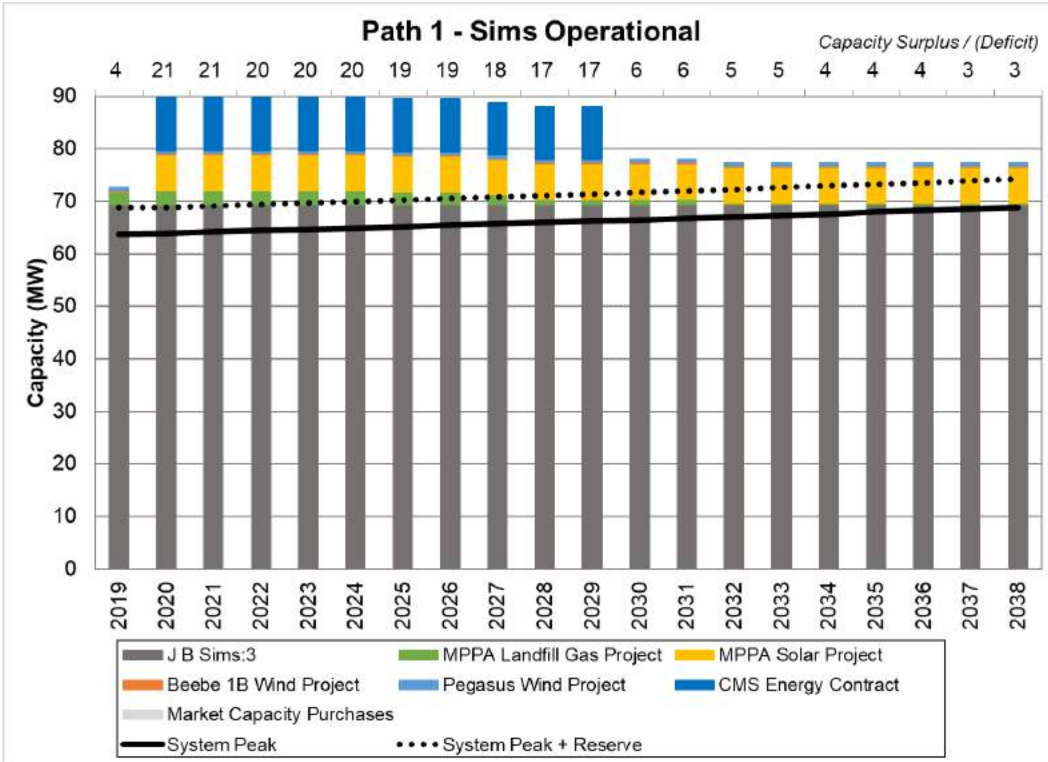


Figure 5-4: 4x9 MW Reciprocating Engines BLR

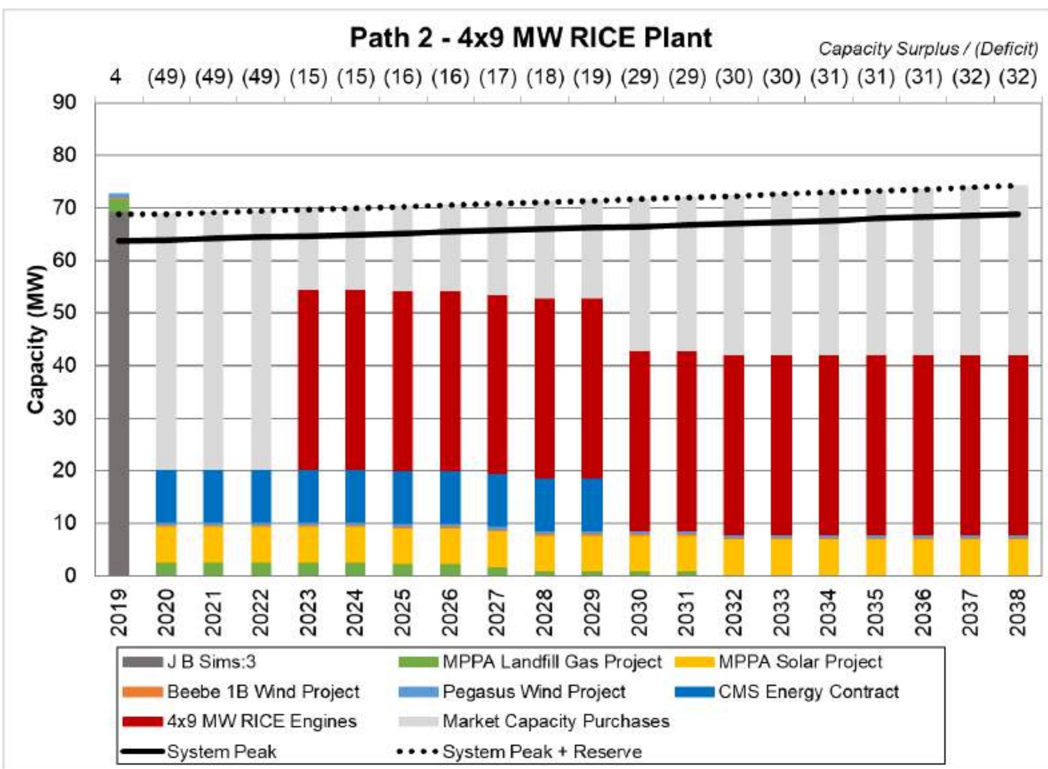


Figure 5-5: 6x9 MW Reciprocating Engines BLR

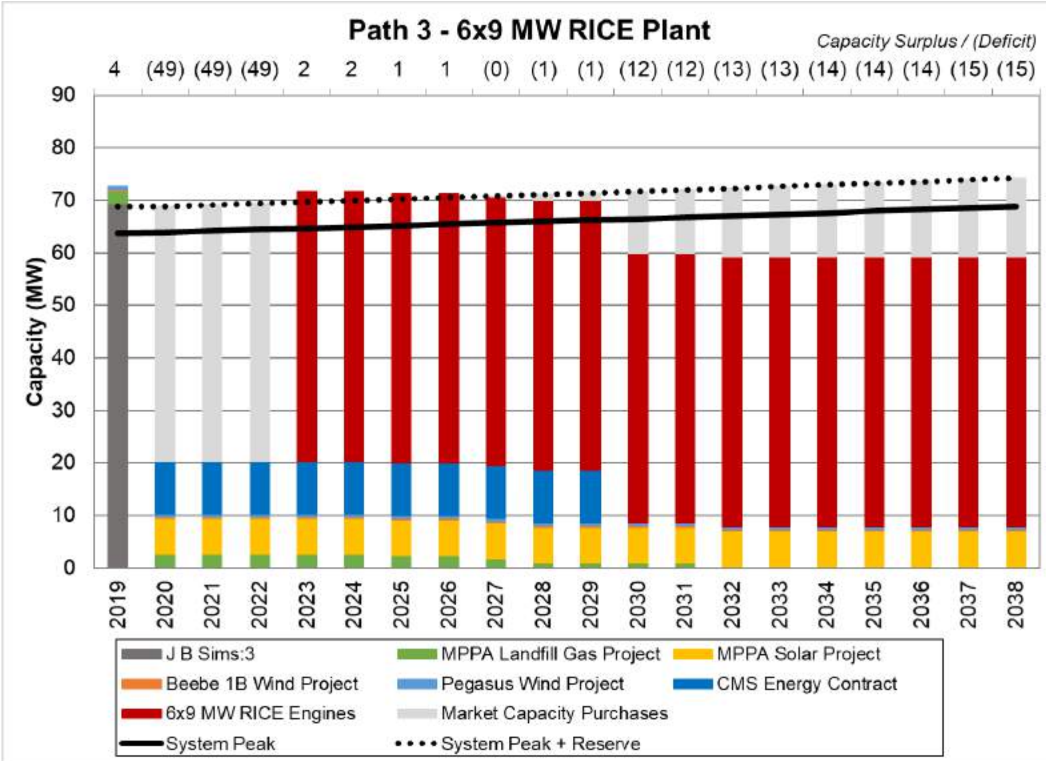
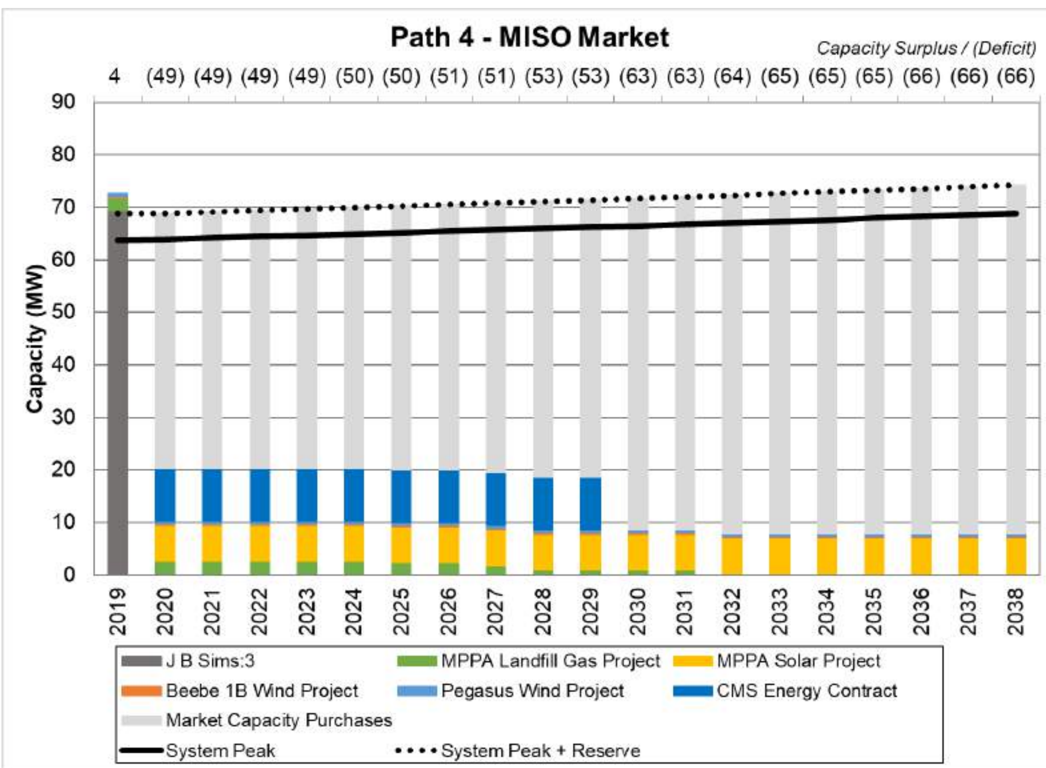


Figure 5-6: Market Only Supply BLR



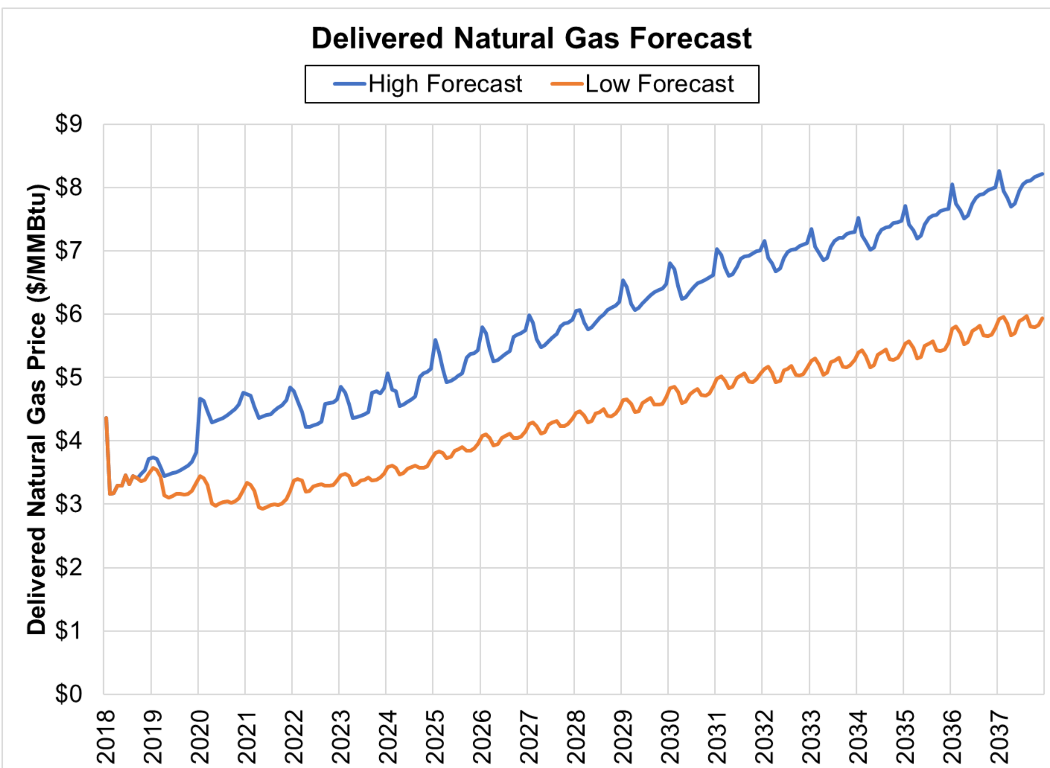
5.3 Fuel Forecasts

Burns & McDonnell utilized historical fuel data provided by GHBLP and projections from public sources to develop the fuel forecasts utilized in this assessment.

5.3.1 Natural Gas Price Forecast

Burns & McDonnell utilized the Henry Hub Natural Gas Futures transactions from the 2018 MISO Transmission Expansion Plans ("MTEP") as the basis of the forecast. MISO develops these MTEP reports to help its members make sound planning and investment decisions. These delivered natural gas futures represent both a high and a low natural gas price scenario through the end of 2038. MTEP data was unavailable for 2018 and 2019. For these years EIA data was used in lieu of MTEP data for the high gas scenario, and NYMEX Henry Hub futures were used for the low gas scenario. Figure 5-7 shows the projected natural gas prices in both scenarios.

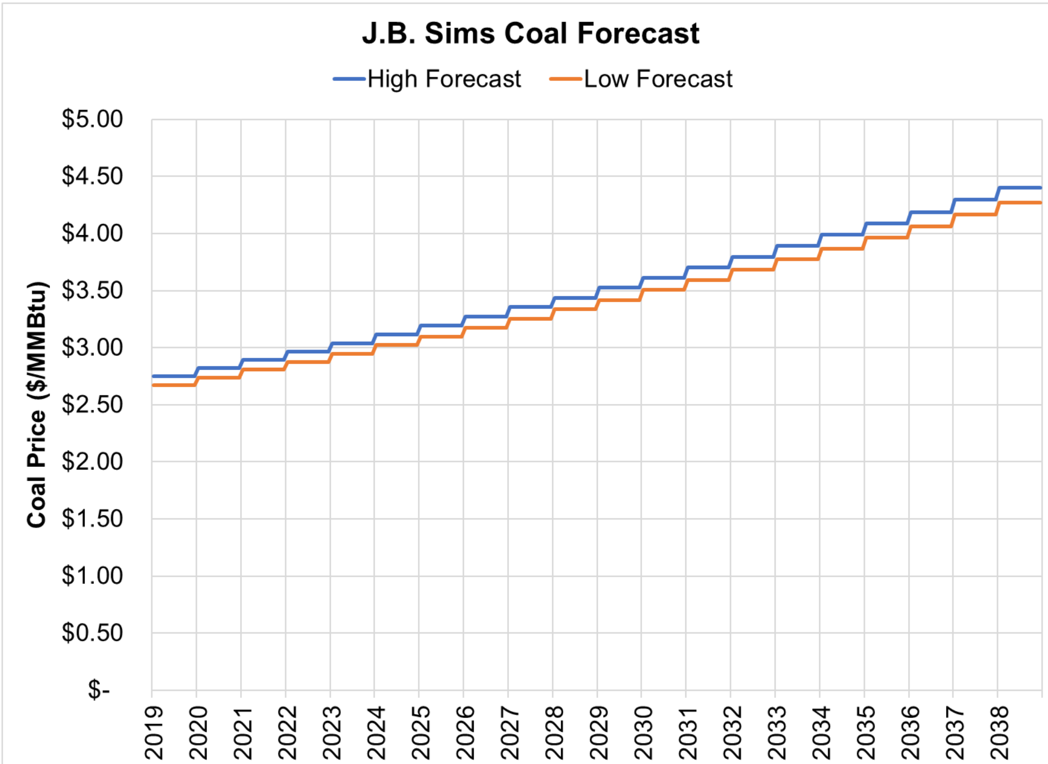
Figure 5-7: Delivered Natural Gas Forecast



5.3.2 Coal Price Forecast

Burns & McDonnel utilized the delivered coal forecasts from the 2018 MTEP models. Two forecasts, a high forecast and a low forecast, were developed to coincide with the two natural gas forecasts. The high coal forecast was used in conjunction with the high natural gas forecast, and the low coal forecast was used with the low natural gas forecast. Figure 5-8 presents the coal forecast for J.B. Sims Unit 3 and includes the high forecast and low forecast.

Figure 5-8: J.B. Sims Coal Forecast



5.4 Market Energy Price Forecast

In addition to developing fuel forecasts, it is important to project anticipated wholesale electricity prices for use within the economic evaluation. Burns & McDonnell developed a wholesale market energy cost forecast using a widely-accepted, hourly dispatch software (PROMOD nodal) over the 20-year study period.

5.4.1 Model Development

PROMOD is a security-constrained economic dispatch software used to simulate energy markets. MISO spends significant effort developing future scenarios to assess the overall transmission system and determine potential areas of concern for reliable operation. MISO assesses the impacts to the transmission system considering power plant retirements and additions, along with load changes. For a member of MISO, it is important to leverage these efforts to maintain consistency between the utility and MISO's planning efforts. Therefore, Burns & McDonnell utilized the MTEP18 model as a baseline to develop energy market prices for this Study. The MTEP18 model has four different futures as within Table 5-1.

Table 5-1: MISO MTEP18 Futures

MTEP18 Future	Limited Fleet Change	Continued Fleet Change	Accelerated Fleet Change	Distributed & Emerging Technologies
Demand and Energy	Low (10/90) High LRZ9 Industrial	Base (50/50)	High (90/10) Low LRZ9 Industrial	Base + EV *Energy: 1.1%* *Demand: 0.6%*
Fuel Prices	Gas: Base -30% Coal: Base -3%	Base	Gas: Base +30% Coal: Base	Base
Demand Side Additions ***By Year 2032***	EE: - GW DR: 2 GW	EE: - GW DR: 3 GW	EE: 5 GW DR: 4 GW	EE: 2 GW DR: 3 GW Storage: 2 GW
Renewable Additions ***By Year 2032*** ***(% Wind and Solar Energy)***	10%	15%	30%	20%
Generation Retirements[1] ***By Year 2032***	Coal: 9 GW Gas/Oil: 17 GW	Coal: 17 GW Gas/Oil: 17 GW	Coal: 17 GW+ Gas/Oil: 17 GW	Coal: 17 GW Gas/Oil: 17 GW Nuclear: 2 GW
CO_2 Reduction Constraint ***From Current Levels by 2032***	None	None	20%	None
Siting Methodology[2]	MTEP Standard	MTEP Standard	MTEP Standard	"Localized"

EV: Electric Vehicles EE: Energy Efficiency DR: Demand Response

1) In Accelerated Fleet Change Scenario, 16 GW of coal retired. In addition, 8 GW of coal dispatch seasonally and must-run removed on all units.

2) "Localized" renewable siting assumes that at least 50% of incremental wind and solar energy will be sourced within each LRZ. Two thirds of solar sitied as distributed.

The MTEP18 Limited Fleet Change ("LFC") and Continued Fleet Change ("CFC") futures were used within this Study. Key aspects of the two futures are as follows:

- MTEP18 LFC
  - Existing generation fleet remains relatively static without significant drivers of change
  - Natural gas prices remain low
  - Demand and energy growth rates are low; however, gulf coast industrial load grows with low natural gas prices
  - Thermal generation retirements are driven by unit useful life limits
  - Renewable additions are driven solely by Renewable Portfolio Standards
- MTEP18 CFC
  - Fleet evolution trends of the past decade continue
  - Demand and energy growth rates are modeled at a level equivalent to a 50/50 forecast
  - Coal retirements reflect historical retirement levels based on average age of retirement
  - Renewable additions continue to exceed Renewable Portfolio Standard Requirements
  - Natural gas prices are consistent with industry long-term reference forecasts
  - Maturity cost curves for renewable resources reflect some advancement in technology and supply chain efficiencies

These futures provide a contrasting view of future market conditions within MISO. The LFC future includes the low natural gas forecast, and the CFC future includes the high natural gas forecast. Both futures were utilized to develop a corresponding market energy forecast. PROMOD nodal analysis was run for the three model years available: 2022, 2027, and 2032. A PROMOD analysis was performed for three power supply paths over two futures and three model years (18 runs total). The market energy prices for the remainder of the 20-year study were interpolated and extrapolated, an industry standard method.

Burns & McDonnell assumed that both on-peak and off-peak prices were set by natural gas-fired resources throughout the study period. Burns & McDonnell established an implied market heat rate for each month of the study period using projected LMPs along with the natural gas price forecast. The implied market heat rate captures the impacts of high levels of renewable generation, specifically wind generation. Typically, when wind generation is high, the market energy price will be lower since wind generation is bid into the market at very low prices. Low market energy prices result in displaced fossil generation and lead to a lower implied market heat rate during those times. From the implied market heat rate, the market energy price forecast was calculated by multiplying the implied market heat rate by the natural gas price forecast. Market energy forecasts were developed for Path 1, Path 2/3, and Path 4 for both the low natural gas forecast and high natural gas forecast. A market energy forecast was not developed for Path 3 (54 MW RICE) since Path 2 is near-identical and could be used as a proxy.

Figure 5-9 and Figure 5-10 include the wholesale market energy forecasts used in this study. The reported prices are at the CONS.CAMPBELL node within MISO and are indicative of what GHBLP would pay for wholesale energy. These market forecasts served as the basis for the economic dispatch of the power supply options under consideration. Currently, natural gas prices have the largest impact on wholesale energy prices and the high gas forecasts has higher market energy prices than the low gas forecast. In both natural gas forecasts, maintaining on-system generation through Sims or a RICE plant shielded GHBLP from spikes in market energy prices. Outside of peak periods, the forecasts between each path are nearly identical.

Figure 5-9: MISO Wholesale Market Energy Forecast – Low Gas

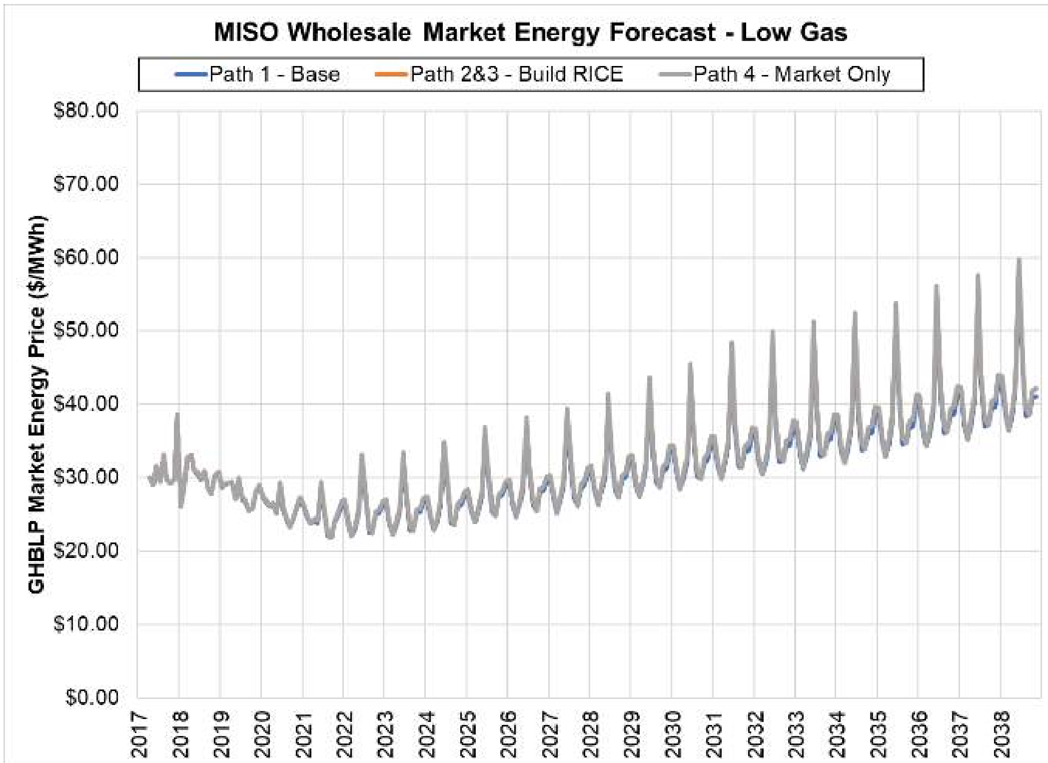
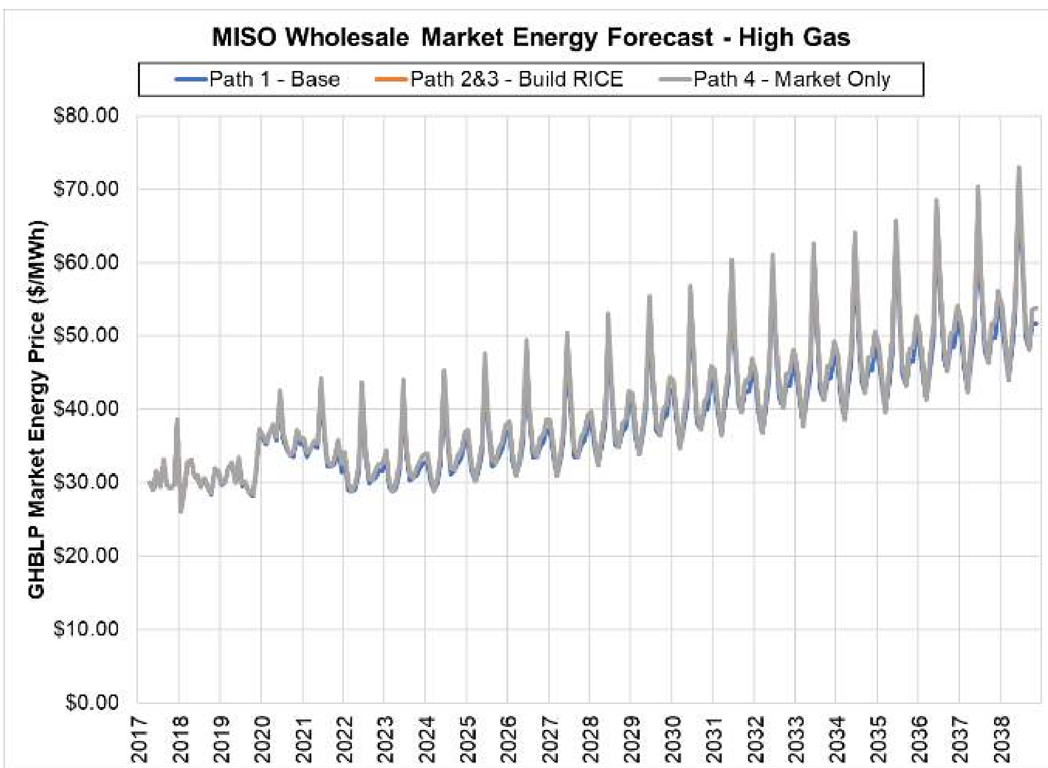


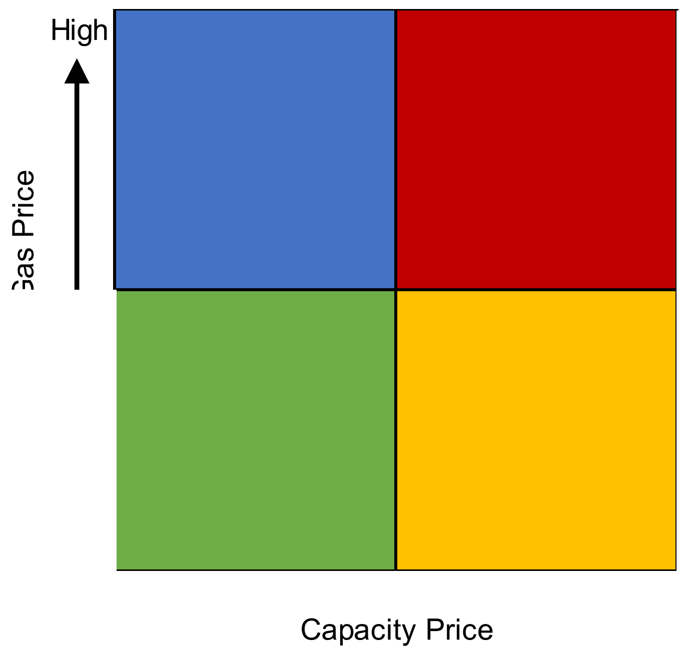
Figure 5-10: MISO Wholesale Market Energy Forecast – High Gas



5.5 Summary of Scenarios

As previously mentioned, sensitivities on natural gas prices and market capacity were used as part of this Study. Two natural gas pricing scenarios (high and low) along with two capacity price scenarios (low and high) were used in conjunction to create four overall scenarios. A style box outlining the scenarios used in this Study is presented below in Figure 5-11. The colors associated with each scenario are used throughout the rest of this report and serve as a visual aid to distinguish between scenarios. Along with the scenarios outlined in the style box, a sensitivity featuring 30-year financing for the reciprocating engine plant.

Figure 5-11: Power Supply Plan Scenarios



6.0 ECONOMIC EVALUATION

Burns & McDonnell utilized ABB's PROMOD software to simulate the dispatch of GHBLP's power supply resources against load requirements or day-ahead market prices, depending on the scenario, for the years 2019 through 2038. The model dispatched available resources on an hourly basis. The output of the model contained the energy dispatch and costs associated with meeting GHBLP's hourly demand and energy requirements. GHBLP's existing resources were input to the model along with each power supply path's resources to determine the most cost-effective method for meeting future power supply needs.

6.1 Balance of Loads and Resources for Selected Paths

The four power supply paths selected for analysis in Section 4.2 included a diverse set of power supply options available to meet GHBLP's capacity and energy requirements. Each path has a unique combination of Sims retirement scenario, capacity additions, fleet composition, and market purchases. A BLR for each path was developed to illustrate the differences between the paths. Figure 6-1, Figure 6-2, Figure 6-3, and Figure 6-4 present the BLR for Path 1, Path 2, Path 3, and Path 4. Path 1 continues operations of Sims throughout the 20-year study period. Path 2, Path 3, and Path 4 all retire Sims in 2020. Path 2 builds an on-system, 4x9 MW RICE plant on-system 2023. Path 3 builds an on-system 6x9 MW RICE plant in 2023. Path 4 is unique and does not replace the lost Sims capacity with on-system generation.

Figure 6-1: Power Supply Path 1 BLR

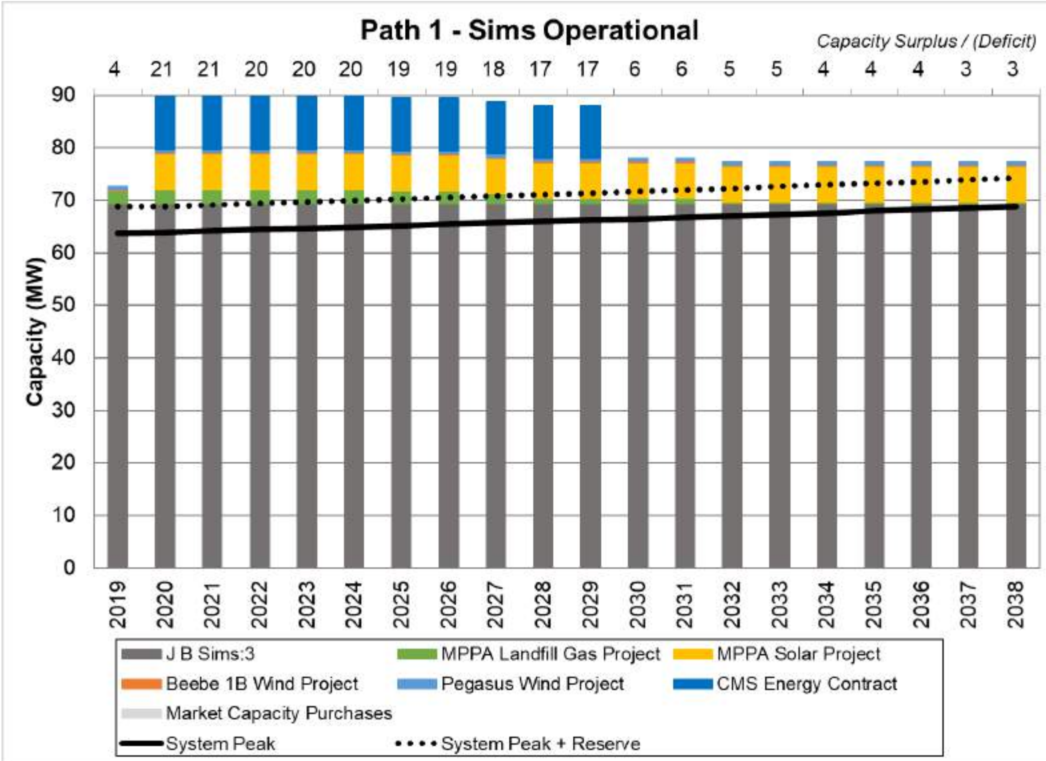


Figure 6-2: Power Supply Path 2 BLR

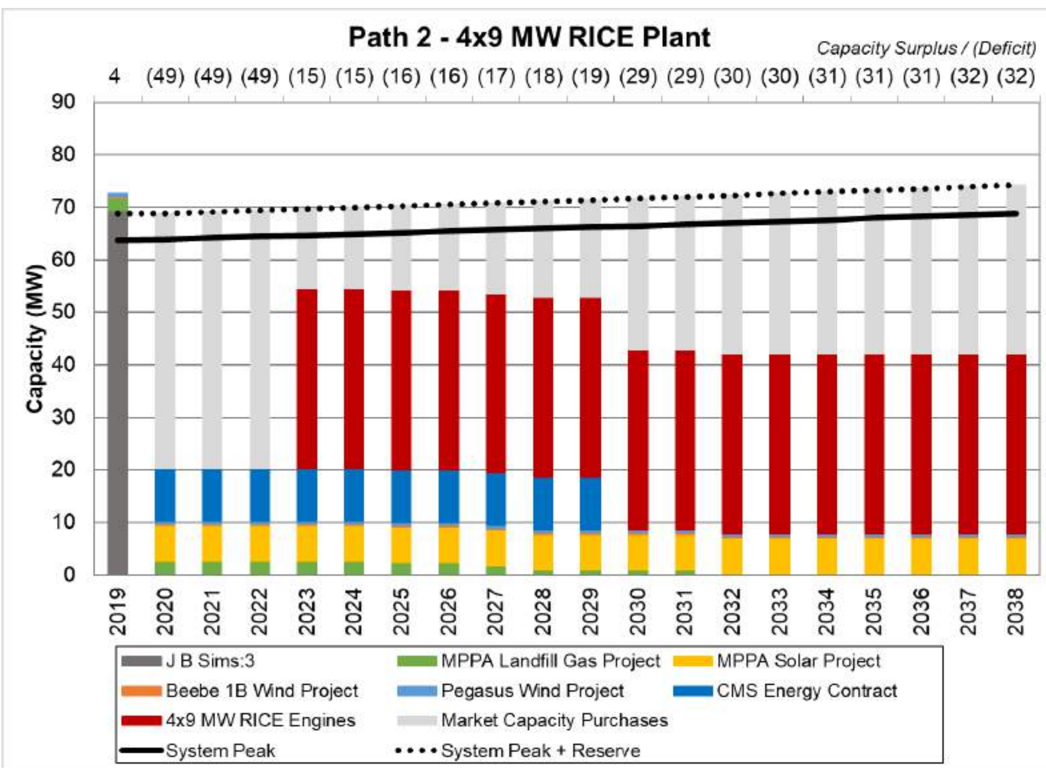


Figure 6-3: Power Supply Path 3 BLR

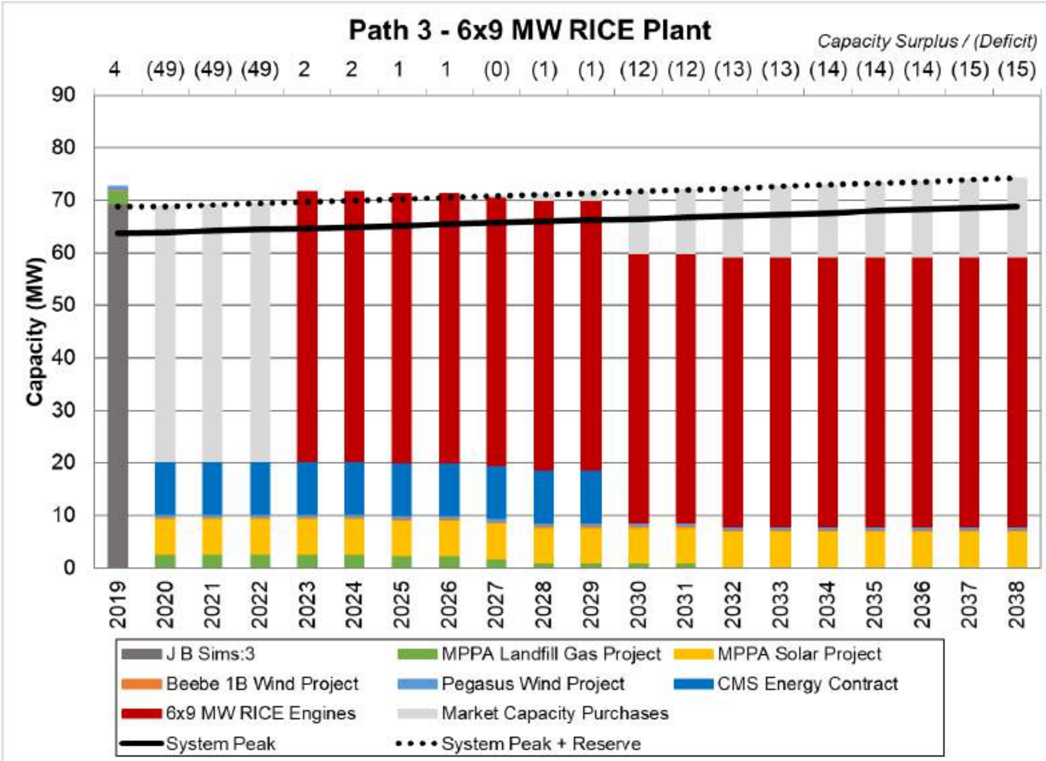
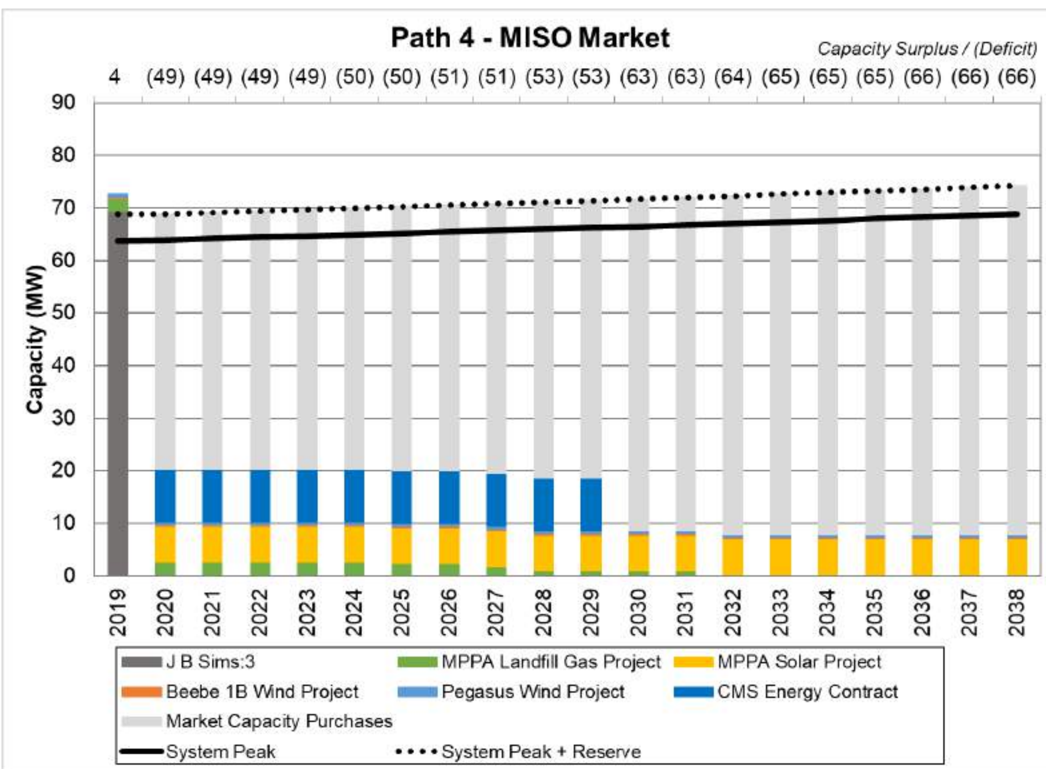


Figure 6-4: Power Supply Path 4 BLR



6.2 Power Supply Portfolio Development Assumptions

As previously discussed, four power supply paths were developed in the context of four different possible market environments. Total costs of each path/scenario were then calculated based on 20-year projections included in the economic model. Table 6-1 displays a breakdown of the potential paths and market scenarios.

Table 6-1: Operating Scenarios and Power Supply Paths

	Scenario A Low Gas				Scenario B Low Gas/Low Capacity				Scenario C High Gas				Scenario D High Gas/Low Capacity			
Power Supply Path	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Power Supply No.	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
Power Supply Portfolio	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only	J.B. Sims Unit 3	4x9 MW Recip	6x9 MW Recip	Market Only

It is assumed that GHBLP will be a full NITS participant in all paths and will purchase all energy from the market. Differences in annual costs are based on debt service, cost of capacity, heat rate, outage rates, O&M, labor, fuel, MISO transaction costs, natural gas snowmelt system costs, and, for Path 1, additional capital expenditures required for continued Sims operation. Market energy and capacity sales were factored into financial models for the four potential paths as revenue. A 5-percent equivalent forced outage rate capacity derating was applied to both J.B. Sims Unit 3 and the RICE generators in Path 1 through Path 3, as this is consistent with MISO standard operating procedure. J.B. Sims Unit 3 was modeled in a "must-run" configuration, consistent with its historical modus operandi. In Path 2 through Path 4, J.B. Sims Unit 3 was retired on June 1, 2020; in Path 2 and Path 3, the RICE plant commercial operation date ("COD") was June 1, 2023. In Path 2 and Path 3 20-year financing was assumed for the RICE plant. A NITS transmission tariff of $4.487 per kW-month against the coincident peak of the local balancing authority was included in the model. Additionally, an annual fixed NITS tariff averaging $3.5M was included. GHBLP's renewable resources were included in the model as shown in Table 6-2.

Table 6-2: Renewable Resources Transaction Assumptions

Transaction	Counterparty	Start Year	End Year	GHBLP Max Capacity (MW)	GHBLP Accredited Capacity (MW)	Capacity Factor	GHBLP Annual Energy (MWh)
MPPA Landfill Gas Project	Energy Developments and NANR	2018		2.5	2.5	90%	19,700
Beebe 1B Wind Project	Exelon Generation	2018		2.3	0.2	33%	6,600
Pegasus Wind Project	NextEra Energy Resources	2019		6.0	0.6	37%	19,400
CMS Energy - Capacity Only	CMS Energy	2020	2029	10.0	10.0		

6.3 Dispatch Modeling

For each of the power supply paths, Burns & McDonnell simulated the power supply resources using PROMOD hourly dispatch software over the 20-year study period. PROMOD simulates the dispatch of power supply resources available to meet GHBLP's load requirements. PROMOD dispatches resources every hour of the year (8,760 hours/year), and incorporates run parameters such as start fuel, minimum runtime, minimum downtime, and ramp rates for each resource. Resources in each select path were dispatched against forecasted MISO wholesale market energy prices at each generator's specific location. When dispatched, those units would generate energy revenues, offsetting their costs. This analysis evaluated total cost of generation including fuel, O&M costs, and capital recovery less any market revenues for each scenario under the selected futures. The total power supply costs over the 20-year period were brought back to a single net present value for comparison. The four sensitivities previously discussed were utilized in this additional analysis to test the robustness of each selected power supply path under a variety of key assumptions. Table 6-3 presents annual resource changes along with the net present value of each power supply path in each of the scenarios evaluated. Figure 6-5 presents the total annual wholesale power supply costs for each path under the Low Gas / Low Capacity Cost scenario. Table 6-4 presents the net present value of each power supply path for the various sensitivities. Detailed PROMOD result summaries are included in Appendix B. An alternative sensitivity with 30-year financing was also evaluated and is included in Appendix C.

Table 6-3: Net Present Value for Power Supply Paths

	Grand Haven Board of Light & Power				
	Power Supply Path	Path 1 J.B. Sims Unit 3	Path 2 4x 9 MW Recips	Path 3 6x 9 MW Recips	Path 4 MISO Market
	2019				
	2020		Retire J.B. Sims	Retire J.B. Sims	Retire J.B. Sims
	2021				
	2022				
	2023		36 MW Recips	54 MW Recips	
	2024				
	2025				
	2026				
	2027				
	2028				
	2029				
	2030				
	2031				
	2032				
	2033				
	2034				
	2035				
	2036				
	2037				
	2038				
NPV	Low Gas/High Capacity	$450,121,714	$407,701,944	$406,609,640	$386,185,943
	Delta $	$63,935,770	$21,516,000	$20,423,697	$0
	Delta %	16.6%	5.6%	5.3%	0.0%
	Low Gas/Low Capacity	$453,384,057	$388,717,345	$395,052,209	$352,347,011
	Delta $	$101,037,046	$36,370,335	$42,705,198	$0
	Delta %	28.7%	10.3%	12.1%	0.0%
	High Gas/High Capacity	$443,735,429	$440,092,581	$438,938,872	$418,780,959
	Delta $	$24,954,470	$21,311,622	$20,157,913	$0
	Delta %	6.0%	5.1%	4.8%	0.0%
	High Gas/Low Capacity	$446,997,772	$421,107,982	$427,381,441	$384,942,027
	Delta $	$62,055,746	$36,165,956	$42,439,415	$0
	Delta %	16.1%	9.4%	11.0%	0.0%

Figure 6-5: Annual Power Supply Costs (Low Gas/Low Capacity)

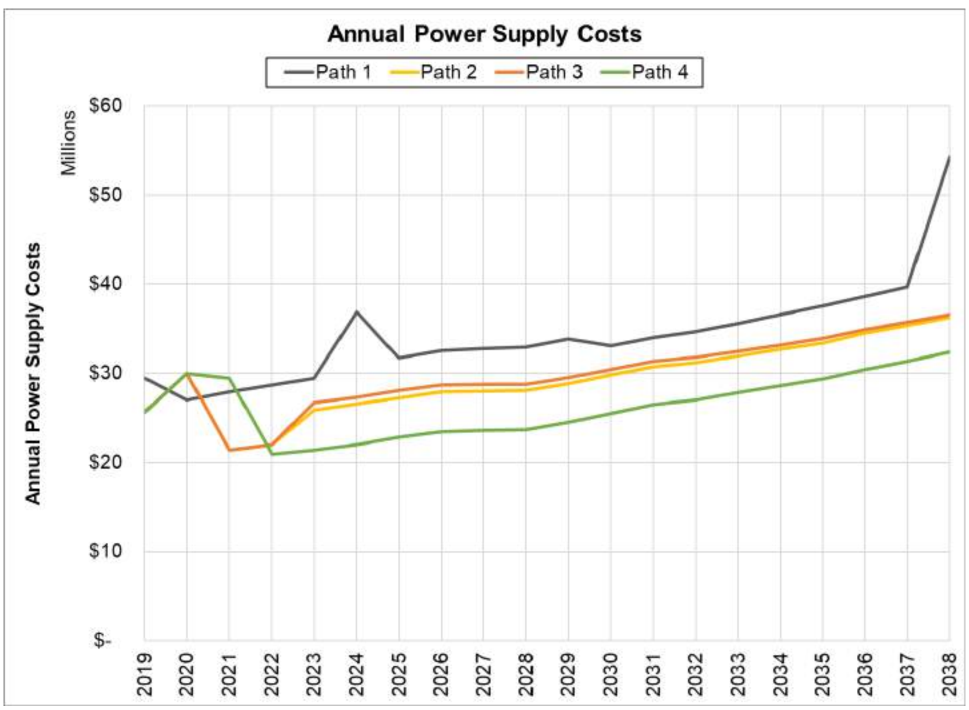
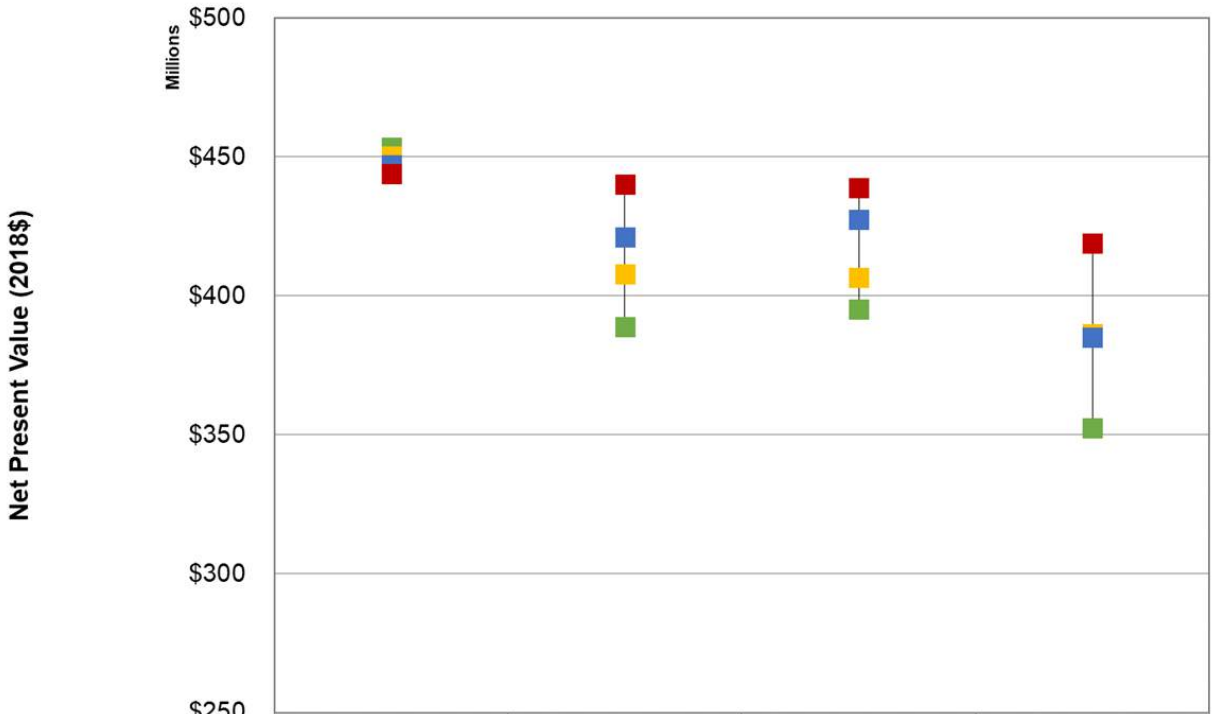


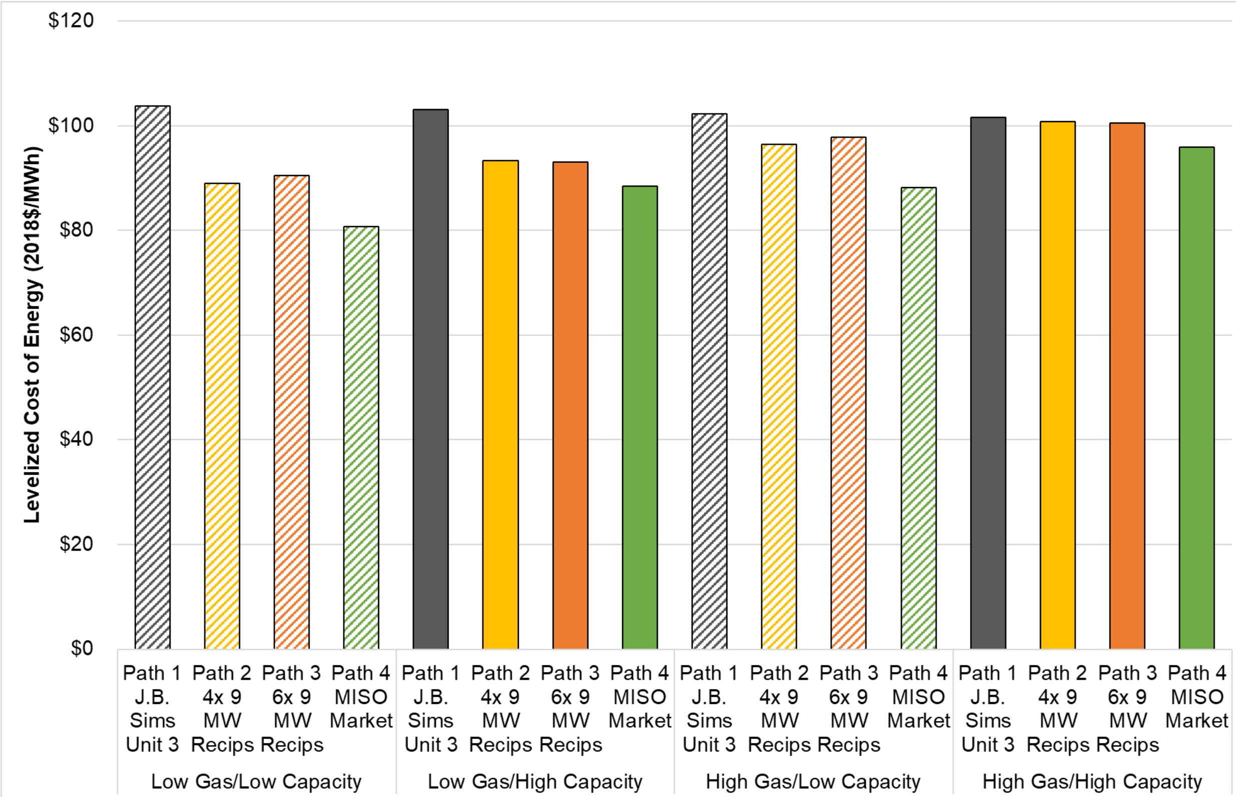
Table 6-4: Net Present Value of Power Supply Costs



	Path 1 J.B. Sims Unit 3	Path 2 4x 9 MW Recips	Path 3 6x 9 MW Recips	Path 4 MISO Market
Low Gas/Low Capacity	$453,384,057	$388,717,345	$395,052,209	$352,347,011
Low Gas/High Capacity	$450,121,714	$407,701,944	$406,609,640	$386,185,943
High Gas/Low Capacity	$446,997,772	$421,107,982	$427,381,441	$384,942,027
High Gas/High Capacity	$443,735,429	$440,092,581	$438,938,872	$418,780,959

An additional metric used to measure the relative cost of electricity in each power supply path is Levelized Cost of Electricity ("LCOE"). LCOE represents an overall average cost to build (if relevant), operate, and maintain a power supply asset or portfolio over an evaluation horizon. LCOE allows for a consistent comparison of the relative cost of electricity between various resources and portfolios. Figure 6-6 includes the LCOE for each power supply path across each of the scenarios evaluated.

Figure 6-6: Levelized Cost of Electricity by Path



6.4 Conclusions

Based on a review of the results presented herein, the following conclusions and observations are presented:

- The overall themes from previous analyses remain consistent within the hourly dispatch economic evaluation
  - Continued operations of Sims Unit 3 provides the most expensive power supply path with the least amount of flexibility
  - Relying only on market capacity and energy provides the lowest cost option in all scenarios
  - New on-system generation provides lower cost energy than continued operations of Sims Unit 3, but at a higher cost than relying solely on the market
  - Path 2 and Path 4, and to some extent Path 3, provide GHBLP flexibility to allow for the use of emerging technologies
- The only scenario in which continued operation of Sims Unit 3 is competitive with the other paths is in a scenario with high natural gas prices and high market capacity prices

    - Even in the unlikely event that coal prices are sufficiently lower than natural gas for this to occur, this path would still be more expensive than the other paths evaluated
- The consistently low cost of Path 4 under all scenarios highlights the economic benefits of participating in the MISO market
    - This path takes advantages of reliable, firm NITS transmission service, which allows GHBLP an opportunity to access the excess capacity available in MISO
- Path 2 and Path 3 are very similar in costs across all scenarios, but consistently higher cost than Path 4
    - Path 2 would provide GHBLP more flexibility by not overcommitting to a single resource or technology
    - If capacity costs remain low, Path 2 is a more economical option if GHBLP intends to pay a premium to maintain on-system generation.

7.0 PUBLIC COMMUNICATION & FORUMS

Over the course of the planning process GHBLP has requested, and received, comments from the public through various platforms to gather feedback regarding the power supply plan. GHBLP provided avenues through its public outreach initiative to inform the public about the key planning process that was underway. Appendix D presents a detailed listing of the public outreach events, articles, documents, and other information provided during the planning process.

7.1 Public Forums

GHBLP hosted two business forums in February and March to solicit feedback from customers regarding power supply. Additionally, the City of Grand Haven hosted two town hall meetings conducted in August to gather information from the public regarding GHBLP's power supply. Furthermore, during the first week of November 2018, Burns & McDonnell along with GHBLP staff held five public forums as part of the power supply planning efforts.

1. November 5, 2018: Community Forum held at the Grand Haven Community Center
2. November 6, 2018: Business Forum held at GHBLP offices
3. November 6, 2018: Community Forum held at Trillium Banquet Center
4. November 7, 2018: Business Forum held at GHBLP offices
5. November 7, 2018: Community Forum held at Grand Haven's City Council Chambers

The forums were held to present preliminary results of the power supply plan and to gain public feedback regarding planning efforts. Public comments and feedback were recorded, and detailed records of public comments are included in Appendix D, along with the results of the City's town hall meetings. Burns & McDonnell and GHBLP's staff provided an overview of the comments that were received during the forums to the Board on November 8, 2018 at the regularly scheduled Board meeting.

7.2 Key Comments

Burns & McDonnell, along with GHBLP staff, reviewed feedback received through the public forum. The majority of comments and feedback are covered in detail in earlier sections of this report. Some of the comments required additional analysis and included the following:

1. Concerns over resiliency of grid and the ability to maintain electric service in the event of widespread grid outage
2. Desire to maintain on-system generation in the form of solar generation

In response to the public feedback, GHBLP recommended Burns & McDonnell further evaluate concerns relating to grid resiliency and maintaining reliable electric service in the event of a widespread grid outage. A solar and energy storage resiliency analysis was completed in response to these concerns and is included in Appendix E. Additionally, in response to the public desire to maintain on-system generation, an evaluation of a 5-MW solar project was completed and is included in Appendix F.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

Burns & McDonnell conducted several assessments within this study, evaluating the economic benefits of maintaining long-term coal-fired operation of J.B. Sims Unit 3 and GHBLP's level of interaction with the MISO energy market. Based on the analysis conducted herein, Burns & McDonnell provides the following conclusions for the various aspects of the Study.

1. Systematic Review of Previous Studies and Community Policies/Resolutions
   a. Two independent engineering firms (Sargent & Lundy and Black & Veatch) recommended the retirement of J.B. Sims Unit 3 on an economic basis. A Life Assessment Report on J.B. Sims Unit 3 further supported the conclusion that the unit has reached the end of its useful life. The report found an estimated $35M of capital expenditure is required to continue operation of the plant.
   b. Production cost modeling, performed at the suggestion of previous studies, supports retirement of J.B. Sims Unit 3.
   c. The 2012 IRP, performed by S&L, recommended GHBLP obtain NITS in MISO and increase wholesale market purchases. GHBLP has taken actions to obtain NITS and necessary transmission upgrades are in-progress. An additional MISO Transmission Report found that increased transmission and distribution capacity will increase reliability.
   d. A Natural Gas Siting Study recommended replacing J.B. Sims Unit 3 with a natural gas peaking plant placed at the existing Sims site on Harbor Island. A supplemental study found conversion of J.B. Sims Unit 3 to natural gas was uneconomical.
   e. An internal staffing report found retiring Sims 3 and building a smaller plant would save an estimated $2.7M annually. The report additionally found staffing levels can be reduced through natural attrition and shifting employees to other opens positions, resulting in no terminations of steam plant employees.
   f. Two independent studies determined the amount of heat and energy to operate the snowmelt system and what would be required to "decouple" the snowmelt system from Sims. The reports recommended natural gas-fired heat generators and electric pumps. Costs are largely dependent on system location and if a local generating facility is built on GHBLP's system.
   g. The City of Grand Haven's City Council passed two resolutions, providing input and guidance on GHBLP's power supply plan.

        i. The City Council passed a resolution emphasizing the importance of the snow melt system to the Grand Haven community, and desire to maintain operation of the system after the retirement of J.B. Sims Unit 3.
        ii. The City Council additionally passed a resolution stating the desire to maintain a local generating resource on the GHBLP system.

2. Economic evaluation
    a. J.B. Sims Unit 3 is higher cost than other power supply alternatives. Similarly, throughout the electric utility industry, older, inefficient steam plants are commonly being retired as they have reached the end of their technical and economic useful life.
        i. In all market scenarios, continued J.B. Sims Unit 3 Operation (Path 1) incurred higher revenue requirements compared to the other paths. This path is only competitive with other paths in the "High Gas / High Capacity Price" Scenario, as it becomes more economical to dispatch Sims into the MISO wholesale market.
    b. Installation of reciprocating engines (Path 2 and Path 3) allows GHBLP to retain local generating capacity while also taking advantage of low MISO wholesale power prices for the bulk of its needs. Based on the model, these generators would operate as peaking units, functioning at a capacity factor of less than 5 percent in all economic scenarios. Due to low natural gas prices, efficient combined cycle resources, and substantial wind generation within the MISO system, wholesale energy from MISO is expected to be lower cost than generation from peaking generation. Despite a larger capital investment, this supply configuration is more economical than continued operation of J.B. Sims Unit 3.
    c. Market Only Supply (Path 4) has the lowest revenue requirements in all economic scenarios. The low cost of this Path is a result of excess MISO network capacity and affordable wholesale energy prices. Given the economic conditions, it is considerably cheaper for GHBLP to source energy and capacity from the MISO network than to dispatch from an on-system resource. The PROMOD hourly dispatch model did not identify any significant transmission issues (i.e. congestion) that would inhibit 100 percent supply import.
    d. Although Path 4 is projected to be the most economical, it does leave GHBLP vulnerable to financial market risk. Path 2 and Path 3 hedge against a potential unfavorable shift in the market as well as provide a contingency supply in the event of network transmission failure. The physical footprint of a RICE plant supports expansion in the event that more local generation capacity is required or economical in the future. Additionally, relying solely on market capacity is an expense that will occur in perpetuity, while investing in a local asset could be paid off in 20 to 30 years.

8.2 Recommendations

Based on the results of this assessment presented herein, the feedback received from the public, and on the desire of the community to maintain local resources, Burns & McDonnell offers the following recommendations.

1. GHBLP should retire J.B. Sims Unit 3 on June 1, 2020.
2. Decommissioning and demolition studies should be considered to determine the costs to permanently retire J.B. Sims Unit 3. These studies should be conducted under the assumption that the Sims site will be utilized as a brownfield location for a new generating asset.
3. MISO power supply is an attractive alternative to J.B. Sims Unit 3. GHBLP should continue efforts to obtain NITS in MISO to secure "firm" capacity and energy which is currently scheduled for June 2020.
4. In accordance with GHBLP's stated policy and the requests of the City's residents, GHBLP should initiate a Preliminary Design Review ("PDR") for a new RICE generating asset consistent with Path 2. If the cost of such an asset is consistent with the assumptions in this Study, GHBLP should make the investment. The RICE configuration offers several attractive advantages:
    a. Reciprocating internal combustion engines are flexible across a wide range of load profiles, have responsive and prompt ramp rates, and take advantage of low natural gas prices.
    b. Staffing and O&M requirements in Path 2 and Path 3 are significantly less than would be needed to operate a steam plant such as Sims.
    c. Local generation serves as a hedge against potentially unfavorable market conditions, mitigating some of the risks of 100 percent network supply.
    d. Although MISO transmission reliability has historically been excellent and will improve even more with NITS, a local generator could provide a potential contingency power supply in the event of a "loss of grid" scenario if natural gas supply to the facility also remains uninterrupted.
5. Should the community decide to pursue a local generating facility, combined heat and power functionality could be evaluated for snowmelt purposes. However, snowmelt for three city blocks should not be used to decide dispatching of power supply resources for 14,000 industrial, commercial, and residential customers. Based on the experience of Burns & McDonnell, a co-located, yet de-coupled, snow melt system will likely be the most effective and efficient option.
6. GHBLP should take action to procure capacity required after the retirement of J.B. Sims Unit 3 on June 1, 2020. Capacity could be procured through MPPA, through power purchase agreements, or the annual MISO Planning Resource Auction.

   a. Assuming GHBLP pursues Path 2 with the installation of a 36-MW local generating facility, the capacity should be procured to cover any interim period between June 1, 2020 and the estimated in-service date of the new generation facility.
   b. If GHBLP opts to rely only on the MISO market for capacity, longer-term contracts, if available, should be considered if cost competitive. GHBLP should consider issuing a Request for Proposals ("RFP") for capacity if the community pursues this option.
7. GHBLP should continue to evaluate participation in renewable generation projects through its membership in MPPA as opportunities arise. Participation in MPPA may provide additional economies of scale and may supplement and provide complementary generation to GHBLP's power supply portfolio.
8. GHBLP should continue to consider adding local solar resources through a small community solar project. Burns & McDonnell recommends that GHBLP should first determine a power supply plan with respect to the local, natural gas-fired resource and then evaluate local solar as part of that plan; a local solar project should not be a guiding factor in deciding a power supply path forward. The reciprocating engine plant is sized appropriately within Path 2 to provide GHBLP the ability to add additional renewables, or other power supply resources, to the portfolio to meet energy and capacity requirements.
9. As determined in the internal Sims Staffing Considerations, GHBLP should continue to reduce staffing level at the Sims plant through attrition and internal transfers.
10. After the completion of the PDR and other engineering studies, Burns & McDonnell recommends GHBLP begin conducting financial studies to support the debt financing of the power generation facility.

APPENDIX A – ASSUMPTIONS

Information for this appendix has been provided in electric format.

APPENDIX B – DETAILED PROMOD RESULTS

Information for this appendix has also been provided in electric format.

Grand Haven Board of Light & Power Planning Analysis

High Gas - J.B. Sims Unit 3

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$ 8,175,215	$ 9,688,683	$ 9,416,156	$ 8,615,315	$ 8,738,884	$ 9,003,273	$ 9,548,448	$ 9,962,296	$ 10,488,786	$ 11,313,806	$ 11,962,969	$ 12,397,383	$ 13,163,498	$ 13,605,871	$ 14,008,111	$ 14,432,720	$ 14,912,182	$ 15,638,017	$ 16,152,908	$ 16,792,905
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 31.06	$ 36.89	$ 35.68	$ 32.49	$ 32.80	$ 33.65	$ 35.43	$ 36.70	$ 37.50	$ 39.16	$ 41.20	$ 42.51	$ 44.93	$ 45.69	$ 46.82	$ 47.96	$ 49.20	$ 51.36	$ 52.80	$ 54.66
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	(14.0)	(13.8)	(13.5)	(13.2)	(12.9)	(12.3)	(12.0)	(11.2)	(10.1)	(9.8)	0.5	0.8	1.8	2.1	2.4	2.7	3.1	3.4	3.6
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ (1,202,167)	$ (1,210,919)	$ (1,216,238)	$ (1,183,043)	$ (1,207,371)	$ (1,152,659)	$ (1,153,754)	$ (1,102,347)	$ (1,044,961)	$ (1,050,370)	$ 50,981	$ 84,119	$ 198,630	$ 230,303	$ 269,042	$ 321,884	$ 389,225	$ 439,332	$ 487,649
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 4,828,158	$ 4,948,862	$ 5,072,584	$ 5,199,398	$ 5,329,383	$ 5,462,618	$ 5,599,183	$ 5,739,163	$ 5,882,642	$ 6,029,708	$ 6,180,451	$ 6,334,962	$ 6,493,336	$ 6,655,670	$ 6,822,061	$ 6,992,613	$ 7,167,428	$ 7,346,614
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPITAL EXPENDITURES	$	J B Sims:3	$ 5,535,000	$ 2,311,375	$ 2,369,159	$ 2,428,388	$ 2,489,098	$ 9,161,578	$ 3,304,546	$ 3,387,160	$ 3,471,839	$ 3,558,635	$ 3,647,601	$ 1,869,395	$ 1,916,130	$ 1,964,034	$ 2,013,134	$ 2,063,463	$ 2,115,049	$ 2,167,926	$ 2,222,124	$ 16,205,917
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 3,179,453	$ 3,258,940	$ 3,340,413	$ 3,423,923	$ 3,509,521	$ 3,597,259	$ 3,687,191	$ 3,779,371	$ 3,873,855	$ 3,970,701	$ 4,069,969	$ 4,171,718	$ 4,276,011	$ 4,382,911	$ 4,492,484	$ 4,604,796	$ 4,719,916	$ 4,837,914	$ 4,958,862
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPACITY	MW	J B Sims:3	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
CAPACITY	MW	GHBLP Recip 9MW:1																				
CAPACITY	MW	GHBLP Recip 9MW:2																				
CAPACITY	MW	GHBLP Recip 9MW:3																				
CAPACITY	MW	GHBLP Recip 9MW:4																				
CAPACITY	MW	GHBLP Recip 9MW:5																				
CAPACITY	MW	GHBLP Recip 9MW:6																				
GENERATION	MWh	J B Sims:3	356,374	434,930	446,867	380,144	369,140	370,159	391,385	398,547	389,831	400,546	412,715	414,735	426,813	428,245	427,583	427,218	427,703	433,789	432,958	439,416
GENERATION	MWh	GHBLP Recip 9MW:1																				
GENERATION	MWh	GHBLP Recip 9MW:2																				
GENERATION	MWh	GHBLP Recip 9MW:3																				
GENERATION	MWh	GHBLP Recip 9MW:4																				
GENERATION	MWh	GHBLP Recip 9MW:5																				
GENERATION	MWh	GHBLP Recip 9MW:6																				
CAPACITY FACTOR	%	J B Sims:3	56%	67%	70%	59%	58%	58%	61%	62%	61%	62%	64%	65%	67%	67%	67%	67%	67%	67%	68%	69%
CAPACITY FACTOR	%	GHBLP Recip 9MW:1																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:2																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:3																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:4																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:5																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:6																				
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,134,728	4,958,153	5,113,826	4,417,766	4,302,769	4,314,837	4,535,065	4,609,769	4,519,205	4,632,482	4,758,925	4,779,084	4,905,101	4,921,621	4,913,166	4,909,400	4,914,514	4,979,523	4,969,356	5,036,824
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6																				
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.4	11.4	11.6	11.7	11.7	11.6	11.6	11.6	11.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:1																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:2																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:3																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:4																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:5																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:6																				
FUEL COST	$	J B Sims:3	$ 11,383,546	$ 13,994,520	$ 14,795,420	$ 13,102,429	$ 13,073,519	$ 13,440,130	$ 14,480,360	$ 15,088,023	$ 15,162,812	$ 15,924,931	$ 16,769,741	$ 17,263,004	$ 18,162,778	$ 18,682,908	$ 19,118,946	$ 19,572,007	$ 20,084,027	$ 20,861,580	$ 21,341,325	$ 21,728,551
FUEL COST	$	GHBLP Recip 9MW:1																				
FUEL COST	$	GHBLP Recip 9MW:2																				
FUEL COST	$	GHBLP Recip 9MW:3																				
FUEL COST	$	GHBLP Recip 9MW:4																				
FUEL COST	$	GHBLP Recip 9MW:5																				
FUEL COST	$	GHBLP Recip 9MW:6																				
UNIT REVENUE	$	J B Sims:3	$ 11,539,230	$ 16,383,763	$ 16,438,973	$ 13,014,649	$ 12,798,678	$ 13,173,173	$ 14,642,420	$ 15,422,390	$ 15,430,293	$ 16,532,968	$ 17,863,190	$ 18,531,896	$ 20,040,761	$ 20,509,461	$ 20,994,647	$ 21,497,643	$ 22,063,311	$ 23,305,936	$ 23,859,289	$ 25,035,381
UNIT REVENUE	$	GHBLP Recip 9MW:1																				
UNIT REVENUE	$	GHBLP Recip 9MW:2																				
UNIT REVENUE	$	GHBLP Recip 9MW:3																				
UNIT REVENUE	$	GHBLP Recip 9MW:4																				
UNIT REVENUE	$	GHBLP Recip 9MW:5																				
UNIT REVENUE	$	GHBLP Recip 9MW:6																				
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

High Gas - J.B. Sims Unit 3

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 15,887,599	$ 12,927,318	$ 13,260,311	$ 13,603,311	$ 13,955,358	$ 20,926,946	$ 15,377,294	$ 15,775,007	$ 16,182,486	$ 16,600,063	$ 17,028,832	$ 15,599,707	$ 16,004,724	$ 16,420,933	$ 16,848,420	$ 17,287,139	$ 17,738,006	$ 18,200,485	$ 18,674,092	$ 33,086,378	**$ 341,384,408**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
TOTAL FUEL COSTS	$		$ 11,383,546	$ 13,994,520	$ 14,795,420	$ 13,102,429	$ 13,073,519	$ 13,440,130	$ 14,480,360	$ 15,088,023	$ 15,162,812	$ 15,924,931	$ 16,769,741	$ 17,263,004	$ 18,162,778	$ 18,682,908	$ 19,118,946	$ 19,572,007	$ 20,084,027	$ 20,861,580	$ 21,341,325	$ 21,728,551	**$ 334,030,556**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,175,215	$ 9,688,683	$ 9,416,156	$ 8,615,315	$ 8,738,884	$ 9,003,273	$ 9,548,448	$ 9,962,296	$ 10,488,786	$ 11,313,806	$ 11,962,969	$ 12,397,383	$ 13,163,498	$ 13,605,871	$ 14,008,111	$ 14,432,720	$ 14,912,182	$ 15,638,017	$ 16,152,908	$ 16,792,905	**$ 238,017,429**
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,539,230)	$(16,383,763)	$(16,438,973)	$(13,014,649)	$(12,798,678)	$(13,173,173)	$(14,642,420)	$(15,422,390)	$(15,430,293)	$(16,532,968)	$(17,863,190)	$(18,531,896)	$(20,040,761)	$(20,509,461)	$(20,994,647)	$(21,497,643)	$(22,063,311)	$(23,305,936)	$(23,859,289)	$(25,035,381)	**$(359,078,051)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,981	$ 84,119	$ 198,630	$ 230,303	$ 269,042	$ 321,884	$ 389,225	$ 439,332	$ 487,649	**$ 2,471,165**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ (1,202,167)	$ (1,210,919)	$ (1,216,238)	$ (1,183,043)	$ (1,207,371)	$ (1,152,659)	$ (1,153,754)	$ (1,102,347)	$ (1,044,961)	$ (1,050,370)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (11,711,683)**
TOTAL COSTS	$		$ 29,565,622	$ 25,557,231	$ 26,510,049	$ 27,943,588	$ 28,808,454	$ 36,212,684	$ 30,940,775	$ 31,700,088	$ 32,089,140	$ 32,216,425	$ 32,946,018	$ 32,552,071	$ 33,305,377	$ 34,086,444	$ 35,055,283	$ 36,027,577	$ 37,037,194	$ 37,999,623	$ 39,136,783	$ 53,625,359	**$ 673,315,784**

NPV @ 4.0%:	**$443,735,429**	**2018$**
Levelized Cost of Energy ($/MWh)	**$101.57**	**2018$**

LOW CAPACITY MARKET SENSITIVITY			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	(14.0)	(13.8)	(13.5)	(13.2)	(12.9)	(12.3)	(12.0)	(11.2)	(10.1)	(9.8)	0.5	0.8	1.8	2.1	2.4	2.7	3.1	3.4	3.6	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ (688,755)	$ (693,769)	$ (696,817)	$ (699,354)	$ (701,347)	$ (685,703)	$ (686,324)	$ (652,090)	$ (604,245)	$ (602,223)	$ 30,623	$ 50,080	$ 117,667	$ 141,713	$ 167,037	$ 194,463	$ 222,998	$ 251,706	$ 279,388	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 15,887,599	$ 12,927,318	$ 13,260,311	$ 13,603,311	$ 13,955,358	$ 20,926,946	$ 15,377,294	$ 15,775,007	$ 16,182,486	$ 16,600,063	$ 17,028,832	$ 15,599,707	$ 16,004,724	$ 16,420,933	$ 16,848,420	$ 17,287,139	$ 17,738,006	$ 18,200,485	$ 18,674,092	$ 33,086,378	$ 341,384,408
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL FUEL COSTS	$		$ 11,383,546	$ 13,994,520	$ 14,795,420	$ 13,102,429	$ 13,073,519	$ 13,440,130	$ 14,480,360	$ 15,088,023	$ 15,162,812	$ 15,924,931	$ 16,769,741	$ 17,263,004	$ 18,162,778	$ 18,682,908	$ 19,118,946	$ 19,572,007	$ 20,084,027	$ 20,861,580	$ 21,341,325	$ 21,728,551	$ 334,030,556
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,175,215	$ 9,688,683	$ 9,416,156	$ 8,615,315	$ 8,738,884	$ 9,003,273	$ 9,548,448	$ 9,962,296	$ 10,488,786	$ 11,313,806	$ 11,962,969	$ 12,397,383	$ 13,163,498	$ 13,605,871	$ 14,008,111	$ 14,432,720	$ 14,912,182	$ 15,638,017	$ 16,152,908	$ 16,792,905	$ 238,017,429
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,539,230)	$(16,383,763)	$(16,438,973)	$(13,014,649)	$(12,798,678)	$(13,173,173)	$(14,642,420)	$(15,422,390)	$(15,430,293)	$(16,532,968)	$(17,863,190)	$(18,531,896)	$(20,040,761)	$(20,509,461)	$(20,994,647)	$(21,497,643)	$(22,063,311)	$(23,305,936)	$(23,859,289)	$(25,035,381)	$(359,078,051)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,623	$ 50,080	$ 117,667	$ 141,713	$ 167,037	$ 194,463	$ 222,998	$ 251,706	$ 279,388	$ 1,455,674
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ (688,755)	$ (693,769)	$ (696,817)	$ (699,354)	$ (701,347)	$ (685,703)	$ (686,324)	$ (652,090)	$ (604,245)	$ (602,223)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (6,898,480)
TOTAL COSTS	$		$ 29,565,622	$ 26,070,643	$ 27,027,199	$ 28,463,009	$ 29,292,144	$ 36,718,707	$ 31,407,731	$ 32,167,518	$ 32,539,397	$ 32,657,142	$ 33,394,164	$ 32,531,713	$ 33,271,337	$ 34,005,482	$ 34,966,692	$ 35,925,573	$ 36,909,773	$ 37,833,396	$ 38,949,156	$ 53,417,098	**$ 677,113,495**

NPV @ 4.0%:	**$446,997,772**	**2018$**
Levelized Cost of Energy ($/MWh)	**$102.33**	**2018$**

IMPLIED CAPACITY COST		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
J B Sims:3	$/kW-Yr	$ 163	$ 90	$ 103	$ 130	$ 136	$ 230	$ 146	$ 148	$ 152	$ 152	$ 149	$ 125	$ 120	$ 125	$ 128	$ 131	$ 134	$ 132	$ 135	$ 319

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Build 4x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928
MISO WHOLESALE MARKET PURCHASES	$		$8,234,855	$9,805,316	$9,578,951	$8,837,899	$8,970,132	$9,248,054	$9,815,147	$10,246,901	$10,799,891	$11,648,280
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 31.29	$ 37.33	$ 36.30	$ 33.32	$ 33.67	$ 34.57	$ 36.41	$ 37.75	$ 38.61	$ 40.32
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	22.0	22.3	22.9	23.2	24.0	25.1
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 1,971,839	$ 2,083,499	$ 2,141,102	$ 2,222,499	$ 2,377,703	$ 2,604,141
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,609,386	$ 1,649,621	$ 1,690,861	$ 1,733,133	$ 1,776,461	$ 1,820,873	$ 1,866,394	$ 1,913,054
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 36,352	$ 45,122	$ 45,665	$ 44,588	$ 45,964	$ 48,173	$ 51,860	$ 54,899	$ 56,824	$ 59,352
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ 702,605	$ 720,170	$ 738,174	$ 756,628	$ 775,544	$ 794,933
CAPACITY	MW	J B Sims:3	73	73								
CAPACITY	MW	GHBLP Recip 9MW:1					9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:2					9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:3					9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:4					9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:5										
CAPACITY	MW	GHBLP Recip 9MW:6										
GENERATION	MWh	J B Sims:3	358,418	159,158								
GENERATION	MWh	GHBLP Recip 9MW:1					1,998	1,746	1,575	1,413	1,647	1,782
GENERATION	MWh	GHBLP Recip 9MW:2					1,980	1,665	1,647	1,503	1,620	1,818
GENERATION	MWh	GHBLP Recip 9MW:3					2,034	1,809	1,656	1,485	1,620	1,683
GENERATION	MWh	GHBLP Recip 9MW:4					2,052	1,755	1,530	1,503	1,584	1,683
GENERATION	MWh	GHBLP Recip 9MW:5										
GENERATION	MWh	GHBLP Recip 9MW:6										
CAPACITY FACTOR	%	J B Sims:3	56%	49%								
CAPACITY FACTOR	%	GHBLP Recip 9MW:1					4%	2%	2%	2%	2%	2%
CAPACITY FACTOR	%	GHBLP Recip 9MW:2					4%	2%	2%	2%	2%	2%
CAPACITY FACTOR	%	GHBLP Recip 9MW:3					4%	2%	2%	2%	2%	2%
CAPACITY FACTOR	%	GHBLP Recip 9MW:4					4%	2%	2%	2%	2%	2%
CAPACITY FACTOR	%	GHBLP Recip 9MW:5										
CAPACITY FACTOR	%	GHBLP Recip 9MW:6										
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,156,140	1,810,801								
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1					17,187	15,025	13,548	12,163	14,176	15,331
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2					17,026	14,329	14,172	12,932	13,946	15,637
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3					17,497	15,561	14,248	12,775	13,946	14,478
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4					17,654	15,102	13,165	12,932	13,640	14,478
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5										
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6										
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.4								
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1					8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2					8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3					8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4					8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5										
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6										
VARIABLE O&M COST	$	GHBLP Recip 9MW:1					$ 22,597	$ 20,254	$ 18,727	$ 17,210	$ 20,571	$ 22,810
VARIABLE O&M COST	$	GHBLP Recip 9MW:2					$ 22,394	$ 19,314	$ 19,583	$ 18,307	$ 20,234	$ 23,270
VARIABLE O&M COST	$	GHBLP Recip 9MW:3					$ 23,005	$ 20,984	$ 19,690	$ 18,087	$ 20,234	$ 21,542
VARIABLE O&M COST	$	GHBLP Recip 9MW:4					$ 23,208	$ 20,358	$ 18,192	$ 18,307	$ 19,784	$ 21,542
VARIABLE O&M COST	$	GHBLP Recip 9MW:5										
VARIABLE O&M COST	$	GHBLP Recip 9MW:6										
FUEL COST	$	J B Sims:3	$ 11,442,486	$ 5,062,738								
FUEL COST	$	GHBLP Recip 9MW:1					$ 75,715	$ 69,500	$ 67,732	$ 64,951	$ 79,149	$ 90,068
FUEL COST	$	GHBLP Recip 9MW:2					$ 75,014	$ 66,257	$ 70,846	$ 69,049	$ 77,871	$ 91,864
FUEL COST	$	GHBLP Recip 9MW:3					$ 77,086	$ 71,977	$ 71,231	$ 68,220	$ 77,899	$ 85,058
FUEL COST	$	GHBLP Recip 9MW:4					$ 77,777	$ 69,875	$ 65,855	$ 69,049	$ 76,153	$ 85,058
FUEL COST	$	GHBLP Recip 9MW:5										
FUEL COST	$	GHBLP Recip 9MW:6										
UNIT REVENUE	$	J B Sims:3	$ 11,699,411	$ 6,020,531								
UNIT REVENUE	$	GHBLP Recip 9MW:1					$ 134,110	$ 124,679	$ 121,621	$ 114,651	$ 123,914	$ 141,039
UNIT REVENUE	$	GHBLP Recip 9MW:2					$ 132,455	$ 118,740	$ 125,862	$ 122,568	$ 122,641	$ 143,506
UNIT REVENUE	$	GHBLP Recip 9MW:3					$ 135,113	$ 128,268	$ 126,419	$ 121,379	$ 122,346	$ 132,874
UNIT REVENUE	$	GHBLP Recip 9MW:4					$ 136,541	$ 123,142	$ 116,767	$ 122,568	$ 119,654	$ 133,359
UNIT REVENUE	$	GHBLP Recip 9MW:5										
UNIT REVENUE	$	GHBLP Recip 9MW:6										
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305

Data Item	Units	Description	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$12,318,576	$12,767,407	$13,556,009	$14,008,180	$14,422,290	$14,860,059	$15,354,791	$16,103,863	$16,632,089	$17,289,386
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 42.43	$ 43.78	$ 46.27	$ 47.05	$ 48.20	$ 49.38	$ 50.66	$ 52.89	$ 54.37	$ 56.28
MARKET CAPACITY DEFICIT / (SALES)	MW		25.4	35.7	36.0	37.0	37.3	37.6	37.9	38.3	38.6	38.8
MARKET CAPACITY PRICE	$/kW-Yr		$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ 2,721,940	$ 3,741,699	$ 3,900,933	$ 4,130,348	$ 4,110,108	$ 4,210,424	$ 4,473,603	$ 4,876,571	$ 5,038,862	$ 5,202,167
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only	$ 480,000									
MISO NITS COST	$		$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 1,960,881	$ 2,009,903	$ 2,060,150	$ 2,111,654	$ 2,164,445	$ 2,218,557	$ 2,274,020	$ 2,330,871	$ 2,389,143	$ 2,448,871
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 62,467	$ 64,449	$ 68,027	$ 68,960	$ 70,719	$ 72,418	$ 74,255	$ 77,493	$ 79,514	$ 82,472
CAPITAL EXPENDITURES	$	J B Sims:3	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115
FIXED O&M COST	$	J B Sims:3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ 814,806	$ 835,176	$ 856,055	$ 877,457	$ 899,393	$ 921,878	$ 944,925	$ 968,548	$ 992,762	$ 1,017,581
CAPACITY	MW	J B Sims:3										
CAPACITY	MW	GHBLP Recip 9MW:1	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:2	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:3	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:4	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:5										
CAPACITY	MW	GHBLP Recip 9MW:6										
GENERATION	MWh	J B Sims:3										
GENERATION	MWh	GHBLP Recip 9MW:1	1,719	1,503	1,773	1,809	1,809	1,953	1,926	1,980	1,953	2,691
GENERATION	MWh	GHBLP Recip 9MW:2	1,827	1,701	1,755	1,872	1,782	1,994	1,962	1,980	1,845	2,628
GENERATION	MWh	GHBLP Recip 9MW:3	1,827	1,755	1,827	1,890	1,944	1,935	1,971	1,899	1,854	2,979
GENERATION	MWh	GHBLP Recip 9MW:4	1,809	1,755	1,782	1,809	1,908	1,926	1,818	1,755	1,836	2,709
GENERATION	MWh	GHBLP Recip 9MW:5										
GENERATION	MWh	GHBLP Recip 9MW:6										
CAPACITY FACTOR	%	J B Sims:3										
CAPACITY FACTOR	%	GHBLP Recip 9MW:1	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:2	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:3	2%	2%	2%	2%	2%	2%	2%	2%	2%	4%
CAPACITY FACTOR	%	GHBLP Recip 9MW:4	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:5										
CAPACITY FACTOR	%	GHBLP Recip 9MW:6										
FUEL CONSUMPTION	MMBtu	J B Sims:3										
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1	14,788	12,948	15,259	15,581	15,565	16,801	16,575	17,038	16,813	23,074
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2	15,718	14,643	15,106	16,116	15,331	17,149	16,885	17,038	15,887	22,554
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3	15,718	15,102	15,722	16,273	16,728	16,648	16,958	16,342	15,959	25,534
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4	15,565	15,102	15,339	15,573	16,422	16,571	15,649	15,106	15,810	23,235
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5										
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6										
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3										
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5										
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6										
VARIABLE O&M COST	$	GHBLP Recip 9MW:1	$ 22,553	$ 20,215	$ 24,450	$ 25,561	$ 26,194	$ 29,002	$ 29,314	$ 30,888	$ 31,228	$ 44,105
VARIABLE O&M COST	$	GHBLP Recip 9MW:2	$ 23,970	$ 22,878	$ 24,201	$ 26,451	$ 25,803	$ 29,603	$ 29,862	$ 30,888	$ 29,502	$ 43,072
VARIABLE O&M COST	$	GHBLP Recip 9MW:3	$ 23,970	$ 23,605	$ 25,194	$ 26,706	$ 28,149	$ 28,735	$ 29,999	$ 29,624	$ 29,645	$ 48,825
VARIABLE O&M COST	$	GHBLP Recip 9MW:4	$ 23,734	$ 23,605	$ 24,574	$ 25,561	$ 27,628	$ 28,601	$ 27,670	$ 27,378	$ 29,358	$ 44,400
VARIABLE O&M COST	$	GHBLP Recip 9MW:5										
VARIABLE O&M COST	$	GHBLP Recip 9MW:6										
FUEL COST	$	J B Sims:3										
FUEL COST	$	GHBLP Recip 9MW:1	$ 91,324	$ 82,576	$ 103,320	$ 107,565	$ 109,980	$ 121,571	$ 123,012	$ 132,052	$ 133,785	$ 116,528
FUEL COST	$	GHBLP Recip 9MW:2	$ 97,063	$ 93,279	$ 102,278	$ 111,255	$ 108,331	$ 124,116	$ 125,305	$ 132,098	$ 126,286	$ 140,646
FUEL COST	$	GHBLP Recip 9MW:3	$ 97,063	$ 96,192	$ 106,436	$ 112,337	$ 118,202	$ 120,493	$ 125,850	$ 126,585	$ 126,939	$ 134,873
FUEL COST	$	GHBLP Recip 9MW:4	$ 96,119	$ 96,192	$ 103,854	$ 107,461	$ 116,040	$ 119,939	$ 116,120	$ 116,994	$ 125,763	$ 136,158
FUEL COST	$	GHBLP Recip 9MW:5										
FUEL COST	$	GHBLP Recip 9MW:6										
UNIT REVENUE	$	J B Sims:3										
UNIT REVENUE	$	GHBLP Recip 9MW:1	$ 142,676	$ 128,684	$ 158,815	$ 159,515	$ 167,958	$ 183,746	$ 185,963	$ 198,671	$ 200,694	$ 229,112
UNIT REVENUE	$	GHBLP Recip 9MW:2	$ 150,358	$ 145,249	$ 156,968	$ 167,868	$ 164,646	$ 186,853	$ 189,243	$ 198,613	$ 190,791	$ 243,928
UNIT REVENUE	$	GHBLP Recip 9MW:3	$ 150,358	$ 149,497	$ 163,317	$ 169,263	$ 178,668	$ 182,334	$ 189,970	$ 191,251	$ 191,482	$ 261,017
UNIT REVENUE	$	GHBLP Recip 9MW:4	$ 148,961	$ 149,497	$ 158,152	$ 162,729	$ 175,325	$ 181,655	$ 176,324	$ 172,023	$ 188,137	$ 245,820
UNIT REVENUE	$	GHBLP Recip 9MW:5										
UNIT REVENUE	$	GHBLP Recip 9MW:6										
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Build 4x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 5,177,094	$ 5,297,846	$ 10,720,287	$ 10,869,028	$ 11,023,704	$ 11,181,542	$ 11,341,959	$ 11,506,854	$ 11,677,145	$ 11,851,266	$ 12,031,762	$ 12,215,101	$ 12,404,700	$ 12,599,479	$ 12,800,404	$ 13,008,048	$ 13,219,149	$ 13,435,014	**$ 227,920,670**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 91,204	$ 80,910	$ 76,191	$ 71,911	$ 80,823	$ 89,165	$ 94,228	$ 90,303	$ 98,419	$ 104,279	$ 107,775	$ 115,941	$ 116,844	$ 118,778	$ 119,733	$ 180,402	**$ 1,636,907**
TOTAL FUEL COSTS	$		$ 11,442,486	$ 5,062,738	$ -	$ -	$ 305,592	$ 277,609	$ 275,665	$ 271,270	$ 311,072	$ 352,047	$ 381,568	$ 368,239	$ 415,888	$ 438,618	$ 452,552	$ 486,119	$ 490,288	$ 507,730	$ 512,773	$ 528,205	**$ 22,880,459**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,234,855	$ 9,805,316	$ 9,578,951	$ 8,837,899	$ 8,970,132	$ 9,248,054	$ 9,815,147	$ 10,246,901	$ 10,799,891	$ 11,648,280	$ 12,318,576	$ 12,767,407	$ 13,556,009	$ 14,008,180	$ 14,422,290	$ 14,860,059	$ 15,354,791	$ 16,103,863	$ 16,632,089	$ 17,289,386	**$ 244,498,073**
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,699,411)	$ (6,020,531)	$ -	$ -	$ (538,219)	$ (494,830)	$ (490,669)	$ (481,166)	$ (488,555)	$ (550,778)	$ (592,353)	$ (572,926)	$ (637,251)	$ (659,376)	$ (686,598)	$ (734,587)	$ (741,500)	$ (760,558)	$ (771,104)	$ (979,878)	**$ (27,900,290)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 1,971,839	$ 2,083,499	$ 2,141,102	$ 2,222,499	$ 2,377,703	$ 2,604,141	$ 2,721,940	$ 3,741,699	$ 3,900,933	$ 4,130,348	$ 4,110,108	$ 4,210,424	$ 4,473,603	$ 4,876,571	$ 5,038,862	$ 5,202,167	**$ 70,507,923**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,825,372	$ 33,509,036	$ 26,341,874	$ 26,034,337	$ 28,543,250	$ 29,287,148	$ 30,170,890	$ 30,963,863	$ 31,210,590	$ 31,605,263	$ 32,699,139	$ 34,018,882	$ 35,296,777	$ 35,924,716	$ 36,654,975	$ 37,501,747	$ 38,538,835	$ 40,070,683	$ 41,139,916	$ 42,220,553	**$ 667,557,848**

NPV @ 4.0%:	**$440,092,581**	**2018$**
Levelized Cost of Energy ($/MWh)	**$100.74**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	22.0	22.3	22.9	23.2	24.0	25.1	25.4	35.7	36.0	37.0	37.3	37.6	37.9	38.3	38.6	38.8	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 1,165,649	$ 1,210,280	$ 1,273,715	$ 1,322,079	$ 1,406,523	$ 1,505,834	$ 1,560,608	$ 2,247,524	$ 2,322,404	$ 2,446,800	$ 2,529,073	$ 2,614,082	$ 2,702,684	$ 2,793,924	$ 2,886,905	$ 2,980,467	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 5,177,094	$ 5,297,846	$ 10,720,287	$ 10,869,028	$ 11,023,704	$ 11,181,542	$ 11,341,959	$ 11,506,854	$ 11,677,145	$ 11,851,266	$ 12,031,762	$ 12,215,101	$ 12,404,700	$ 12,599,479	$ 12,800,404	$ 13,008,048	$ 13,219,149	$ 13,435,014	$ 227,920,670
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 91,204	$ 80,910	$ 76,191	$ 71,911	$ 80,823	$ 89,165	$ 94,228	$ 90,303	$ 98,419	$ 104,279	$ 107,775	$ 115,941	$ 116,844	$ 118,778	$ 119,733	$ 180,402	$ 1,636,907
TOTAL FUEL COSTS	$		$ 11,442,486	$ 5,062,738	$ -	$ -	$ 305,592	$ 277,609	$ 275,665	$ 271,270	$ 311,072	$ 352,047	$ 381,568	$ 368,239	$ 415,888	$ 438,618	$ 452,552	$ 486,119	$ 490,288	$ 507,730	$ 512,773	$ 528,205	$ 22,880,459
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,234,855	$ 9,805,316	$ 9,578,951	$ 8,837,899	$ 8,970,132	$ 9,248,054	$ 9,815,147	$ 10,246,901	$ 10,799,891	$ 11,648,280	$ 12,318,576	$ 12,767,407	$ 13,556,009	$ 14,008,180	$ 14,422,290	$ 14,860,059	$ 15,354,791	$ 16,103,863	$ 16,632,089	$ 17,289,386	$ 244,498,073
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,699,411)	$ (6,020,531)	$ -	$ -	$ (538,219)	$ (494,830)	$ (490,669)	$ (481,166)	$ (488,555)	$ (550,778)	$ (592,353)	$ (572,926)	$ (637,251)	$ (659,376)	$ (686,598)	$ (734,587)	$ (741,500)	$ (760,558)	$ (771,104)	$ (979,878)	$ (27,900,290)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 1,165,649	$ 1,210,280	$ 1,273,715	$ 1,322,079	$ 1,406,523	$ 1,505,834	$ 1,560,608	$ 2,247,524	$ 2,322,404	$ 2,446,800	$ 2,529,073	$ 2,614,082	$ 2,702,684	$ 2,793,924	$ 2,886,905	$ 2,980,467	$ 41,390,870
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$		$ 25,825,372	$ 31,477,226	$ 24,250,172	$ 23,879,684	$ 27,737,060	$ 28,413,929	$ 29,303,504	$ 30,063,443	$ 30,239,410	$ 30,506,956	$ 31,537,807	$ 32,524,707	$ 33,718,249	$ 34,241,167	$ 35,073,941	$ 35,905,405	$ 36,767,916	$ 37,988,036	$ 38,987,959	$ 39,998,853	**$ 638,440,795**

NPV @ 4.0%:	**$421,107,982**	**2018$**
Levelized Cost of Energy ($/MWh)	**$96.40**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
4x 9 MW Recips	$/kW-Yr						$ 154	$ 155	$ 156	$ 156	$ 158	$ 159	$ 160	$ 160	$ 161	$ 162	$ 163	$ 164	$ 165	$ 166	$ 167	$ 164

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Build 6x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$8,234,855	$9,805,316	$9,578,951	$8,837,899	$8,970,132	$9,248,054	$9,815,147	$10,246,901	$10,799,891	$11,648,280	$12,318,576	$12,767,407	$13,556,009	$14,008,180	$14,422,290	$14,860,059	$15,354,791	$16,103,863	$16,632,089	$17,289,386
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 31.29	$ 37.33	$ 36.30	$ 33.32	$ 33.67	$ 34.57	$ 36.41	$ 37.75	$ 38.61	$ 40.32	$ 42.43	$ 43.78	$ 46.27	$ 47.05	$ 48.20	$ 49.38	$ 50.66	$ 52.89	$ 54.37	$ 56.28
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	4.9	5.2	5.8	6.1	6.9	8.0	8.3	18.6	18.9	19.9	20.2	20.5	20.8	21.2	21.5	21.7
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 439,212	$ 484,810	$ 541,008	$ 582,330	$ 687,111	$ 831,424	$ 889,369	$ 1,948,765	$ 2,046,742	$ 2,220,337	$ 2,225,316	$ 2,295,718	$ 2,456,716	$ 2,696,639	$ 2,804,431	$ 2,911,876
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,609,386	$ 1,649,621	$ 1,690,861	$ 1,733,133	$ 1,776,461	$ 1,820,873	$ 1,866,394	$ 1,913,054	$ 1,960,881	$ 2,009,903	$ 2,060,150	$ 2,111,654	$ 2,164,445	$ 2,218,557	$ 2,274,020	$ 2,330,871	$ 2,389,143	$ 2,448,871
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 36,352	$ 45,122	$ 45,665	$ 44,588	$ 45,964	$ 48,173	$ 51,860	$ 54,899	$ 56,824	$ 59,352	$ 62,467	$ 64,449	$ 68,027	$ 68,960	$ 70,719	$ 72,418	$ 74,255	$ 77,493	$ 79,514	$ 82,472
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ 763,701	$ 782,793	$ 802,363	$ 822,422	$ 842,983	$ 864,057	$ 885,658	$ 907,800	$ 930,495	$ 953,757	$ 977,601	$ 1,002,041	$ 1,027,092	$ 1,052,770	$ 1,079,089	$ 1,106,066
CAPACITY	MW	J B Sims:3	73	73																		
CAPACITY	MW	GHBLP Recip 9MW:1					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:2					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:3					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:4					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:5					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:6					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
GENERATION	MWh	J B Sims:3	358,418	159,158																		
GENERATION	MWh	GHBLP Recip 9MW:1					1,998	1,746	1,575	1,413	1,647	1,782	1,719	1,503	1,773	1,809	1,809	1,953	1,926	1,980	1,953	2,691
GENERATION	MWh	GHBLP Recip 9MW:2					1,980	1,665	1,647	1,503	1,620	1,818	1,827	1,701	1,755	1,872	1,782	1,994	1,962	1,980	1,845	2,628
GENERATION	MWh	GHBLP Recip 9MW:3					2,034	1,809	1,656	1,485	1,620	1,683	1,827	1,755	1,827	1,890	1,944	1,935	1,971	1,899	1,854	2,979
GENERATION	MWh	GHBLP Recip 9MW:4					2,052	1,755	1,530	1,503	1,584	1,683	1,809	1,755	1,782	1,809	1,908	1,926	1,818	1,755	1,836	2,709
GENERATION	MWh	GHBLP Recip 9MW:5					1,872	1,737	1,638	1,503	1,611	1,773	1,836	1,746	1,674	1,728	1,863	1,908	1,908	1,971	1,908	3,060
GENERATION	MWh	GHBLP Recip 9MW:6					1,926	1,764	1,494	1,404	1,656	1,719	1,809	1,647	1,827	1,827	1,872	1,989	1,845	1,917	1,953	2,925
CAPACITY FACTOR	%	J B Sims:3	56%	49%																		
CAPACITY FACTOR	%	GHBLP Recip 9MW:1					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:2					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:3					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	4%
CAPACITY FACTOR	%	GHBLP Recip 9MW:4					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:5					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	4%
CAPACITY FACTOR	%	GHBLP Recip 9MW:6					4%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	4%
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,156,140	1,810,801																		
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1					17,187	15,025	13,548	12,163	14,176	15,331	14,788	12,948	15,259	15,581	15,565	16,801	16,575	17,038	16,813	23,074
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2					17,026	14,329	14,172	12,932	13,946	15,637	15,718	14,643	15,106	16,116	15,331	17,149	16,885	17,038	15,887	22,554
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3					17,497	15,561	14,248	12,775	13,946	14,478	15,718	15,102	15,722	16,273	16,728	16,648	16,958	16,342	15,959	25,534
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4					17,654	15,102	13,165	12,932	13,640	14,478	15,565	15,102	15,339	15,573	16,422	16,571	15,649	15,106	15,810	23,235
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5					16,108	14,949	14,091	12,932	13,866	15,259	15,803	15,021	14,405	14,884	16,032	16,410	16,418	16,962	16,422	26,226
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6					16,571	15,174	12,855	12,082	14,256	14,784	15,565	14,168	15,722	15,734	16,108	17,111	15,883	16,495	16,813	25,067
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.4																		
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
VARIABLE O&M COST	$	GHBLP Recip 9MW:1					$ 22,597	$ 20,254	$ 18,727	$ 17,210	$ 20,571	$ 22,810	$ 22,553	$ 20,215	$ 24,450	$ 25,561	$ 26,194	$ 29,002	$ 29,314	$ 30,888	$ 31,228	$ 44,105
VARIABLE O&M COST	$	GHBLP Recip 9MW:2					$ 22,394	$ 19,314	$ 19,583	$ 18,307	$ 20,234	$ 23,270	$ 23,970	$ 22,878	$ 24,201	$ 26,451	$ 25,803	$ 29,603	$ 29,862	$ 30,888	$ 29,502	$ 43,072
VARIABLE O&M COST	$	GHBLP Recip 9MW:3					$ 23,005	$ 20,984	$ 19,690	$ 18,087	$ 20,234	$ 21,542	$ 23,970	$ 23,605	$ 25,194	$ 26,706	$ 28,149	$ 28,735	$ 29,999	$ 29,624	$ 29,645	$ 48,825
VARIABLE O&M COST	$	GHBLP Recip 9MW:4					$ 23,208	$ 20,358	$ 18,192	$ 18,307	$ 19,784	$ 21,542	$ 23,734	$ 23,605	$ 24,574	$ 25,561	$ 27,628	$ 28,601	$ 27,670	$ 27,378	$ 29,358	$ 44,400
VARIABLE O&M COST	$	GHBLP Recip 9MW:5					$ 21,172	$ 20,149	$ 19,476	$ 18,307	$ 20,121	$ 22,694	$ 24,088	$ 23,484	$ 23,084	$ 24,417	$ 26,976	$ 28,334	$ 29,040	$ 30,748	$ 30,509	$ 50,153
VARIABLE O&M COST	$	GHBLP Recip 9MW:6					$ 21,783	$ 20,462	$ 17,764	$ 17,101	$ 20,683	$ 22,003	$ 23,734	$ 22,152	$ 25,194	$ 25,816	$ 27,107	$ 29,537	$ 28,081	$ 29,905	$ 31,228	$ 47,940
FUEL COST	$	J B Sims:3	$ 11,442,486	$ 5,062,738																		
FUEL COST	$	GHBLP Recip 9MW:1					$ 75,715	$ 69,500	$ 67,732	$ 64,951	$ 79,149	$ 90,068	$ 91,324	$ 82,576	$ 103,320	$ 107,565	$ 109,980	$ 121,571	$ 123,012	$ 132,052	$ 133,785	$ 116,528
FUEL COST	$	GHBLP Recip 9MW:2					$ 75,014	$ 66,257	$ 70,846	$ 69,049	$ 77,871	$ 91,864	$ 97,063	$ 93,279	$ 102,278	$ 111,255	$ 108,331	$ 124,116	$ 125,305	$ 132,098	$ 126,286	$ 140,646
FUEL COST	$	GHBLP Recip 9MW:3					$ 77,086	$ 71,977	$ 71,231	$ 68,220	$ 77,899	$ 85,058	$ 97,063	$ 96,192	$ 106,436	$ 112,337	$ 118,202	$ 120,493	$ 125,850	$ 126,585	$ 126,939	$ 134,873
FUEL COST	$	GHBLP Recip 9MW:4					$ 77,777	$ 69,875	$ 65,855	$ 69,049	$ 76,153	$ 85,058	$ 96,119	$ 96,192	$ 103,854	$ 107,461	$ 116,040	$ 119,939	$ 116,120	$ 116,994	$ 125,763	$ 136,158
FUEL COST	$	GHBLP Recip 9MW:5					$ 70,984	$ 69,162	$ 70,441	$ 69,049	$ 77,423	$ 89,642	$ 97,590	$ 95,687	$ 97,579	$ 102,712	$ 113,245	$ 118,769	$ 121,806	$ 131,476	$ 130,596	$ 140,646
FUEL COST	$	GHBLP Recip 9MW:6					$ 73,006	$ 70,212	$ 64,264	$ 64,510	$ 79,621	$ 86,823	$ 96,119	$ 90,242	$ 106,436	$ 108,571	$ 113,792	$ 123,843	$ 117,849	$ 127,860	$ 133,739	$ 131,092
UNIT REVENUE	$	J B Sims:3	$ 11,699,411	$ 6,020,531																		
UNIT REVENUE	$	GHBLP Recip 9MW:1					$ 134,110	$ 124,679	$ 121,621	$ 114,651	$ 123,914	$ 141,039	$ 142,676	$ 128,684	$ 158,815	$ 159,515	$ 167,958	$ 183,746	$ 185,963	$ 198,671	$ 200,694	$ 229,112
UNIT REVENUE	$	GHBLP Recip 9MW:2					$ 132,455	$ 118,740	$ 125,862	$ 122,568	$ 122,641	$ 143,506	$ 150,358	$ 145,249	$ 156,968	$ 167,868	$ 164,646	$ 186,853	$ 189,243	$ 198,613	$ 190,791	$ 243,928
UNIT REVENUE	$	GHBLP Recip 9MW:3					$ 135,113	$ 128,268	$ 126,419	$ 121,379	$ 122,346	$ 132,874	$ 150,358	$ 149,497	$ 163,317	$ 169,263	$ 178,668	$ 182,334	$ 189,970	$ 191,251	$ 191,482	$ 261,017
UNIT REVENUE	$	GHBLP Recip 9MW:4					$ 136,541	$ 123,142	$ 116,767	$ 122,568	$ 119,654	$ 133,359	$ 148,961	$ 149,497	$ 158,152	$ 162,729	$ 175,325	$ 181,655	$ 176,324	$ 172,023	$ 188,137	$ 245,820
UNIT REVENUE	$	GHBLP Recip 9MW:5					$ 124,827	$ 119,690	$ 125,173	$ 122,568	$ 121,762	$ 138,781	$ 150,873	$ 148,871	$ 150,577	$ 155,291	$ 171,974	$ 180,166	$ 184,623	$ 197,571	$ 195,988	$ 269,081
UNIT REVENUE	$	GHBLP Recip 9MW:6					$ 125,457	$ 125,877	$ 115,877	$ 116,352	$ 124,915	$ 136,843	$ 149,093	$ 140,708	$ 163,317	$ 163,953	$ 172,915	$ 186,716	$ 173,136	$ 192,301	$ 200,619	$ 255,531
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Build 6x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 5,177,094	$ 5,297,846	$ 12,480,505	$ 12,630,774	$ 12,787,016	$ 12,946,458	$ 13,108,520	$ 13,275,101	$ 13,447,120	$ 13,623,013	$ 13,805,324	$ 13,990,524	$ 14,182,030	$ 14,378,764	$ 14,581,694	$ 14,791,392	$ 15,004,599	$ 15,222,622	**$ 256,290,685**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 134,159	$ 121,522	$ 113,431	$ 107,318	$ 121,628	$ 133,862	$ 142,050	$ 135,939	$ 146,698	$ 154,512	$ 161,857	$ 173,812	$ 173,965	$ 179,431	$ 181,471	$ 278,495	**$ 2,460,149**
TOTAL FUEL COSTS	$		$ 11,442,486	$ 5,062,738	$ -	$ -	$ 449,582	$ 416,983	$ 410,370	$ 404,829	$ 468,116	$ 528,512	$ 575,277	$ 554,168	$ 619,903	$ 649,901	$ 679,589	$ 728,732	$ 729,943	$ 767,066	$ 777,108	$ 799,942	**$ 26,065,243**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,234,855	$ 9,805,316	$ 9,578,951	$ 8,837,899	$ 8,970,132	$ 9,248,054	$ 9,815,147	$ 10,246,901	$ 10,799,891	$ 11,648,280	$ 12,318,576	$ 12,767,407	$ 13,556,009	$ 14,008,180	$ 14,422,290	$ 14,860,059	$ 15,354,791	$ 16,103,863	$ 16,632,089	$ 17,289,386	**$ 244,498,073**
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,699,411)	$ (6,020,531)	$ -	$ -	$ (788,503)	$ (740,397)	$ (731,719)	$ (720,086)	$ (735,232)	$ (826,403)	$ (892,319)	$ (862,504)	$ (951,145)	$ (978,620)	$ (1,031,487)	$ (1,101,469)	$ (1,099,259)	$ (1,150,430)	$ (1,167,711)	$ (1,504,490)	**$ (33,001,715)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 439,212	$ 484,810	$ 541,008	$ 582,330	$ 687,111	$ 831,424	$ 889,369	$ 1,948,765	$ 2,046,742	$ 2,220,337	$ 2,225,316	$ 2,295,718	$ 2,456,716	$ 2,696,639	$ 2,804,431	$ 2,911,876	**$ 40,762,289**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,825,372	$ 33,509,036	$ 26,341,874	$ 26,034,337	$ 28,707,503	$ 29,384,623	$ 30,265,003	$ 31,018,657	$ 31,237,730	$ 31,546,331	$ 32,578,108	$ 33,939,681	$ 35,154,548	$ 35,732,398	$ 36,483,746	$ 37,299,928	$ 38,242,255	$ 39,604,212	$ 40,620,400	$ 41,563,087	**$ 665,088,830**

NPV @ 4.0%:	**$438,938,872**	**2018$**
Levelized Cost of Energy ($/MWh)	**$100.48**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	4.9	5.2	5.8	6.1	6.9	8.0	8.3	18.6	18.9	19.9	20.2	20.5	20.8	21.2	21.5	21.7	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 259,639	$ 281,620	$ 321,839	$ 346,406	$ 406,458	$ 480,768	$ 509,914	$ 1,170,564	$ 1,218,520	$ 1,315,318	$ 1,369,304	$ 1,425,319	$ 1,484,201	$ 1,544,980	$ 1,606,737	$ 1,668,295	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 5,177,094	$ 5,297,846	$ 12,480,505	$ 12,630,774	$ 12,787,016	$ 12,946,458	$ 13,108,520	$ 13,275,101	$ 13,447,120	$ 13,623,013	$ 13,805,324	$ 13,990,524	$ 14,182,030	$ 14,378,764	$ 14,581,694	$ 14,791,392	$ 15,004,599	$ 15,222,622	$ 256,290,685
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 134,159	$ 121,522	$ 113,431	$ 107,318	$ 121,628	$ 133,862	$ 142,050	$ 135,939	$ 146,698	$ 154,512	$ 161,857	$ 173,812	$ 173,965	$ 179,431	$ 181,471	$ 278,495	$ 2,460,149
TOTAL FUEL COSTS	$		$ 11,442,486	$ 5,062,738	$ -	$ -	$ 449,582	$ 416,983	$ 410,370	$ 404,829	$ 468,116	$ 528,512	$ 575,277	$ 554,168	$ 619,903	$ 649,901	$ 679,589	$ 728,732	$ 729,943	$ 767,066	$ 777,108	$ 799,942	$ 26,065,243
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,234,855	$ 9,805,316	$ 9,578,951	$ 8,837,899	$ 8,970,132	$ 9,248,054	$ 9,815,147	$ 10,246,901	$ 10,799,891	$ 11,648,280	$ 12,318,576	$ 12,767,407	$ 13,556,009	$ 14,008,180	$ 14,422,290	$ 14,860,059	$ 15,354,791	$ 16,103,863	$ 16,632,089	$ 17,289,386	$ 244,498,073
TOTAL MISO WHOLESALE MARKET SALES	$		$(11,699,411)	$ (6,020,531)	$ -	$ -	$ (788,503)	$ (740,397)	$ (731,719)	$ (720,086)	$ (735,232)	$ (826,403)	$ (892,319)	$ (862,504)	$ (951,145)	$ (978,620)	$ (1,031,487)	$ (1,101,469)	$ (1,099,259)	$ (1,150,430)	$ (1,167,711)	$ (1,504,490)	$ (33,001,715)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 259,639	$ 281,620	$ 321,839	$ 346,406	$ 406,458	$ 480,768	$ 509,914	$ 1,170,564	$ 1,218,520	$ 1,315,318	$ 1,369,304	$ 1,425,319	$ 1,484,201	$ 1,544,980	$ 1,606,737	$ 1,668,295	$ 23,832,200
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$		$ 25,825,372	$ 31,477,226	$ 24,250,172	$ 23,879,684	$ 28,527,930	$ 29,181,433	$ 30,045,834	$ 30,782,733	$ 30,957,077	$ 31,195,675	$ 32,198,654	$ 33,161,479	$ 34,326,325	$ 34,827,379	$ 35,627,734	$ 36,429,528	$ 37,269,740	$ 38,452,553	$ 39,422,706	$ 40,319,507	**$ 648,158,742**

NPV @ 4.0%:	**$427,381,441**	**2018$**
Levelized Cost of Energy ($/MWh)	**$97.83**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
6x 9 MW Recips	$/kW-Yr						$ 134	$ 135	$ 135	$ 136	$ 137	$ 138	$ 138	$ 139	$ 139	$ 140	$ 140	$ 141	$ 142	$ 142	$ 143	$ 140

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Purchase MISO Market Energy

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$8,254,893	$9,842,087	$9,628,007	$8,898,360	$9,028,308	$9,304,278	$9,874,894	$10,302,729	$10,857,630	$11,707,479	$12,377,273	$12,823,151	$13,611,997	$14,059,077	$14,474,847	$14,913,756	$15,410,184	$16,163,119	$16,692,389	$17,352,253
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 31.36	$ 37.47	$ 36.48	$ 33.55	$ 33.89	$ 34.78	$ 36.64	$ 37.95	$ 38.82	$ 40.52	$ 42.63	$ 43.97	$ 46.46	$ 47.22	$ 48.38	$ 49.56	$ 50.84	$ 53.08	$ 54.57	$ 56.48
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	56.2	56.5	57.1	57.4	58.2	59.3	59.6	69.9	70.2	71.2	71.5	71.8	72.1	72.5	72.8	73.0
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 5,037,094	$ 5,280,879	$ 5,341,290	$ 5,502,836	$ 5,758,889	$ 6,149,576	$ 6,387,082	$ 7,327,568	$ 7,609,314	$ 7,950,371	$ 7,879,690	$ 8,039,835	$ 8,507,375	$ 9,236,436	$ 9,507,723	$ 9,782,750
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,237,989	$ 1,268,939	$ 1,300,663	$ 1,333,179	$ 1,366,509	$ 1,400,671	$ 1,435,688	$ 1,471,580	$ 1,508,370	$ 1,546,079	$ 1,584,731	$ 1,624,349	$ 1,664,958	$ 1,706,582	$ 1,749,247	$ 1,792,978	$ 1,837,802	$ 1,883,747
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 36,352	$ 45,122	$ 45,665	$ 44,588	$ 45,964	$ 48,173	$ 51,860	$ 54,899	$ 56,824	$ 59,352	$ 62,467	$ 64,449	$ 68,027	$ 68,960	$ 70,719	$ 72,418	$ 74,255	$ 77,493	$ 79,514	$ 82,472
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 9,153,570	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPACITY	MW	J B Sims:3	73	73																		
CAPACITY	MW	GHBLP Recip 9MW:1																				
CAPACITY	MW	GHBLP Recip 9MW:2																				
CAPACITY	MW	GHBLP Recip 9MW:3																				
CAPACITY	MW	GHBLP Recip 9MW:4																				
CAPACITY	MW	GHBLP Recip 9MW:5																				
CAPACITY	MW	GHBLP Recip 9MW:6																				
GENERATION	MWh	J B Sims:3	357,406	159,158																		
GENERATION	MWh	GHBLP Recip 9MW:1																				
GENERATION	MWh	GHBLP Recip 9MW:2																				
GENERATION	MWh	GHBLP Recip 9MW:3																				
GENERATION	MWh	GHBLP Recip 9MW:4																				
GENERATION	MWh	GHBLP Recip 9MW:5																				
GENERATION	MWh	GHBLP Recip 9MW:6																				
CAPACITY FACTOR	%	J B Sims:3	56%	49%																		
CAPACITY FACTOR	%	GHBLP Recip 9MW:1																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:2																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:3																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:4																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:5																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:6																				
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,145,612	1,810,801																		
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6																				
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.4																		
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:1																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:2																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:3																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:4																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:5																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:6																				
FUEL COST	$	J B Sims:3	$ 11,413,505	$ 5,062,738																		
FUEL COST	$	GHBLP Recip 9MW:1																				
FUEL COST	$	GHBLP Recip 9MW:2																				
FUEL COST	$	GHBLP Recip 9MW:3																				
FUEL COST	$	GHBLP Recip 9MW:4																				
FUEL COST	$	GHBLP Recip 9MW:5																				
FUEL COST	$	GHBLP Recip 9MW:6																				
UNIT REVENUE	$	J B Sims:3	$ 11,710,163	$ 6,020,646																		
UNIT REVENUE	$	GHBLP Recip 9MW:1																				
UNIT REVENUE	$	GHBLP Recip 9MW:2																				
UNIT REVENUE	$	GHBLP Recip 9MW:3																				
UNIT REVENUE	$	GHBLP Recip 9MW:4																				
UNIT REVENUE	$	GHBLP Recip 9MW:5																				
UNIT REVENUE	$	GHBLP Recip 9MW:6																				
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

High Gas - Retire J.B. Sims Unit 3 - Purchase MISO Market Energy

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 13,241,278	$ 4,199,175	$ 4,316,379	$ 4,437,800	$ 4,564,474	$ 4,693,608	$ 4,824,604	$ 4,959,343	$ 5,098,724	$ 5,241,162	$ 5,389,183	$ 5,539,235	$ 5,694,715	$ 5,854,522	$ 6,019,601	$ 6,190,502	$ 6,363,942	$ 6,541,205	**$ 128,729,740**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
TOTAL FUEL COSTS	$		$ 11,413,505	$ 5,062,738	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 16,476,243**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,254,893	$ 9,842,087	$ 9,628,007	$ 8,898,360	$ 9,028,308	$ 9,304,278	$ 9,874,894	$ 10,302,729	$ 10,857,630	$ 11,707,479	$ 12,377,273	$ 12,823,151	$ 13,611,997	$ 14,059,077	$ 14,474,847	$ 14,913,756	$ 15,410,184	$ 16,163,119	$ 16,692,389	$ 17,352,253	**$ 245,576,712**
TOTAL MISO WHOLESALE MARKET SALES	$		$ (11,710,163)	$ (6,020,646)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (17,730,809)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 5,037,094	$ 5,280,879	$ 5,341,290	$ 5,502,836	$ 5,758,889	$ 6,149,576	$ 6,387,082	$ 7,327,568	$ 7,609,314	$ 7,950,371	$ 7,879,690	$ 8,039,835	$ 8,507,375	$ 9,236,436	$ 9,507,723	$ 9,782,750	**$ 129,999,192**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,805,678	$ 33,545,692	$ 34,455,115	$ 24,996,127	$ 25,404,196	$ 26,245,835	$ 27,110,409	$ 27,950,080	$ 28,228,819	$ 28,771,953	$ 29,961,115	$ 31,164,774	$ 32,541,511	$ 33,236,247	$ 33,893,401	$ 34,772,425	$ 35,981,566	$ 37,806,308	$ 38,952,469	$ 40,241,465	**$ 631,065,183**

NPV @ 4.0%:	**$418,780,959**	**2018$**
Levelized Cost of Energy ($/MWh)	**$95.93**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	56.2	56.5	57.1	57.4	58.2	59.3	59.6	69.9	70.2	71.2	71.5	71.8	72.1	72.5	72.8	73.0	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 2,977,668	$ 3,067,600	$ 3,177,468	$ 3,273,426	$ 3,406,654	$ 3,555,968	$ 3,661,994	$ 4,401,446	$ 4,530,174	$ 4,709,763	$ 4,848,611	$ 4,991,608	$ 5,139,648	$ 5,291,813	$ 5,447,241	$ 5,604,812	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 12,188,951	$ 13,371,339	$ 13,241,278	$ 4,199,175	$ 4,316,379	$ 4,437,800	$ 4,564,474	$ 4,693,608	$ 4,824,604	$ 4,959,343	$ 5,098,724	$ 5,241,162	$ 5,389,183	$ 5,539,235	$ 5,694,715	$ 5,854,522	$ 6,019,601	$ 6,190,502	$ 6,363,942	$ 6,541,205	$ 128,729,740
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL FUEL COSTS	$		$ 11,413,505	$ 5,062,738	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,476,243
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 8,254,893	$ 9,842,087	$ 9,628,007	$ 8,898,360	$ 9,028,308	$ 9,304,278	$ 9,874,894	$ 10,302,729	$ 10,857,630	$ 11,707,479	$ 12,377,273	$ 12,823,151	$ 13,611,997	$ 14,059,077	$ 14,474,847	$ 14,913,756	$ 15,410,184	$ 16,163,119	$ 16,692,389	$ 17,352,253	$ 245,576,712
TOTAL MISO WHOLESALE MARKET SALES	$		$ (11,710,163)	$ (6,020,646)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (17,730,809)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 2,977,668	$ 3,067,600	$ 3,177,468	$ 3,273,426	$ 3,406,654	$ 3,555,968	$ 3,661,994	$ 4,401,446	$ 4,530,174	$ 4,709,763	$ 4,848,611	$ 4,991,608	$ 5,139,648	$ 5,291,813	$ 5,447,241	$ 5,604,812	$ 76,508,211
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$		$ 25,805,678	$ 31,513,882	$ 32,363,412	$ 22,841,474	$ 23,344,770	$ 24,032,556	$ 24,946,586	$ 25,720,669	$ 25,876,584	$ 26,178,344	$ 27,236,027	$ 28,238,651	$ 29,462,371	$ 29,995,640	$ 30,862,323	$ 31,724,198	$ 32,613,839	$ 33,861,684	$ 34,891,986	$ 36,063,526	**$ 577,574,203**

NPV @ 4.0%:	**$384,942,027**	**2018$**
Levelized Cost of Energy ($/MWh)	**$88.22**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94

Grand Haven Board of Light & Power Planning Analysis

Low Gas - J.B. Sims Unit 3

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$7,530,873	$6,969,415	$6,629,570	$6,816,441	$6,903,354	$7,145,808	$7,561,921	$7,876,896	$8,381,207	$9,010,179	$9,433,920	$9,829,267	$10,352,154	$10,799,034	$11,125,506	$11,455,733	$11,830,921	$12,410,159	$12,809,889	$13,316,387
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 28.61	$ 26.54	$ 25.12	$ 25.70	$ 25.91	$ 26.71	$ 28.06	$ 29.02	$ 29.96	$ 31.18	$ 32.49	$ 33.70	$ 35.34	$ 36.27	$ 37.19	$ 38.07	$ 39.03	$ 40.76	$ 41.87	$ 43.35
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	(14.0)	(13.8)	(13.5)	(13.2)	(12.9)	(12.3)	(12.0)	(11.2)	(10.1)	(9.8)	0.5	0.8	1.8	2.1	2.4	2.7	3.1	3.4	3.6
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ (1,202,167)	$ (1,210,919)	$ (1,216,238)	$ (1,183,043)	$ (1,207,371)	$ (1,152,659)	$ (1,153,754)	$ (1,102,347)	$ (1,044,961)	$ (1,050,370)	$ 50,981	$ 84,119	$ 198,630	$ 230,303	$ 269,042	$ 321,884	$ 389,225	$ 439,332	$ 487,649
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 4,828,158	$ 4,948,862	$ 5,072,584	$ 5,199,398	$ 5,329,383	$ 5,462,618	$ 5,599,183	$ 5,739,163	$ 5,882,642	$ 6,029,708	$ 6,180,451	$ 6,334,962	$ 6,493,336	$ 6,655,670	$ 6,822,061	$ 6,992,613	$ 7,167,428	$ 7,346,614
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPITAL EXPENDITURES	$	J B Sims:3	$ 5,535,000	$ 2,311,375	$ 2,369,159	$ 2,428,388	$ 2,489,098	$ 9,161,578	$ 3,304,546	$ 3,387,160	$ 3,471,839	$ 3,558,635	$ 3,647,601	$ 1,869,395	$ 1,916,130	$ 1,964,034	$ 2,013,134	$ 2,063,463	$ 2,115,049	$ 2,167,926	$ 2,222,124	$ 16,205,917
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 3,179,453	$ 3,258,940	$ 3,340,413	$ 3,423,923	$ 3,509,521	$ 3,597,259	$ 3,687,191	$ 3,779,371	$ 3,873,855	$ 3,970,701	$ 4,069,969	$ 4,171,718	$ 4,276,011	$ 4,382,911	$ 4,492,484	$ 4,604,796	$ 4,719,916	$ 4,837,914	$ 4,958,862
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPACITY	MW	J B Sims:3	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
CAPACITY	MW	GHBLP Recip 9MW:1																				
CAPACITY	MW	GHBLP Recip 9MW:2																				
CAPACITY	MW	GHBLP Recip 9MW:3																				
CAPACITY	MW	GHBLP Recip 9MW:4																				
CAPACITY	MW	GHBLP Recip 9MW:5																				
CAPACITY	MW	GHBLP Recip 9MW:6																				
GENERATION	MWh	J B Sims:3	357,231	297,823	260,969	257,279	250,799	253,301	263,759	267,359	263,194	272,496	280,842	289,754	302,157	300,268	298,289	298,624	298,120	312,091	311,713	323,689
GENERATION	MWh	GHBLP Recip 9MW:1																				
GENERATION	MWh	GHBLP Recip 9MW:2																				
GENERATION	MWh	GHBLP Recip 9MW:3																				
GENERATION	MWh	GHBLP Recip 9MW:4																				
GENERATION	MWh	GHBLP Recip 9MW:5																				
GENERATION	MWh	GHBLP Recip 9MW:6																				
CAPACITY FACTOR	%	J B Sims:3	56%	46%	41%	40%	39%	39%	41%	42%	41%	42%	44%	45%	47%	47%	47%	47%	46%	49%	49%	50%
CAPACITY FACTOR	%	GHBLP Recip 9MW:1																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:2																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:3																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:4																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:5																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:6																				
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,143,655	3,528,777	3,178,353	3,141,015	3,074,003	3,101,487	3,208,268	3,245,471	3,201,974	3,299,712	3,385,482	3,477,073	3,605,752	3,587,862	3,565,942	3,569,365	3,564,149	3,710,817	3,705,294	3,830,186
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6																				
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.8	12.2	12.2	12.3	12.2	12.2	12.1	12.2	12.1	12.1	12.0	11.9	11.9	12.0	12.0	12.0	11.9	11.9	11.8
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:1																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:2																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:3																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:4																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:5																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:6																				
FUEL COST	$	J B Sims:3	$ 11,065,863	$ 9,660,834	$ 8,919,638	$ 9,035,706	$ 9,059,840	$ 9,370,752	$ 9,936,606	$ 10,303,847	$ 10,420,916	$ 11,003,010	$ 11,571,994	$ 12,183,011	$ 12,951,003	$ 13,210,550	$ 13,459,071	$ 13,802,878	$ 14,128,478	$ 15,079,361	$ 15,434,762	$ 15,927,702
FUEL COST	$	GHBLP Recip 9MW:1																				
FUEL COST	$	GHBLP Recip 9MW:2																				
FUEL COST	$	GHBLP Recip 9MW:3																				
FUEL COST	$	GHBLP Recip 9MW:4																				
FUEL COST	$	GHBLP Recip 9MW:5																				
FUEL COST	$	GHBLP Recip 9MW:6																				
UNIT REVENUE	$	J B Sims:3	$ 10,730,593	$ 8,360,987	$ 6,853,248	$ 6,962,323	$ 6,818,741	$ 7,102,924	$ 7,816,577	$ 8,201,250	$ 8,316,165	$ 8,994,477	$ 9,672,124	$ 10,352,049	$ 11,314,975	$ 11,593,036	$ 11,823,460	$ 12,121,851	$ 12,406,059	$ 13,533,081	$ 13,863,987	$ 14,883,671
UNIT REVENUE	$	GHBLP Recip 9MW:1																				
UNIT REVENUE	$	GHBLP Recip 9MW:2																				
UNIT REVENUE	$	GHBLP Recip 9MW:3																				
UNIT REVENUE	$	GHBLP Recip 9MW:4																				
UNIT REVENUE	$	GHBLP Recip 9MW:5																				
UNIT REVENUE	$	GHBLP Recip 9MW:6																				
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

Low Gas - J.B. Sims Unit 3

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 15,887,599	$ 12,927,318	$ 13,260,311	$ 13,603,311	$ 13,955,358	$ 20,926,946	$ 15,377,294	$ 15,775,007	$ 16,182,486	$ 16,600,063	$ 17,028,832	$ 15,599,707	$ 16,004,724	$ 16,420,933	$ 16,848,420	$ 17,287,139	$ 17,738,006	$ 18,200,485	$ 18,674,092	$ 33,086,378	**$ 341,384,408**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
TOTAL FUEL COSTS	$		$ 11,065,863	$ 9,660,834	$ 8,919,638	$ 9,035,706	$ 9,059,840	$ 9,370,752	$ 9,936,606	$ 10,303,847	$ 10,420,916	$ 11,003,010	$ 11,571,994	$ 12,183,011	$ 12,951,003	$ 13,210,550	$ 13,459,071	$ 13,802,878	$ 14,128,478	$ 15,079,361	$ 15,434,762	$ 15,927,702	**$ 236,525,823**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,530,873	$ 6,969,415	$ 6,629,570	$ 6,816,441	$ 6,903,354	$ 7,145,808	$ 7,561,921	$ 7,876,896	$ 8,381,207	$ 9,010,179	$ 9,433,920	$ 9,829,267	$ 10,352,154	$ 10,799,034	$ 11,125,506	$ 11,455,733	$ 11,830,921	$ 12,410,159	$ 12,809,889	$ 13,316,387	**$ 188,188,633**
TOTAL MISO WHOLESALE MARKET SALES	$		$ (10,730,593)	$ (8,360,987)	$ (6,853,248)	$ (6,962,323)	$ (6,818,741)	$ (7,102,924)	$ (7,816,577)	$ (8,201,250)	$ (8,316,165)	$ (8,994,477)	$ (9,672,124)	$ (10,352,049)	$ (11,314,975)	$ (11,593,036)	$ (11,823,460)	$ (12,121,851)	$ (12,406,059)	$ (13,533,081)	$ (13,863,987)	$ (14,883,671)	**$ (201,721,577)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,981	$ 84,119	$ 198,630	$ 230,303	$ 269,042	$ 321,884	$ 389,225	$ 439,332	$ 487,649	**$ 2,471,165**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ (1,202,167)	$ (1,210,919)	$ (1,216,238)	$ (1,183,043)	$ (1,207,371)	$ (1,152,659)	$ (1,153,754)	$ (1,102,347)	$ (1,044,961)	$ (1,050,370)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (11,711,683)**
TOTAL COSTS	$		$ 29,412,234	$ 26,527,053	$ 27,433,406	$ 28,130,317	$ 28,939,183	$ 36,356,088	$ 31,236,336	$ 32,051,651	$ 32,353,793	$ 32,529,369	$ 33,410,288	$ 33,083,809	$ 34,008,042	$ 34,723,674	$ 35,683,990	$ 36,657,253	$ 37,657,635	$ 38,762,400	$ 39,882,503	$ 54,499,702	**$ 683,338,729**

NPV @ 4.0%:	**$450,121,714**	**2018$**
Levelized Cost of Energy ($/MWh)	**$103.03**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	(14.0)	(13.8)	(13.5)	(13.2)	(12.9)	(12.3)	(12.0)	(11.2)	(10.1)	(9.8)	0.5	0.8	1.8	2.1	2.4	2.7	3.1	3.4	3.6	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ (688,755)	$ (693,769)	$ (696,817)	$ (699,354)	$ (701,347)	$ (685,703)	$ (686,324)	$ (652,090)	$ (604,245)	$ (602,223)	$ 30,623	$ 50,080	$ 117,667	$ 141,713	$ 167,037	$ 194,463	$ 222,998	$ 251,706	$ 279,388	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 15,887,599	$ 12,927,318	$ 13,260,311	$ 13,603,311	$ 13,955,358	$ 20,926,946	$ 15,377,294	$ 15,775,007	$ 16,182,486	$ 16,600,063	$ 17,028,832	$ 15,599,707	$ 16,004,724	$ 16,420,933	$ 16,848,420	$ 17,287,139	$ 17,738,006	$ 18,200,485	$ 18,674,092	$ 33,086,378	$ 341,384,408
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL FUEL COSTS	$		$ 11,065,863	$ 9,660,834	$ 8,919,638	$ 9,035,706	$ 9,059,840	$ 9,370,752	$ 9,936,606	$ 10,303,847	$ 10,420,916	$ 11,003,010	$ 11,571,994	$ 12,183,011	$ 12,951,003	$ 13,210,550	$ 13,459,071	$ 13,802,878	$ 14,128,478	$ 15,079,361	$ 15,434,762	$ 15,927,702	$ 236,525,823
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,530,873	$ 6,969,415	$ 6,629,570	$ 6,816,441	$ 6,903,354	$ 7,145,808	$ 7,561,921	$ 7,876,896	$ 8,381,207	$ 9,010,179	$ 9,433,920	$ 9,829,267	$ 10,352,154	$ 10,799,034	$ 11,125,506	$ 11,455,733	$ 11,830,921	$ 12,410,159	$ 12,809,889	$ 13,316,387	$ 188,188,633
TOTAL MISO WHOLESALE MARKET SALES	$		$ (10,730,593)	$ (8,360,987)	$ (6,853,248)	$ (6,962,323)	$ (6,818,741)	$ (7,102,924)	$ (7,816,577)	$ (8,201,250)	$ (8,316,165)	$ (8,994,477)	$ (9,672,124)	$ (10,352,049)	$ (11,314,975)	$ (11,593,036)	$ (11,823,460)	$ (12,121,851)	$ (12,406,059)	$ (13,533,081)	$ (13,863,987)	$ (14,883,671)	$ (201,721,577)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,623	$ 50,080	$ 117,667	$ 141,713	$ 167,037	$ 194,463	$ 222,998	$ 251,706	$ 279,388	$ 1,455,674
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ (688,755)	$ (693,769)	$ (696,817)	$ (699,354)	$ (701,347)	$ (685,703)	$ (686,324)	$ (652,090)	$ (604,245)	$ (602,223)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (6,898,480)
TOTAL COSTS	$		$ 29,412,234	$ 27,040,465	$ 27,950,556	$ 28,649,738	$ 29,422,873	$ 36,862,112	$ 31,703,292	$ 32,519,082	$ 32,804,050	$ 32,970,085	$ 33,858,435	$ 33,063,451	$ 33,974,003	$ 34,642,712	$ 35,595,400	$ 36,555,248	$ 37,530,214	$ 38,596,173	$ 39,694,877	$ 54,291,441	**$ 687,136,440**

NPV @ 4.0%:	**$453,384,057**	**2018$**
Levelized Cost of Energy ($/MWh)	**$103.79**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
J B Sims:3	$/kW-Yr		$ 169	$ 141	$ 154	$ 157	$ 163	$ 257	$ 177	$ 181	$ 185	$ 187	$ 190	$ 167	$ 168	$ 172	$ 176	$ 180	$ 185	$ 186	$ 191	$ 378

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Build 4x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$7,573,707	$7,033,898	$6,717,663	$6,948,969	$7,039,348	$7,288,426	$7,714,215	$8,038,059	$8,556,337	$9,200,176	$9,635,438	$10,042,451	$10,578,551	$11,039,236	$11,373,008	$11,711,262	$12,095,332	$12,686,393	$13,095,544	$13,612,552
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 28.78	$ 26.78	$ 25.45	$ 26.20	$ 26.42	$ 27.24	$ 28.62	$ 29.61	$ 30.59	$ 31.84	$ 33.19	$ 34.43	$ 36.11	$ 37.07	$ 38.01	$ 38.92	$ 39.90	$ 41.66	$ 42.81	$ 44.31
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	22.0	22.3	22.9	23.2	24.0	25.1	25.4	35.7	36.0	37.0	37.3	37.6	37.9	38.3	38.6	38.8
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 1,971,839	$ 2,083,499	$ 2,141,102	$ 2,222,499	$ 2,377,703	$ 2,604,141	$ 2,721,940	$ 3,741,699	$ 3,900,933	$ 4,130,348	$ 4,110,108	$ 4,210,424	$ 4,473,603	$ 4,876,571	$ 5,038,862	$ 5,202,167
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,609,386	$ 1,649,621	$ 1,690,861	$ 1,733,133	$ 1,776,461	$ 1,820,873	$ 1,866,394	$ 1,913,054	$ 1,960,881	$ 2,009,903	$ 2,060,150	$ 2,111,654	$ 2,164,445	$ 2,218,557	$ 2,274,020	$ 2,330,871	$ 2,389,143	$ 2,448,871
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 32,970	$ 31,636	$ 30,980	$ 33,185	$ 34,084	$ 35,781	$ 38,330	$ 40,424	$ 42,321	$ 44,010	$ 45,766	$ 47,365	$ 49,504	$ 50,622	$ 51,922	$ 53,151	$ 54,507	$ 56,851	$ 58,336	$ 60,483
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115	$ 4,593,115
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ 702,605	$ 720,170	$ 738,174	$ 756,628	$ 775,544	$ 794,933	$ 814,806	$ 835,176	$ 856,055	$ 877,457	$ 899,393	$ 921,878	$ 944,925	$ 968,548	$ 992,762	$ 1,017,581
CAPACITY	MW	J B Sims:3	73	73																		
CAPACITY	MW	GHBLP Recip 9MW:1					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:2					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:3					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:4					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:5																				
CAPACITY	MW	GHBLP Recip 9MW:6																				
GENERATION	MWh	J B Sims:3	360,195	123,708																		
GENERATION	MWh	GHBLP Recip 9MW:1					855	774	747	603	1,098	1,233	1,224	1,233	1,458	1,278	1,368	1,413	1,413	1,404	1,368	2,187
GENERATION	MWh	GHBLP Recip 9MW:2					855	666	783	639	1,134	1,251	1,332	1,395	1,422	1,332	1,269	1,422	1,422	1,404	1,359	2,025
GENERATION	MWh	GHBLP Recip 9MW:3					828	774	783	630	1,071	1,143	1,332	1,422	1,485	1,350	1,422	1,422	1,413	1,350	1,332	2,394
GENERATION	MWh	GHBLP Recip 9MW:4					846	720	729	639	1,098	1,161	1,332	1,422	1,449	1,296	1,395	1,386	1,359	1,206	1,305	2,178
GENERATION	MWh	GHBLP Recip 9MW:5																				
GENERATION	MWh	GHBLP Recip 9MW:6																				
CAPACITY FACTOR	%	J B Sims:3	56%	38%																		
CAPACITY FACTOR	%	GHBLP Recip 9MW:1					2%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:2					2%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:3					2%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:4					2%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:5																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:6																				
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,174,579	1,440,408																		
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1					7,380	6,675	6,442	5,214	9,461	10,613	10,536	10,613	12,545	11,035	11,788	12,175	12,179	12,102	11,792	18,742
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2					7,380	5,741	6,756	5,520	9,767	10,766	11,466	12,006	12,235	11,490	10,943	12,251	12,255	12,102	11,720	17,388
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3					7,150	6,675	6,756	5,439	9,232	9,836	11,466	12,235	12,775	11,647	12,255	12,255	12,175	11,639	11,490	20,521
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4					7,303	6,216	6,289	5,520	9,461	9,993	11,466	12,235	12,469	11,184	12,026	11,945	11,708	10,411	11,257	18,689
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6																				
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.6																		
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:1					$ 9,670	$ 8,978	$ 8,882	$ 7,345	$ 13,714	$ 15,782	$ 16,059	$ 16,584	$ 20,106	$ 18,058	$ 19,809	$ 20,983	$ 21,506	$ 21,902	$ 21,874	$ 35,844
VARIABLE O&M COST	$	GHBLP Recip 9MW:2					$ 9,670	$ 7,726	$ 9,310	$ 7,783	$ 14,164	$ 16,013	$ 17,476	$ 18,763	$ 19,609	$ 18,821	$ 18,375	$ 21,117	$ 21,643	$ 21,902	$ 21,730	$ 33,189
VARIABLE O&M COST	$	GHBLP Recip 9MW:3					$ 9,365	$ 8,978	$ 9,310	$ 7,673	$ 13,377	$ 14,630	$ 17,476	$ 19,126	$ 20,478	$ 19,076	$ 20,591	$ 21,117	$ 21,506	$ 21,060	$ 21,299	$ 39,237
VARIABLE O&M COST	$	GHBLP Recip 9MW:4					$ 9,568	$ 8,352	$ 8,668	$ 7,783	$ 13,714	$ 14,861	$ 17,476	$ 19,126	$ 19,982	$ 18,312	$ 20,200	$ 20,582	$ 20,684	$ 18,814	$ 20,867	$ 35,697
VARIABLE O&M COST	$	GHBLP Recip 9MW:5																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:6																				
FUEL COST	$	J B Sims:3	$ 11,148,457	$ 3,904,424																		
FUEL COST	$	GHBLP Recip 9MW:1					$ 24,869	$ 23,714	$ 24,787	$ 21,119	$ 40,245	$ 46,936	$ 48,395	$ 50,343	$ 62,624	$ 56,282	$ 61,616	$ 65,155	$ 66,845	$ 69,291	$ 69,293	$ 60,036
FUEL COST	$	GHBLP Recip 9MW:2					$ 24,869	$ 20,390	$ 25,999	$ 22,358	$ 41,553	$ 47,614	$ 52,673	$ 56,880	$ 61,074	$ 58,607	$ 57,185	$ 65,584	$ 67,266	$ 69,291	$ 68,844	$ 72,813
FUEL COST	$	GHBLP Recip 9MW:3					$ 24,095	$ 23,714	$ 25,999	$ 22,041	$ 39,314	$ 43,494	$ 52,673	$ 57,959	$ 63,771	$ 59,410	$ 64,064	$ 65,592	$ 66,820	$ 66,619	$ 67,517	$ 69,508
FUEL COST	$	GHBLP Recip 9MW:4					$ 24,611	$ 22,080	$ 24,225	$ 22,358	$ 40,245	$ 44,190	$ 52,673	$ 57,959	$ 62,241	$ 57,032	$ 62,861	$ 63,929	$ 64,253	$ 59,548	$ 66,125	$ 73,301
FUEL COST	$	GHBLP Recip 9MW:5																				
FUEL COST	$	GHBLP Recip 9MW:6																				
UNIT REVENUE	$	J B Sims:3	$ 10,879,506	$ 3,607,645																		
UNIT REVENUE	$	GHBLP Recip 9MW:1					$ 48,666	$ 46,967	$ 48,655	$ 42,852	$ 72,336	$ 83,830	$ 86,693	$ 89,147	$ 109,196	$ 109,564	$ 129,266	$ 135,691	$ 139,077	$ 143,547	$ 143,548	$ 165,067
UNIT REVENUE	$	GHBLP Recip 9MW:2					$ 48,666	$ 40,984	$ 50,392	$ 45,165	$ 74,443	$ 84,798	$ 93,072	$ 100,251	$ 106,399	$ 123,293	$ 121,377	$ 136,279	$ 139,659	$ 143,547	$ 142,383	$ 176,060
UNIT REVENUE	$	GHBLP Recip 9MW:3					$ 47,272	$ 46,967	$ 50,392	$ 44,719	$ 69,916	$ 78,171	$ 93,072	$ 101,986	$ 111,146	$ 124,400	$ 133,164	$ 136,401	$ 139,055	$ 139,380	$ 140,676	$ 187,290
UNIT REVENUE	$	GHBLP Recip 9MW:4					$ 48,285	$ 43,554	$ 47,007	$ 45,165	$ 72,411	$ 78,992	$ 93,072	$ 101,986	$ 106,815	$ 119,031	$ 130,999	$ 133,609	$ 134,674	$ 115,501	$ 138,334	$ 183,071
UNIT REVENUE	$	GHBLP Recip 9MW:5																				
UNIT REVENUE	$	GHBLP Recip 9MW:6																				
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Build 4x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,185,569	$ 13,357,852	$ 5,162,409	$ 5,286,443	$ 10,708,407	$ 10,856,636	$ 11,010,175	$ 11,167,067	$ 11,327,456	$ 11,491,511	$ 11,660,445	$ 11,834,182	$ 12,013,239	$ 12,196,763	$ 12,385,903	$ 12,580,212	$ 12,780,656	$ 12,987,405	$ 13,197,972	$ 13,413,025	**$ 227,603,325**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 38,273	$ 34,034	$ 36,169	$ 30,584	$ 54,968	$ 61,286	$ 68,486	$ 73,598	$ 80,175	$ 74,267	$ 78,974	$ 83,799	$ 85,339	$ 83,678	$ 85,770	$ 143,968	**$ 1,113,370**
TOTAL FUEL COSTS	$		$ 11,148,457	$ 3,904,424	$ -	$ -	$ 98,444	$ 89,898	$ 101,009	$ 87,877	$ 161,357	$ 182,234	$ 206,413	$ 223,141	$ 249,711	$ 231,331	$ 245,725	$ 260,261	$ 265,184	$ 264,750	$ 271,779	$ 275,658	**$ 18,267,652**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,573,707	$ 7,033,898	$ 6,717,663	$ 6,948,969	$ 7,039,348	$ 7,288,426	$ 7,714,215	$ 8,038,059	$ 8,556,337	$ 9,200,176	$ 9,635,438	$ 10,042,451	$ 10,578,551	$ 11,039,236	$ 11,373,008	$ 11,711,262	$ 12,095,332	$ 12,686,393	$ 13,095,544	$ 13,612,552	**$ 191,980,567**
TOTAL MISO WHOLESALE MARKET SALES	$		$(10,879,506)	$ (3,607,645)	$ -	$ -	$ (192,888)	$ (178,473)	$ (196,447)	$ (177,901)	$ (289,106)	$ (325,791)	$ (365,909)	$ (393,371)	$ (433,555)	$ (476,289)	$ (514,805)	$ (541,980)	$ (552,464)	$ (541,975)	$ (564,941)	$ (711,488)	**$ (20,944,534)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 1,971,839	$ 2,083,499	$ 2,141,102	$ 2,222,499	$ 2,377,703	$ 2,604,141	$ 2,721,940	$ 3,741,699	$ 3,900,933	$ 4,130,348	$ 4,110,108	$ 4,210,424	$ 4,473,603	$ 4,876,571	$ 5,038,862	$ 5,202,167	**$ 70,507,923**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,686,719	$ 31,978,704	$ 23,465,902	$ 24,134,004	$ 26,685,838	$ 27,396,899	$ 28,135,974	$ 28,819,091	$ 28,976,413	$ 29,169,113	$ 30,024,848	$ 31,294,594	$ 32,320,071	$ 32,883,221	$ 33,523,062	$ 34,268,290	$ 35,192,055	$ 36,573,073	$ 37,513,400	$ 38,501,139	**$ 616,542,410**

NPV @ 4.0%:	**$407,701,944**	**2018$**
Levelized Cost of Energy ($/MWh)	**$93.35**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	22.0	22.3	22.9	23.2	24.0	25.1	25.4	35.7	36.0	37.0	37.3	37.6	37.9	38.3	38.6	38.8	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 1,165,649	$ 1,210,280	$ 1,273,715	$ 1,322,079	$ 1,406,523	$ 1,505,834	$ 1,560,608	$ 2,247,524	$ 2,322,404	$ 2,446,800	$ 2,529,073	$ 2,614,082	$ 2,702,684	$ 2,793,924	$ 2,886,905	$ 2,980,467	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 12,185,569	$ 13,357,852	$ 5,162,409	$ 5,286,443	$ 10,708,407	$ 10,856,636	$ 11,010,175	$ 11,167,067	$ 11,327,456	$ 11,491,511	$ 11,660,445	$ 11,834,182	$ 12,013,239	$ 12,196,763	$ 12,385,903	$ 12,580,212	$ 12,780,656	$ 12,987,405	$ 13,197,972	$ 13,413,025	$ 227,603,325
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 38,273	$ 34,034	$ 36,169	$ 30,584	$ 54,968	$ 61,286	$ 68,486	$ 73,598	$ 80,175	$ 74,267	$ 78,974	$ 83,799	$ 85,339	$ 83,678	$ 85,770	$ 143,968	$ 1,113,370
TOTAL FUEL COSTS	$		$ 11,148,457	$ 3,904,424	$ -	$ -	$ 98,444	$ 89,898	$ 101,009	$ 87,877	$ 161,357	$ 182,234	$ 206,413	$ 223,141	$ 249,711	$ 231,331	$ 245,725	$ 260,261	$ 265,184	$ 264,750	$ 271,779	$ 275,658	$ 18,267,652
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,573,707	$ 7,033,898	$ 6,717,663	$ 6,948,969	$ 7,039,348	$ 7,288,426	$ 7,714,215	$ 8,038,059	$ 8,556,337	$ 9,200,176	$ 9,635,438	$ 10,042,451	$ 10,578,551	$ 11,039,236	$ 11,373,008	$ 11,711,262	$ 12,095,332	$ 12,686,393	$ 13,095,544	$ 13,612,552	$ 191,980,567
TOTAL MISO WHOLESALE MARKET SALES	$		$(10,879,506)	$ (3,607,645)	$ -	$ -	$ (192,888)	$ (178,473)	$ (196,447)	$ (177,901)	$ (289,106)	$ (325,791)	$ (365,909)	$ (393,371)	$ (433,555)	$ (476,289)	$ (514,805)	$ (541,980)	$ (552,464)	$ (541,975)	$ (564,941)	$ (711,488)	$ (20,944,534)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 1,165,649	$ 1,210,280	$ 1,273,715	$ 1,322,079	$ 1,406,523	$ 1,505,834	$ 1,560,608	$ 2,247,524	$ 2,322,404	$ 2,446,800	$ 2,529,073	$ 2,614,082	$ 2,702,684	$ 2,793,924	$ 2,886,905	$ 2,980,467	$ 41,390,870
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$		$ 25,686,719	$ 29,946,894	$ 21,374,199	$ 21,979,352	$ 25,879,648	$ 26,523,680	$ 27,268,588	$ 27,918,671	$ 28,005,233	$ 28,070,806	$ 28,863,516	$ 29,800,418	$ 30,741,542	$ 31,199,672	$ 31,942,028	$ 32,671,948	$ 33,421,136	$ 34,490,426	$ 35,361,443	$ 36,279,439	**$ 587,425,357**

NPV @ 4.0%:	**$388,717,345**	**2018$**
Levelized Cost of Energy ($/MWh)	**$89.01**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
4x 9 MW Recips	$/kW-Yr						$ 156	$ 157	$ 158	$ 159	$ 159	$ 160	$ 160	$ 161	$ 162	$ 161	$ 161	$ 162	$ 163	$ 164	$ 165	$ 163

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Build 6x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$7,573,707	$7,033,898	$6,717,663	$6,948,969	$7,039,348	$7,288,426	$7,714,215	$8,038,059	$8,556,337	$9,200,176	$9,635,438	$10,042,451	$10,578,551	$11,039,236	$11,373,008	$11,711,262	$12,095,332	$12,686,393	$13,095,544	$13,612,552
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 28.78	$ 26.78	$ 25.45	$ 26.20	$ 26.42	$ 27.24	$ 28.62	$ 29.61	$ 30.59	$ 31.84	$ 33.19	$ 34.43	$ 36.11	$ 37.07	$ 38.01	$ 38.92	$ 39.90	$ 41.66	$ 42.81	$ 44.31
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	4.9	5.2	5.8	6.1	6.9	8.0	8.3	18.6	18.9	19.9	20.2	20.5	20.8	21.2	21.5	21.7
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 439,212	$ 484,810	$ 541,008	$ 582,330	$ 687,111	$ 831,424	$ 889,369	$ 1,948,765	$ 2,046,742	$ 2,220,337	$ 2,225,316	$ 2,295,718	$ 2,456,716	$ 2,696,639	$ 2,804,431	$ 2,911,876
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,609,386	$ 1,649,621	$ 1,690,861	$ 1,733,133	$ 1,776,461	$ 1,820,873	$ 1,866,394	$ 1,913,054	$ 1,960,881	$ 2,009,903	$ 2,060,150	$ 2,111,654	$ 2,164,445	$ 2,218,557	$ 2,274,020	$ 2,330,871	$ 2,389,143	$ 2,448,871
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 32,970	$ 31,636	$ 30,980	$ 33,185	$ 34,084	$ 35,781	$ 38,330	$ 40,424	$ 42,321	$ 44,010	$ 45,766	$ 47,365	$ 49,504	$ 50,622	$ 51,922	$ 53,151	$ 54,507	$ 56,851	$ 58,336	$ 60,483
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989	$ 717,989
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238	$ 6,292,238
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ 763,701	$ 782,793	$ 802,363	$ 822,422	$ 842,983	$ 864,057	$ 885,658	$ 907,800	$ 930,495	$ 953,757	$ 977,601	$ 1,002,041	$ 1,027,092	$ 1,052,770	$ 1,079,089	$ 1,106,066
CAPACITY	MW	J B Sims:3	73	73																		
CAPACITY	MW	GHBLP Recip 9MW:1					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:2					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:3					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:4					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:5					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
CAPACITY	MW	GHBLP Recip 9MW:6					9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
GENERATION	MWh	J B Sims:3	360,195	123,708																		
GENERATION	MWh	GHBLP Recip 9MW:1					855	774	747	603	1,098	1,233	1,224	1,233	1,458	1,278	1,368	1,413	1,413	1,404	1,368	2,187
GENERATION	MWh	GHBLP Recip 9MW:2					855	666	783	639	1,134	1,251	1,332	1,395	1,422	1,332	1,269	1,422	1,422	1,404	1,359	2,025
GENERATION	MWh	GHBLP Recip 9MW:3					828	774	783	630	1,071	1,143	1,332	1,422	1,485	1,350	1,422	1,422	1,413	1,350	1,332	2,394
GENERATION	MWh	GHBLP Recip 9MW:4					846	720	729	639	1,098	1,161	1,332	1,422	1,449	1,296	1,395	1,386	1,359	1,206	1,305	2,178
GENERATION	MWh	GHBLP Recip 9MW:5					765	675	783	639	1,071	1,215	1,332	1,422	1,305	1,278	1,377	1,386	1,395	1,368	1,341	2,475
GENERATION	MWh	GHBLP Recip 9MW:6					765	765	684	639	1,107	1,224	1,287	1,359	1,485	1,305	1,404	1,422	1,278	1,332	1,386	2,367
CAPACITY FACTOR	%	J B Sims:3	56%	38%																		
CAPACITY FACTOR	%	GHBLP Recip 9MW:1					2%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:2					2%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:3					2%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:4					2%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:5					1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
CAPACITY FACTOR	%	GHBLP Recip 9MW:6					1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,174,579	1,440,408																		
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1					7,380	6,675	6,442	5,214	9,461	10,613	10,536	10,613	12,545	11,035	11,788	12,175	12,179	12,102	11,792	18,742
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2					7,380	5,741	6,756	5,520	9,767	10,766	11,466	12,006	12,235	11,490	10,943	12,251	12,255	12,102	11,720	17,388
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3					7,150	6,675	6,756	5,439	9,232	9,836	11,466	12,235	12,775	11,647	12,255	12,255	12,175	11,639	11,490	20,521
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4					7,303	6,216	6,289	5,520	9,461	9,993	11,466	12,235	12,469	11,184	12,026	11,945	11,708	10,411	11,257	18,689
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5					6,607	5,822	6,756	5,520	9,224	10,464	11,466	12,235	11,229	11,027	11,869	11,945	12,030	11,792	11,567	21,218
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6					6,607	6,599	5,902	5,520	9,538	10,532	11,080	11,696	12,775	11,265	12,098	12,255	11,019	11,482	11,945	20,284
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.6																		
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6					8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
VARIABLE O&M COST	$	GHBLP Recip 9MW:1					$ 9,670	$ 8,978	$ 8,882	$ 7,345	$ 13,714	$ 15,782	$ 16,059	$ 16,584	$ 20,106	$ 18,058	$ 19,809	$ 20,983	$ 21,506	$ 21,902	$ 21,874	$ 35,844
VARIABLE O&M COST	$	GHBLP Recip 9MW:2					$ 9,670	$ 7,726	$ 9,310	$ 7,783	$ 14,164	$ 16,013	$ 17,476	$ 18,763	$ 19,609	$ 18,821	$ 18,375	$ 21,117	$ 21,643	$ 21,902	$ 21,730	$ 33,189
VARIABLE O&M COST	$	GHBLP Recip 9MW:3					$ 9,365	$ 8,978	$ 9,310	$ 7,673	$ 13,377	$ 14,630	$ 17,476	$ 19,126	$ 20,478	$ 19,076	$ 20,591	$ 21,117	$ 21,506	$ 21,060	$ 21,299	$ 39,237
VARIABLE O&M COST	$	GHBLP Recip 9MW:4					$ 9,568	$ 8,352	$ 8,668	$ 7,783	$ 13,714	$ 14,861	$ 17,476	$ 19,126	$ 19,982	$ 18,312	$ 20,200	$ 20,582	$ 20,684	$ 18,814	$ 20,867	$ 35,697
VARIABLE O&M COST	$	GHBLP Recip 9MW:5					$ 8,652	$ 7,830	$ 9,310	$ 7,783	$ 13,377	$ 15,552	$ 17,476	$ 19,126	$ 17,996	$ 18,058	$ 19,939	$ 20,582	$ 21,232	$ 21,341	$ 21,443	$ 40,565
VARIABLE O&M COST	$	GHBLP Recip 9MW:6					$ 8,652	$ 8,874	$ 8,133	$ 7,783	$ 13,826	$ 15,667	$ 16,885	$ 18,279	$ 20,478	$ 18,440	$ 20,330	$ 21,117	$ 19,451	$ 20,779	$ 22,162	$ 38,795
FUEL COST	$	J B Sims:3	$ 11,148,457	$ 3,904,424																		
FUEL COST	$	GHBLP Recip 9MW:1					$ 24,869	$ 23,714	$ 24,787	$ 21,119	$ 40,245	$ 46,936	$ 48,395	$ 50,343	$ 62,624	$ 56,282	$ 61,616	$ 65,155	$ 66,845	$ 69,291	$ 69,293	$ 60,036
FUEL COST	$	GHBLP Recip 9MW:2					$ 24,869	$ 20,390	$ 25,999	$ 22,358	$ 41,553	$ 47,614	$ 52,673	$ 56,880	$ 61,074	$ 58,607	$ 57,185	$ 65,584	$ 67,266	$ 69,291	$ 68,844	$ 72,813
FUEL COST	$	GHBLP Recip 9MW:3					$ 24,095	$ 23,714	$ 25,999	$ 22,041	$ 39,314	$ 43,494	$ 52,673	$ 57,959	$ 63,771	$ 59,410	$ 64,064	$ 65,592	$ 66,820	$ 66,619	$ 67,517	$ 69,508
FUEL COST	$	GHBLP Recip 9MW:4					$ 24,611	$ 22,080	$ 24,225	$ 22,358	$ 40,245	$ 44,190	$ 52,673	$ 57,959	$ 62,241	$ 57,032	$ 62,861	$ 63,929	$ 64,253	$ 59,548	$ 66,125	$ 73,301
FUEL COST	$	GHBLP Recip 9MW:5					$ 22,270	$ 20,676	$ 25,999	$ 22,358	$ 39,238	$ 46,276	$ 52,673	$ 57,959	$ 56,092	$ 56,241	$ 62,026	$ 63,929	$ 66,025	$ 67,512	$ 67,938	$ 73,777
FUEL COST	$	GHBLP Recip 9MW:6					$ 22,261	$ 23,442	$ 22,710	$ 22,358	$ 40,578	$ 46,573	$ 50,895	$ 55,402	$ 63,771	$ 57,444	$ 63,236	$ 65,592	$ 60,455	$ 65,733	$ 70,180	$ 68,074
UNIT REVENUE	$	J B Sims:3	$ 10,879,506	$ 3,607,645																		
UNIT REVENUE	$	GHBLP Recip 9MW:1					$ 48,666	$ 46,967	$ 48,655	$ 42,852	$ 72,336	$ 83,830	$ 86,693	$ 89,147	$ 109,196	$ 109,564	$ 129,266	$ 135,691	$ 139,077	$ 143,547	$ 143,548	$ 165,067
UNIT REVENUE	$	GHBLP Recip 9MW:2					$ 48,666	$ 40,984	$ 50,392	$ 45,165	$ 74,443	$ 84,798	$ 93,072	$ 100,251	$ 106,399	$ 123,293	$ 121,377	$ 136,279	$ 139,659	$ 143,547	$ 142,383	$ 176,060
UNIT REVENUE	$	GHBLP Recip 9MW:3					$ 47,272	$ 46,967	$ 50,392	$ 44,719	$ 69,916	$ 78,171	$ 93,072	$ 101,986	$ 111,146	$ 124,400	$ 133,164	$ 136,401	$ 139,055	$ 139,380	$ 140,676	$ 187,290
UNIT REVENUE	$	GHBLP Recip 9MW:4					$ 48,285	$ 43,554	$ 47,007	$ 45,165	$ 72,411	$ 78,992	$ 93,072	$ 101,986	$ 106,815	$ 119,031	$ 130,999	$ 133,609	$ 134,674	$ 115,501	$ 138,334	$ 183,071
UNIT REVENUE	$	GHBLP Recip 9MW:5					$ 43,869	$ 40,909	$ 50,392	$ 45,165	$ 71,005	$ 81,190	$ 93,072	$ 101,986	$ 98,228	$ 116,369	$ 129,154	$ 133,609	$ 136,838	$ 140,038	$ 139,343	$ 196,317
UNIT REVENUE	$	GHBLP Recip 9MW:6					$ 43,172	$ 46,584	$ 45,173	$ 45,165	$ 73,112	$ 83,361	$ 90,429	$ 97,470	$ 111,146	$ 120,494	$ 131,941	$ 136,401	$ 115,904	$ 136,410	$ 145,186	$ 186,697
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Build 6x 9MW Recip Engines

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,185,569	$ 13,357,852	$ 5,162,409	$ 5,286,443	$ 12,468,625	$ 12,618,382	$ 12,773,486	$ 12,931,983	$ 13,094,017	$ 13,259,759	$ 13,430,420	$ 13,605,928	$ 13,786,801	$ 13,972,186	$ 14,163,234	$ 14,359,497	$ 14,561,946	$ 14,770,749	$ 14,983,421	$ 15,200,633	**$ 255,973,341**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ 55,577	$ 50,738	$ 53,612	$ 46,150	$ 82,172	$ 92,506	$ 102,848	$ 111,003	$ 118,649	$ 110,765	$ 119,243	$ 125,497	$ 126,022	$ 125,798	$ 129,375	$ 223,327	**$ 1,673,282**
TOTAL FUEL COSTS	$		$ 11,148,457	$ 3,904,424	$ -	$ -	$ 142,974	$ 134,016	$ 149,717	$ 132,594	$ 241,173	$ 275,083	$ 309,980	$ 336,501	$ 369,575	$ 345,016	$ 370,987	$ 389,783	$ 391,665	$ 397,995	$ 409,896	$ 417,509	**$ 19,867,345**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,573,707	$ 7,033,898	$ 6,717,663	$ 6,948,969	$ 7,039,348	$ 7,288,426	$ 7,714,215	$ 8,038,059	$ 8,556,337	$ 9,200,176	$ 9,635,438	$ 10,042,451	$ 10,578,551	$ 11,039,236	$ 11,373,008	$ 11,711,262	$ 12,095,332	$ 12,686,393	$ 13,095,544	$ 13,612,552	**$ 191,980,567**
TOTAL MISO WHOLESALE MARKET SALES	$		$ (10,879,506)	$ (3,607,645)	$ -	$ -	$ (279,930)	$ (265,965)	$ (292,012)	$ (268,232)	$ (433,223)	$ (490,342)	$ (549,410)	$ (592,827)	$ (642,929)	$ (713,152)	$ (775,900)	$ (811,990)	$ (805,206)	$ (818,423)	$ (849,471)	$ (1,094,501)	**$ (24,170,665)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 439,212	$ 484,810	$ 541,008	$ 582,330	$ 687,111	$ 831,424	$ 889,369	$ 1,948,765	$ 2,046,742	$ 2,220,337	$ 2,225,316	$ 2,295,718	$ 2,456,716	$ 2,696,639	$ 2,804,431	$ 2,911,876	**$ 40,762,289**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,686,719	$ 31,978,704	$ 23,465,902	$ 24,134,004	$ 26,888,222	$ 27,533,284	$ 28,269,778	$ 28,913,790	$ 29,015,283	$ 29,124,159	$ 29,916,681	$ 31,224,714	$ 32,188,406	$ 32,661,953	$ 33,320,038	$ 34,034,080	$ 34,870,880	$ 36,075,402	$ 36,961,611	$ 37,836,652	**$ 614,100,264**

NPV @ 4.0%:	**$406,609,640**	**2018$**
Levelized Cost of Energy ($/MWh)	**$93.11**	**2018$**

Data Item	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
LOW CAPACITY MARKET SENSITIVITY																						
MARKET CAPACITY DEFICIT / (SALES)	MW	(3.9)	55.4	55.6	55.9	4.9	5.2	5.8	6.1	6.9	8.0	8.3	18.6	18.9	19.9	20.2	20.5	20.8	21.2	21.5	21.7	
MARKET CAPACITY PRICE	$/kW-Yr	$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$	$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 259,639	$ 281,620	$ 321,839	$ 346,406	$ 406,458	$ 480,768	$ 509,914	$ 1,170,564	$ 1,218,520	$ 1,315,318	$ 1,369,304	$ 1,425,319	$ 1,484,201	$ 1,544,980	$ 1,606,737	$ 1,668,295	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																						**Total**
MISO NITS COST	$	$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$	$ 12,185,569	$ 13,357,852	$ 5,162,409	$ 5,286,443	$ 12,468,625	$ 12,618,382	$ 12,773,486	$ 12,931,983	$ 13,094,017	$ 13,259,759	$ 13,430,420	$ 13,605,928	$ 13,786,801	$ 13,972,186	$ 14,163,234	$ 14,359,497	$ 14,561,946	$ 14,770,749	$ 14,983,421	$ 15,200,633	$ 255,973,341
TOTAL VARIABLE (EXCL. FUEL) COSTS	$	$ -	$ -	$ -	$ -	$ 55,577	$ 50,738	$ 53,612	$ 46,150	$ 82,172	$ 92,506	$ 102,848	$ 111,003	$ 118,649	$ 110,765	$ 119,243	$ 125,497	$ 126,022	$ 125,798	$ 129,375	$ 223,327	$ 1,673,282
TOTAL FUEL COSTS	$	$ 11,148,457	$ 3,904,424	$ -	$ -	$ 142,974	$ 134,016	$ 149,717	$ 132,594	$ 241,173	$ 275,083	$ 309,980	$ 336,501	$ 369,575	$ 345,016	$ 370,987	$ 389,783	$ 391,665	$ 397,995	$ 409,896	$ 417,509	$ 19,867,345
TOTAL TRANSACTION COSTS		$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$	$ 7,573,707	$ 7,033,898	$ 6,717,663	$ 6,948,969	$ 7,039,348	$ 7,288,426	$ 7,714,215	$ 8,038,059	$ 8,556,337	$ 9,200,176	$ 9,635,438	$ 10,042,451	$ 10,578,551	$ 11,039,236	$ 11,373,008	$ 11,711,262	$ 12,095,332	$ 12,686,393	$ 13,095,544	$ 13,612,552	$ 191,980,567
TOTAL MISO WHOLESALE MARKET SALES	$	$ (10,879,506)	$ (3,607,645)	$ -	$ -	$ (279,930)	$ (265,965)	$ (292,012)	$ (268,232)	$ (433,223)	$ (490,342)	$ (549,410)	$ (592,827)	$ (642,929)	$ (713,152)	$ (775,900)	$ (811,990)	$ (805,206)	$ (818,423)	$ (849,471)	$ (1,094,501)	$ (24,170,665)
TOTAL CAPACITY MARKET PURCHASES	$	$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 259,639	$ 281,620	$ 321,839	$ 346,406	$ 406,458	$ 480,768	$ 509,914	$ 1,170,564	$ 1,218,520	$ 1,315,318	$ 1,369,304	$ 1,425,319	$ 1,484,201	$ 1,544,980	$ 1,606,737	$ 1,668,295	$ 23,832,200
TOTAL CAPACITY MARKET SALES	$	$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$	$ 25,686,719	$ 29,946,894	$ 21,374,199	$ 21,979,352	$ 26,708,650	$ 27,330,095	$ 28,050,609	$ 28,677,866	$ 28,734,631	$ 28,773,503	$ 29,537,226	$ 30,446,513	$ 31,360,183	$ 31,756,934	$ 32,464,026	$ 33,163,680	$ 33,898,365	$ 34,923,743	$ 35,763,917	$ 36,593,072	**$ 597,170,176**

NPV @ 4.0%:	**$395,052,209**	**2018$**
Levelized Cost of Energy ($/MWh)	**$90.46**	**2018$**

Data Item	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																					
6x 9 MW Recips	$/kW-Yr					$ 136	$ 137	$ 137	$ 138	$ 138	$ 138	$ 139	$ 139	$ 140	$ 138	$ 139	$ 139	$ 140	$ 141	$ 141	$ 139

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Purchase MISO Market Energy

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
ANNUAL PEAK LOAD	MW	Grand Haven Board of Light & Power	63.8	63.9	64.2	64.4	64.7	64.9	65.2	65.5	65.8	66.0	66.3	66.5	66.8	67.1	67.4	67.7	68.0	68.3	68.5	68.8
ANNUAL ENERGY REQUIREMENTS	MWh	Grand Haven Board of Light & Power	310,892	311,410	312,503	313,752	315,022	316,310	317,647	318,956	320,215	321,435	322,694	323,993	325,301	326,668	328,073	329,489	330,963	332,427	333,823	335,082
MISO WHOLESALE MARKET PURCHASES	MWh		263,201	262,633	263,906	265,205	266,404	267,531	269,538	271,470	279,700	288,928	290,353	291,653	292,963	297,761	299,187	300,932	303,112	304,495	305,912	307,212
MISO WHOLESALE MARKET PURCHASES	$		$7,587,346	$7,052,357	$6,741,264	$6,982,905	$7,073,585	$7,322,755	$7,750,702	$8,075,370	$8,596,742	$9,244,968	$9,684,369	$10,098,562	$10,641,025	$11,105,272	$11,441,549	$11,780,713	$12,166,679	$12,765,874	$13,173,902	$13,694,009
MISO WHOLESALE MARKET PURCHASES	$/MWh		$ 28.83	$ 26.85	$ 25.54	$ 26.33	$ 26.55	$ 27.37	$ 28.76	$ 29.75	$ 30.74	$ 32.00	$ 33.35	$ 34.63	$ 36.32	$ 37.30	$ 38.24	$ 39.15	$ 40.14	$ 41.92	$ 43.06	$ 44.58
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	56.2	56.5	57.1	57.4	58.2	59.3	59.6	69.9	70.2	71.2	71.5	71.8	72.1	72.5	72.8	73.0
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 5,037,094	$ 5,280,879	$ 5,341,290	$ 5,502,836	$ 5,758,889	$ 6,149,576	$ 6,387,082	$ 7,327,568	$ 7,609,314	$ 7,950,371	$ 7,879,690	$ 8,039,835	$ 8,507,375	$ 9,236,436	$ 9,507,723	$ 9,782,750
TRANSACTION CAPACITY PRICE	$/MW-Mo	CMS Energy - Capacity Only		$ 3,800	$ 3,800	$ 3,900	$ 3,900	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000									
TRANSACTION CAPACITY AMOUNT	MW	CMS Energy - Capacity Only	10	10	10	10	10	10	10	10	10	10	10									
TRANSACTION CAPACITY COST	$	CMS Energy - Capacity Only		$ 456,000	$ 456,000	$ 468,000	$ 468,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000									
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986
POWER SUPPLY LABOR	$	Grand Haven Board of Light & Power	$ 4,595,511	$ 4,710,398	$ 1,237,989	$ 1,268,939	$ 1,300,663	$ 1,333,179	$ 1,366,509	$ 1,400,671	$ 1,435,688	$ 1,471,580	$ 1,508,370	$ 1,546,079	$ 1,584,731	$ 1,624,349	$ 1,664,958	$ 1,706,582	$ 1,749,247	$ 1,792,978	$ 1,837,802	$ 1,883,747
SNOW MELT SYSTEM COST	$	Grand Haven Board of Light & Power	$ 32,970	$ 31,636	$ 30,980	$ 33,185	$ 34,084	$ 35,781	$ 38,330	$ 40,424	$ 42,321	$ 44,010	$ 45,766	$ 47,365	$ 49,504	$ 50,622	$ 51,922	$ 53,151	$ 54,507	$ 56,851	$ 58,336	$ 60,483
CAPITAL EXPENDITURES	$	J B Sims:3	$ 1,800,000	$ 1,800,000	$ 9,153,570	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPITAL EXPENDITURES	$	Snow Melt System	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DEBT SERVICE	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	J B Sims:3	$ 3,101,906	$ 1,589,727	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
FIXED O&M COST	$	Recips	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CAPACITY	MW	J B Sims:3	73	73																		
CAPACITY	MW	GHBLP Recip 9MW:1																				
CAPACITY	MW	GHBLP Recip 9MW:2																				
CAPACITY	MW	GHBLP Recip 9MW:3																				
CAPACITY	MW	GHBLP Recip 9MW:4																				
CAPACITY	MW	GHBLP Recip 9MW:5																				
CAPACITY	MW	GHBLP Recip 9MW:6																				
GENERATION	MWh	J B Sims:3	359,141	123,779																		
GENERATION	MWh	GHBLP Recip 9MW:1																				
GENERATION	MWh	GHBLP Recip 9MW:2																				
GENERATION	MWh	GHBLP Recip 9MW:3																				
GENERATION	MWh	GHBLP Recip 9MW:4																				
GENERATION	MWh	GHBLP Recip 9MW:5																				
GENERATION	MWh	GHBLP Recip 9MW:6																				
CAPACITY FACTOR	%	J B Sims:3	56%	38%																		
CAPACITY FACTOR	%	GHBLP Recip 9MW:1																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:2																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:3																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:4																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:5																				
CAPACITY FACTOR	%	GHBLP Recip 9MW:6																				
FUEL CONSUMPTION	MMBtu	J B Sims:3	4,163,584	1,441,153																		
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:1																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:2																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:3																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:4																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:5																				
FUEL CONSUMPTION	MMBtu	GHBLP Recip 9MW:6																				
AVERAGE HEAT RATE	MMBtu/MWh	J B Sims:3	11.6	11.6																		
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:1																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:2																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:3																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:4																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:5																				
AVERAGE HEAT RATE	MMBtu/MWh	GHBLP Recip 9MW:6																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:1																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:2																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:3																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:4																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:5																				
VARIABLE O&M COST	$	GHBLP Recip 9MW:6																				
FUEL COST	$	J B Sims:3	$ 11,119,101	$ 3,906,000																		
FUEL COST	$	GHBLP Recip 9MW:1																				
FUEL COST	$	GHBLP Recip 9MW:2																				
FUEL COST	$	GHBLP Recip 9MW:3																				
FUEL COST	$	GHBLP Recip 9MW:4																				
FUEL COST	$	GHBLP Recip 9MW:5																				
FUEL COST	$	GHBLP Recip 9MW:6																				
UNIT REVENUE	$	J B Sims:3	$ 10,874,698	$ 3,609,656																		
UNIT REVENUE	$	GHBLP Recip 9MW:1																				
UNIT REVENUE	$	GHBLP Recip 9MW:2																				
UNIT REVENUE	$	GHBLP Recip 9MW:3																				
UNIT REVENUE	$	GHBLP Recip 9MW:4																				
UNIT REVENUE	$	GHBLP Recip 9MW:5																				
UNIT REVENUE	$	GHBLP Recip 9MW:6																				
TRANSACTION GENERATION	MWh	Beebe 1B Wind Project	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625	6,625	6,635	6,625	6,625
TRANSACTION GENERATION	MWh	Pegasus Wind Project	19,447	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,531	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441	19,441
TRANSACTION GENERATION	MWh	MPPA Landfill Gas Project	21,626	22,601	22,528	22,528	22,528	22,601	21,995	21,463	14,434	6,305	6,281	6,281	6,272	2,861	2,847	2,502	1,822	1,829	1,822	1,822

Grand Haven Board of Light & Power Planning Analysis

Low Gas - Retire J.B. Sims Unit 3 - Purchase MISO Market Energy

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
TRANSACTION PPA PRICE	$/MWh	Beebe 1B Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	Pegasus Wind Project	$ 41.77	$ 42.24	$ 43.50	$ 44.06	$ 45.08	$ 46.21	$ 47.36	$ 48.55	$ 49.76	$ 51.00	$ 52.28	$ 53.58	$ 54.92	$ 56.30	$ 57.70	$ 59.15	$ 60.63	$ 62.14	$ 63.70	$ 65.29	
TRANSACTION PPA PRICE	$/MWh	MPPA Landfill Gas Project	$ 97.20	$ 99.34	$ 101.83	$ 104.38	$ 106.96	$ 109.61	$ 112.26	$ 114.96	$ 116.30	$ 113.02	$ 115.82	$ 118.70	$ 121.64	$ 130.57	$ 133.82	$ 138.71	$ 147.11	$ 150.76	$ 154.50	$ 158.34	
TRANSACTION PPA COST	$	Beebe 1B Wind Project	$ 276,739	$ 280,285	$ 288,206	$ 291,866	$ 298,643	$ 306,583	$ 313,762	$ 321,606	$ 329,647	$ 338,410	$ 346,335	$ 354,993	$ 363,868	$ 373,541	$ 382,289	$ 391,846	$ 401,642	$ 412,320	$ 421,975	$ 432,525	
TRANSACTION PPA COST	$	Pegasus Wind Project	$ 812,362	$ 825,053	$ 845,750	$ 856,492	$ 876,380	$ 902,463	$ 920,746	$ 943,765	$ 967,359	$ 996,151	$ 1,016,331	$ 1,041,739	$ 1,067,784	$ 1,094,478	$ 1,121,840	$ 1,149,886	$ 1,178,633	$ 1,208,099	$ 1,238,302	$ 1,269,259	
TRANSACTION PPA COST	$	MPPA Landfill Gas Project	$ 2,102,062	$ 2,245,210	$ 2,294,044	$ 2,351,413	$ 2,409,640	$ 2,477,384	$ 2,469,137	$ 2,467,497	$ 1,678,598	$ 712,584	$ 727,482	$ 745,526	$ 762,941	$ 373,619	$ 380,983	$ 347,058	$ 268,031	$ 275,802	$ 281,511	$ 288,488	
SUMMARY OF COSTS																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	**$ 70,554,994**
TOTAL FIXED COSTS	$		$ 12,185,569	$ 13,357,852	$ 13,226,594	$ 4,187,772	$ 4,304,499	$ 4,425,408	$ 4,550,944	$ 4,679,133	$ 4,810,102	$ 4,944,000	$ 5,082,024	$ 5,224,078	$ 5,370,660	$ 5,520,897	$ 5,675,918	$ 5,835,255	$ 5,999,852	$ 6,169,860	$ 6,342,765	$ 6,519,216	**$ 128,412,396**
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
TOTAL FUEL COSTS	$		$ 11,119,101	$ 3,906,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 15,025,101**
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	**$ 57,646,965**
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,587,346	$ 7,052,357	$ 6,741,264	$ 6,982,905	$ 7,073,585	$ 7,322,755	$ 7,750,702	$ 8,075,370	$ 8,596,742	$ 9,244,968	$ 9,684,369	$ 10,098,562	$ 10,641,025	$ 11,105,272	$ 11,441,549	$ 11,780,713	$ 12,166,679	$ 12,765,874	$ 13,173,902	$ 13,694,009	**$ 192,979,947**
TOTAL MISO WHOLESALE MARKET SALES	$		$ (10,874,698)	$ (3,609,656)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (14,484,353)**
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 4,757,535	$ 4,897,775	$ 5,045,174	$ 5,037,094	$ 5,280,879	$ 5,341,290	$ 5,502,836	$ 5,758,889	$ 6,149,576	$ 6,387,082	$ 7,327,568	$ 7,609,314	$ 7,950,371	$ 7,879,690	$ 8,039,835	$ 8,507,375	$ 9,236,436	$ 9,507,723	$ 9,782,750	**$ 129,999,192**
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ (187,853)**
TOTAL COSTS	$		$ 25,675,811	$ 31,996,729	$ 31,553,688	$ 23,069,269	$ 23,437,593	$ 24,251,920	$ 24,972,686	$ 25,708,245	$ 25,953,429	$ 26,294,099	$ 27,251,510	$ 28,423,100	$ 29,552,016	$ 30,264,103	$ 30,841,307	$ 31,620,115	$ 32,718,311	$ 34,388,421	$ 35,412,804	$ 36,561,232	**$ 579,946,387**

NPV @ 4.0%:	**$386,185,943**	**2018$**
Levelized Cost of Energy ($/MWh)	**$88.50**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total
LOW CAPACITY MARKET SENSITIVITY																							
MARKET CAPACITY DEFICIT / (SALES)	MW		(3.9)	55.4	55.6	55.9	56.2	56.5	57.1	57.4	58.2	59.3	59.6	69.9	70.2	71.2	71.5	71.8	72.1	72.5	72.8	73.0	
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 49.20	$ 50.43	$ 51.69	$ 52.98	$ 54.31	$ 55.67	$ 57.06	$ 58.48	$ 59.95	$ 61.44	$ 62.98	$ 64.55	$ 66.17	$ 67.82	$ 69.52	$ 71.26	$ 73.04	$ 74.86	$ 76.74	
MARKET CAPACITY COST / (REVENUE)	$		$ (187,853)	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 2,977,668	$ 3,067,600	$ 3,177,468	$ 3,273,426	$ 3,406,654	$ 3,555,968	$ 3,661,994	$ 4,401,446	$ 4,530,174	$ 4,709,763	$ 4,848,611	$ 4,991,608	$ 5,139,648	$ 5,291,813	$ 5,447,241	$ 5,604,812	
SUMMARY OF COSTS (LOW CAPACITY MARKET)																							**Total**
MISO NITS COST	$		$ 2,655,183	$ 2,726,091	$ 2,804,054	$ 2,885,648	$ 2,969,752	$ 3,056,448	$ 3,146,105	$ 3,238,038	$ 3,332,093	$ 3,428,410	$ 3,527,888	$ 3,630,634	$ 3,736,425	$ 3,845,926	$ 3,959,038	$ 4,075,522	$ 4,196,099	$ 4,320,031	$ 4,446,626	$ 4,574,986	$ 70,554,994
TOTAL FIXED COSTS	$		$ 12,185,569	$ 13,357,852	$ 13,226,594	$ 4,187,772	$ 4,304,499	$ 4,425,408	$ 4,550,944	$ 4,679,133	$ 4,810,102	$ 4,944,000	$ 5,082,024	$ 5,224,078	$ 5,370,660	$ 5,520,897	$ 5,675,918	$ 5,835,255	$ 5,999,852	$ 6,169,860	$ 6,342,765	$ 6,519,216	$ 128,412,396
TOTAL VARIABLE (EXCL. FUEL) COSTS	$		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL FUEL COSTS	$		$ 11,119,101	$ 3,906,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,025,101
TOTAL TRANSACTION COSTS			$ 3,191,163	$ 3,806,549	$ 3,884,000	$ 3,967,771	$ 4,052,663	$ 4,166,430	$ 4,183,646	$ 4,212,869	$ 3,455,604	$ 2,527,145	$ 2,570,148	$ 2,142,259	$ 2,194,593	$ 1,841,638	$ 1,885,112	$ 1,888,790	$ 1,848,306	$ 1,896,221	$ 1,941,788	$ 1,990,271	$ 57,646,965
TOTAL MISO WHOLESALE MARKET PURCHASES	$		$ 7,587,346	$ 7,052,357	$ 6,741,264	$ 6,982,905	$ 7,073,585	$ 7,322,755	$ 7,750,702	$ 8,075,370	$ 8,596,742	$ 9,244,968	$ 9,684,369	$ 10,098,562	$ 10,641,025	$ 11,105,272	$ 11,441,549	$ 11,780,713	$ 12,166,679	$ 12,765,874	$ 13,173,902	$ 13,694,009	$ 192,979,947
TOTAL MISO WHOLESALE MARKET SALES	$		$ (10,874,698)	$ (3,609,656)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (14,484,353)
TOTAL CAPACITY MARKET PURCHASES	$		$ -	$ 2,725,725	$ 2,806,073	$ 2,890,521	$ 2,977,668	$ 3,067,600	$ 3,177,468	$ 3,273,426	$ 3,406,654	$ 3,555,968	$ 3,661,994	$ 4,401,446	$ 4,530,174	$ 4,709,763	$ 4,848,611	$ 4,991,608	$ 5,139,648	$ 5,291,813	$ 5,447,241	$ 5,604,812	$ 76,508,211
TOTAL CAPACITY MARKET SALES	$		$ (187,853)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (187,853)
TOTAL COSTS	$		$ 25,675,811	$ 29,964,919	$ 29,461,985	$ 20,914,617	$ 21,378,167	$ 22,038,641	$ 22,808,864	$ 23,478,834	$ 23,601,193	$ 23,700,491	$ 24,526,423	$ 25,496,978	$ 26,472,876	$ 27,023,496	$ 27,810,228	$ 28,571,888	$ 29,350,584	$ 30,443,798	$ 31,352,322	$ 32,383,293	**$ 526,455,406**

NPV @ 4.0%:	**$352,347,011**	**2018$**
Levelized Cost of Energy ($/MWh)	**$80.79**	**2018$**

Data Item	Units	Description	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
IMPLIED CAPACITY COST																						
MARKET CAPACITY PRICE	$/kW-Yr		$ 48.00	$ 85.87	$ 88.02	$ 90.22	$ 89.63	$ 93.49	$ 93.57	$ 95.92	$ 98.87	$ 103.67	$ 107.17	$ 104.85	$ 108.43	$ 111.70	$ 110.22	$ 111.97	$ 117.95	$ 127.48	$ 130.67	$ 133.94

APPENDIX C – 30-YEAR FINANCING SENSITIVITY

December 14, 2018

Mr. Erik Booth, P.E.
Power Supply Manager
Grand Haven Board of Light & Power
1700 Eaton Drive
Grand Haven, MI 49417

Re: 30-year Financing Sensitivity

Dear Mr. Booth:

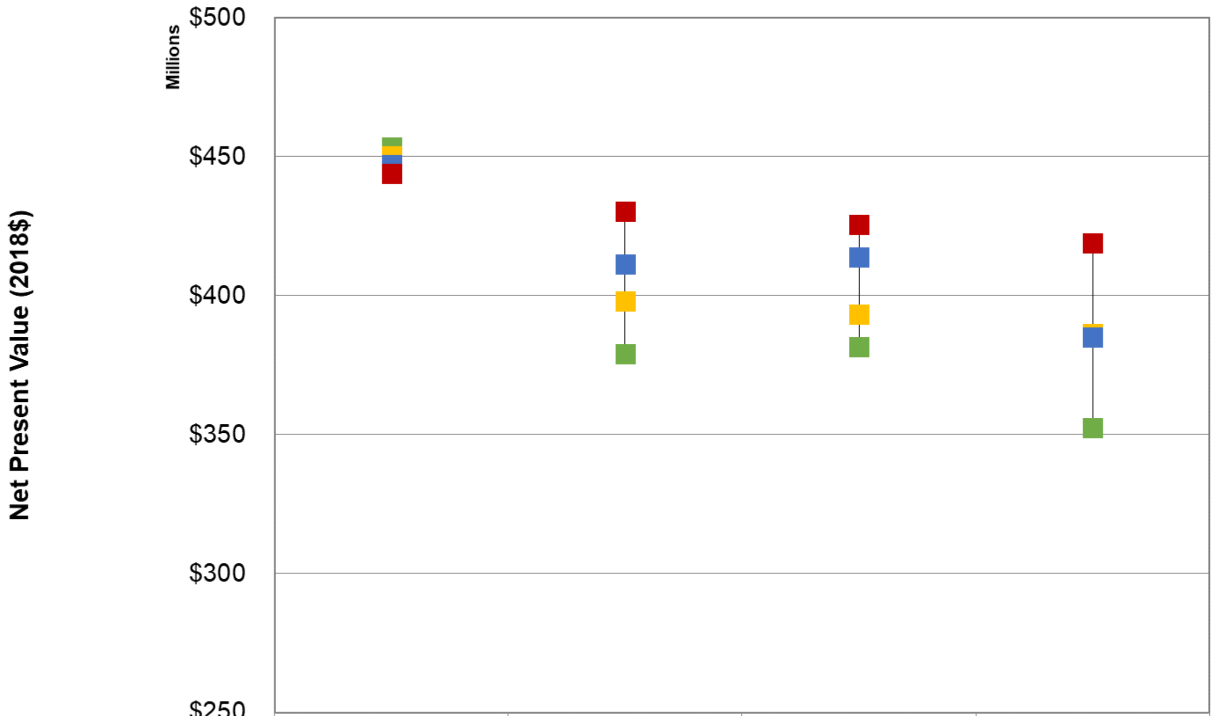
As part of the Power Supply Plan, Grand Haven Board of Light & Power ("GHBLP") requested that Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") conduct a supplementary sensitivity of the power supply paths using 30-year financing. The results of that sensitivity are included below.

RESULTS

Table 1 illustrates the net present value of each power supply path for the various scenarios.

BURNS McDONNELL

Table 1: Net Present Value of Power Supply Costs



	Path 1 J.B. Sims Unit 3	Path 2 4x 9 MW Recips	Path 3 6x 9 MW Recips	Path 4 MISO Market
Low Gas/Low Capacity	$453,384,057	$378,923,766	$381,635,709	$352,347,011
Low Gas/High Capacity	$450,121,714	$397,908,364	$393,193,140	$386,185,943
High Gas/Low Capacity	$446,997,772	$411,314,403	$413,964,941	$384,942,027
High Gas/High Capacity	$443,735,429	$430,299,001	$425,522,372	$418,780,959

Sincerely,

Mike Borgstadt, P.E.
Project Manager

APPENDIX D – PUBLIC COMMUNICATION & FORUMS

Customer Communications

Town Hall Meetings 2 Total

Community Forums 3 Total

Business Forums 4 Total

Presentation: Grand Haven Chamber of Commerce Board of Directors - 1 Meeting

Presentation: Grand Haven Chamber Breakfast - 1 Meeting

Information Notice on Electric Bills - 1 Notice

GHBLP Facebook Postings 1,150 followers - 27 Posts

Twitter 31 Posts

LinkedIn 16 Posts

Plugged In Bill Inserts 3 Issues

SmartHub 1 Ad

Media

Newspaper: Grand Haven Tribune - Articles, Ads, Your View Letters - 33 Total

Television: WZZM - 1 Story

Radio: WGHN and WAWL - 3 months

Facebook: WZZM Branding Ad reaching a combined 36,525 people

Facebook: Grand Haven Tribune - 16,260 followers, 14 Postings

Facebook: City of Grand Haven - 2,731 followers, 1 Post

Documents Made Available to Public

Letter: Utility Workers Union of America Local 582-Letter to Community 6/28/2018

Presentation: GHBLP Condition Assessment Presentation 6/29/2018

Presentation: Michigan Public Power Agency Presentation 6/28/2018

Presentation: Staffing Analysis in Preparation for Sims Closure 6/28/2018

Video: June 28, 2018 Board Meeting 6/28/2018

Report: Sims Life Assessment Report 6/13/2018

Letter: Letter to Customers and Community from Board Chair 5/21/2018

Letter: Letter to Grand Haven City Mayor and City Council from Board Chair 4/26/2018

Presentation: Sims Power Plant Closure Report 4/24/2018

Report: Board Approved Sims Power Plant Closure Report 4/24/2018

Report: Board Approved Response to City of Grand Haven's Sims Closure Questions 4/24/2018

PUBLIC OUTREACH AND COMMUNICATIONS

PUBLIC FORUMS & PRESENTATIONS

9 TOTAL

IN THE NEWS

52 MEDIA SPOTS

Documents & Reports Available to Public 11 Total

2018 TOWN HALLS

SUMMARY OF FINDINGS

REGARDING

PROPOSED CLOSURE OF THE SIMS PLANT

August 15 & 16th

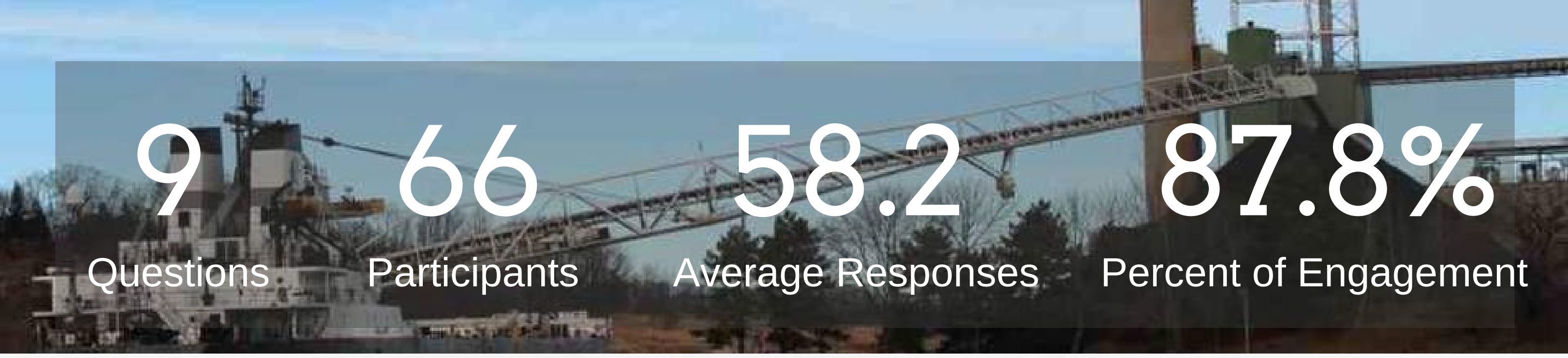
RESULTS FROM 8/15/18

In Attendance:

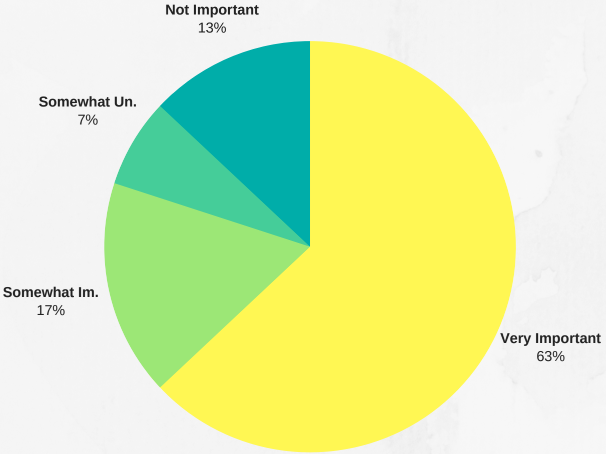
69 Residents

14 Non-Resident/Customers

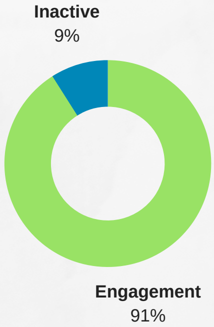
There were 83 in attendance, however only 66 completed either the electronic or paper survey.



Is local energy production important for Grand Haven?

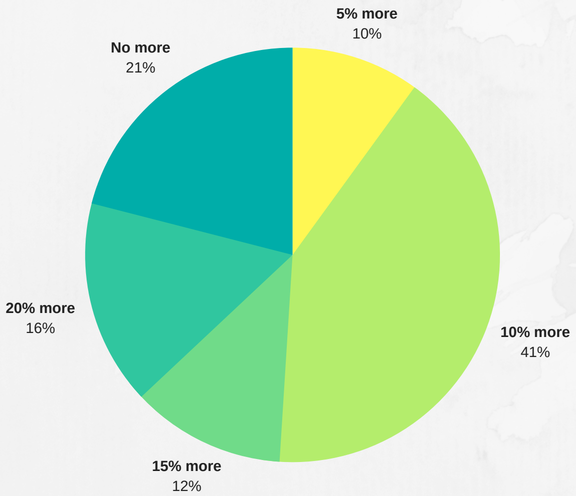


Response Option	Count	Percentage
Very Important	**38**	**63%**
Somewhat Important	10	17%
Somewhat Unimportant	4	7%
Not Important	8	13%

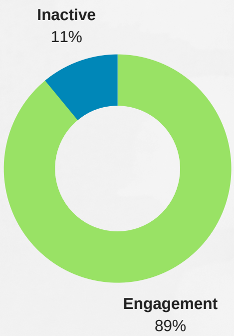


60
Responses

I understand that local energy production may cost more; I would be willing to pay....

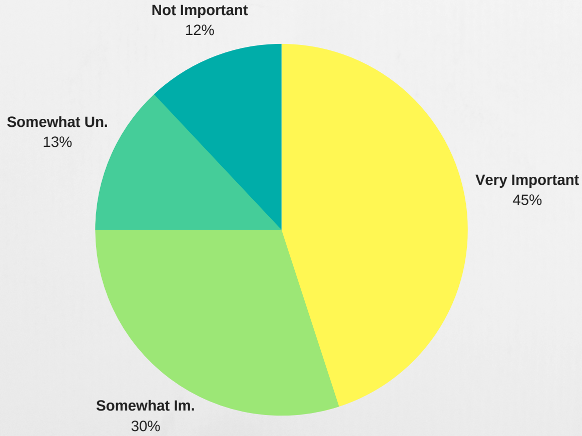


Response Option	Count	Percentage
5% more	6	10%
10% more	24	**41%**
15% more	7	12%
20% more	9	16%
I am unwilling to pay more	12	21%

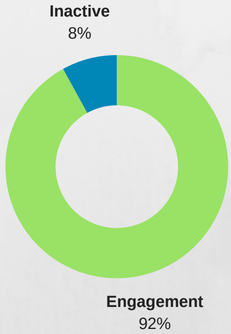


59
Responses

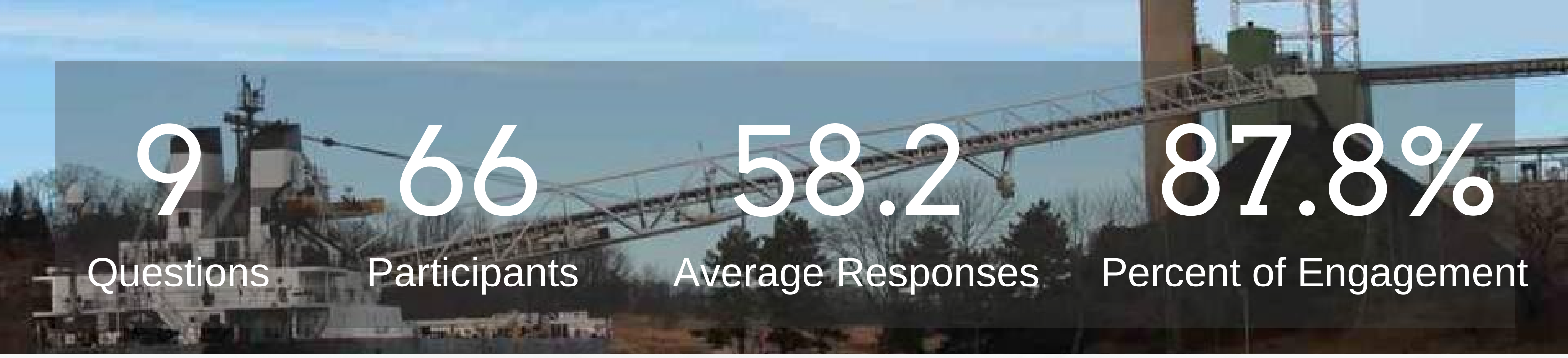
How important is it that the City preserve the Snowmelt System?



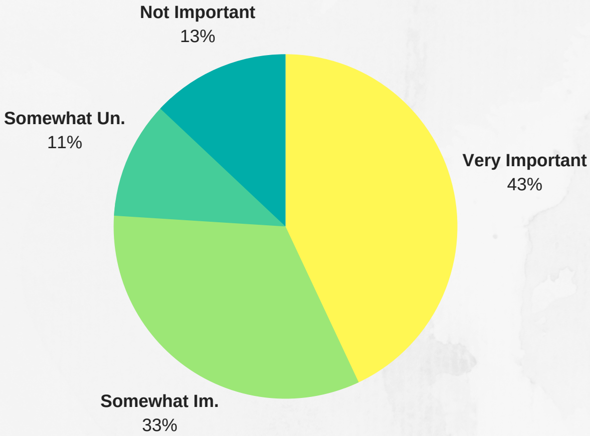
	Count	Percent
Very Important	27	45%
Somewhat Important	18	30%
Somewhat Unimportant	8	13%
Not Important	7	12%



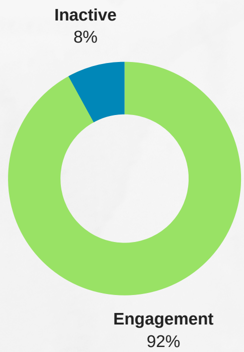
61
Responses



Do you feel renewable energy options are...

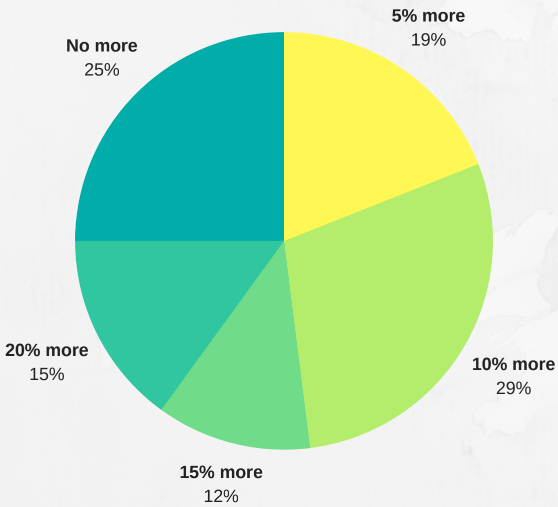


	Count	Percent
Very Important	26	43%
Somewhat Important	20	33%
Somewhat Unimportant	7	11%
Not Important	8	13%

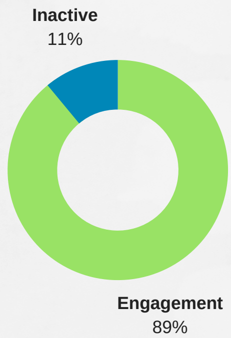


61
Responses

I understand that renewable energy options may cost more; I would be willing to pay...

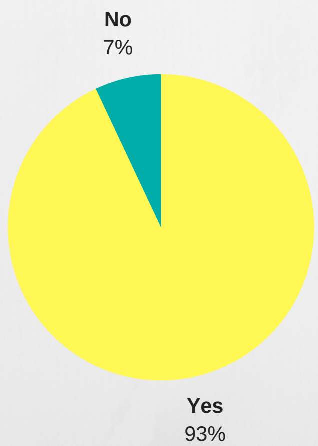


	Count	Percent
5% more	11	19%
10% more	17	29%
15% more	7	12%
20% more	9	15%
I am unwilling to pay more	15	25%

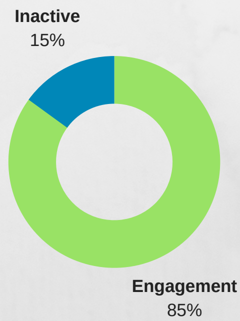


59
Responses

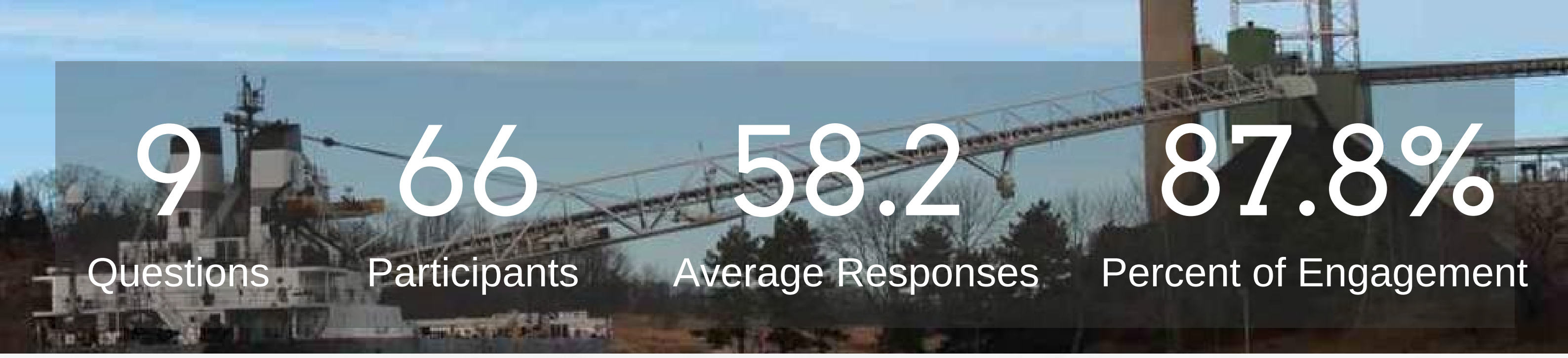
Is the BLP more reliable than surrounding areas?



	Count	Percent
Yes	52	93%
No	4	7%



56
Responses



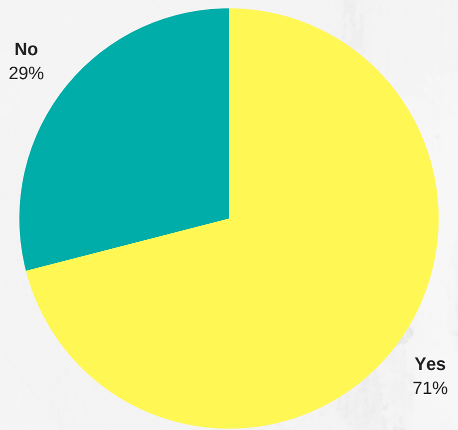
9 Questions

66 Participants

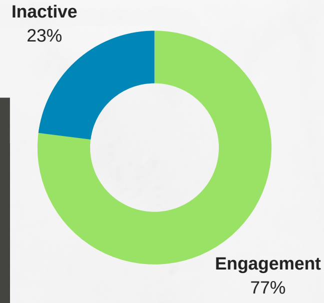
58.2 Average Responses

87.8% Percent of Engagement

Is the BLP more affordable than surrounding areas?



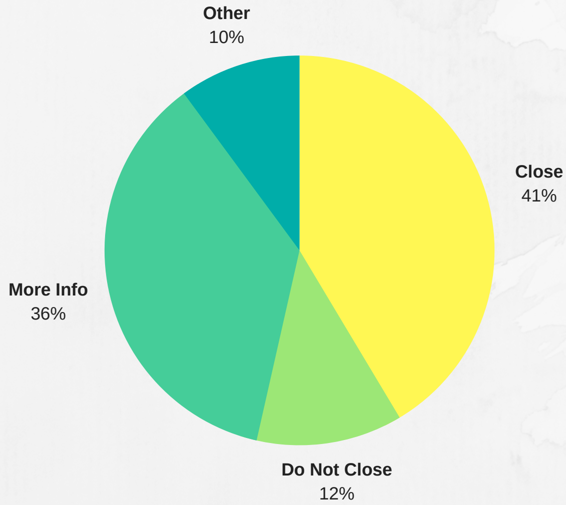
	Count	Percent
Yes	36	71%
No	15	29%



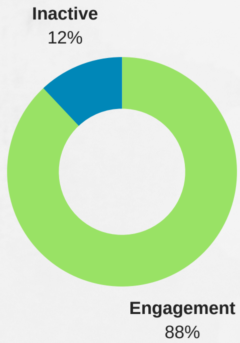
51

Responses

What is your vision for the future of the Sims Plant?



	Count	Percent
Close The Sims Plant in June of 2020	24	41%
Do Not Close The Sims Plant	7	12%
Make a Decision Once More Information is Available	21	36%
Other	6	10%



58

Responses

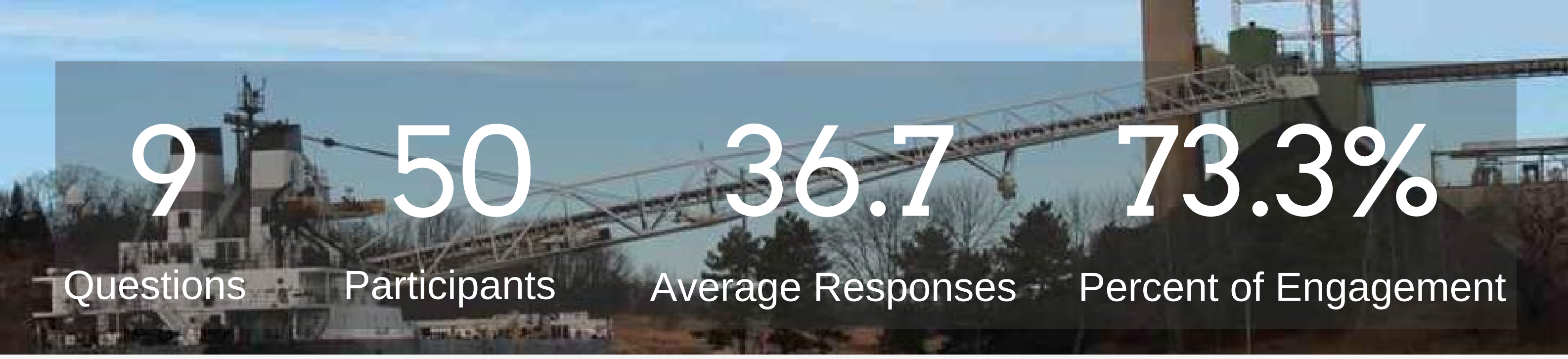
RESULTS FROM 8/16/18

In Attendance:

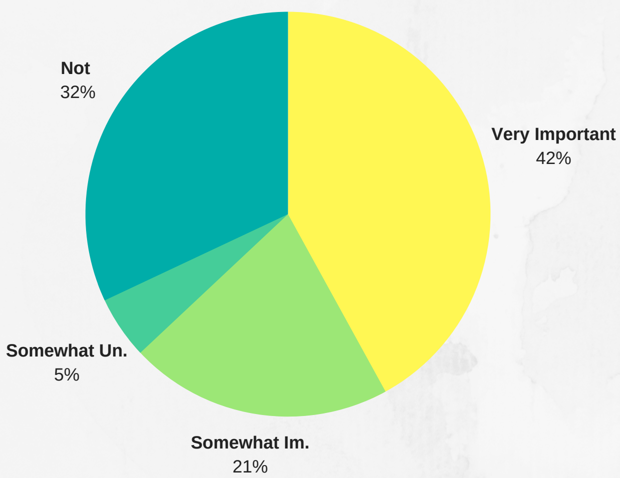
46 Residents

3 Non-Residents/Customers

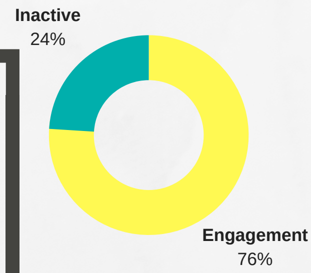
The attendance sheet reports 49 attendees, however the survey results reflect an additional individual who arrived after attendance was taken



Is local energy production important for Grand Haven?



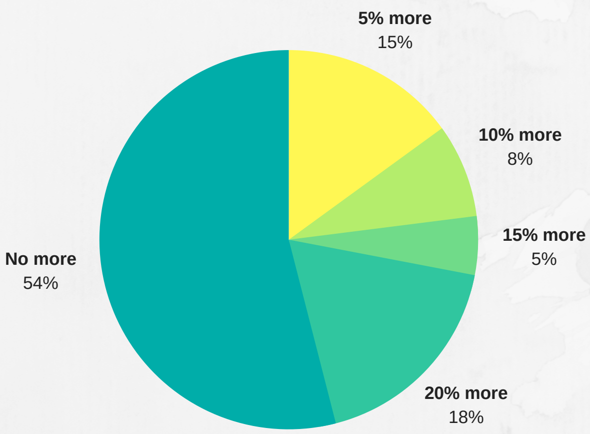
	Count	Percent
Very Important	16	42%
Somewhat Im.	8	21%
Somewhat Un.	2	5%
Not	12	32%



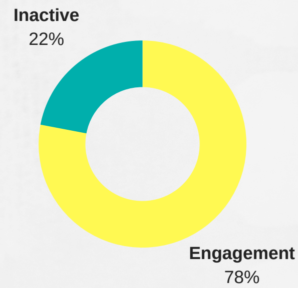
38

Responses

I understand that local energy production may cost more; I would be willing to pay...



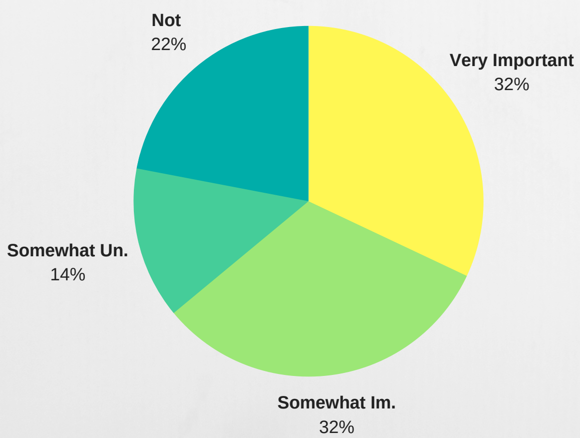
	Count	Percent
5% more	6	15%
10% more	3	8%
15% more	2	5%
20% more	7	18%
No more	21	54%



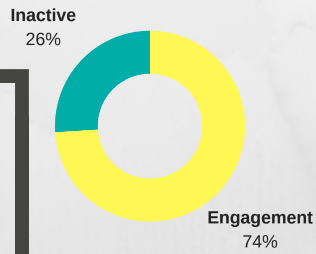
39

Responses

How important is it that the City preserve the Snowmelt System?

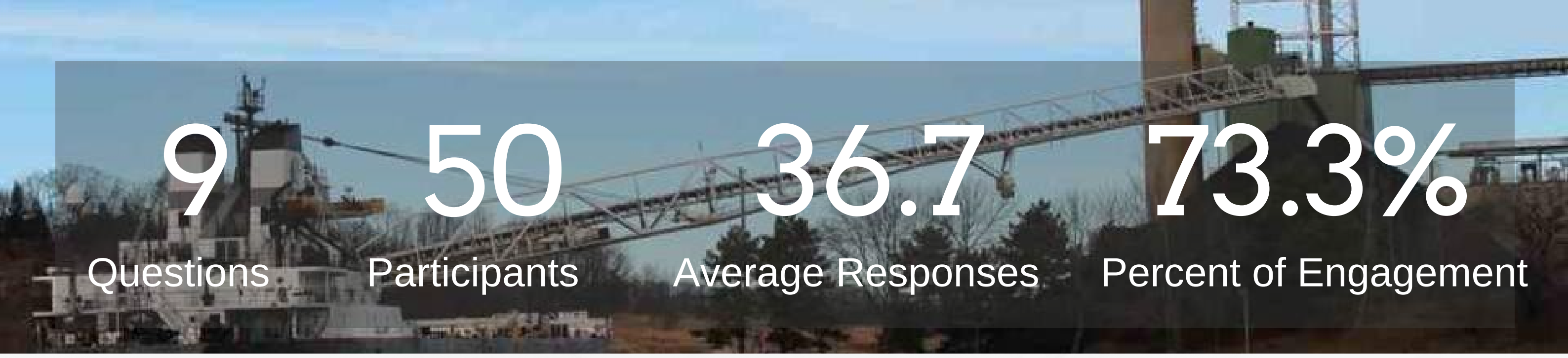


	Count	Percent
Very Important	12	32%
Somewhat Im.	12	32%
Somewhat Un.	5	14%
Not	8	22%

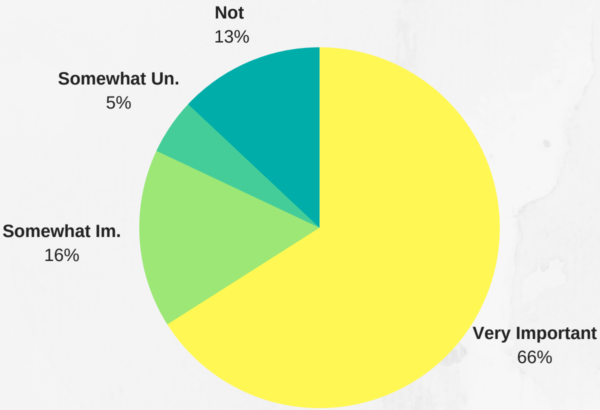


37

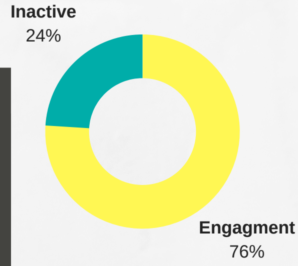
Responses



Do you feel renewable energy options are...

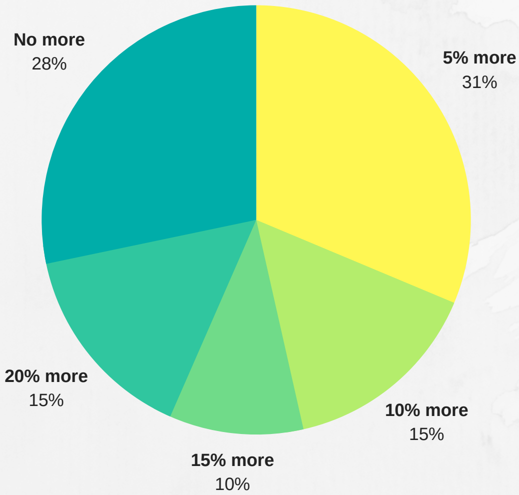


	Count	Percent
Very Important	25	66%
Somewhat Im.	6	16%
Somewhat Un.	2	5%
Not	5	13%

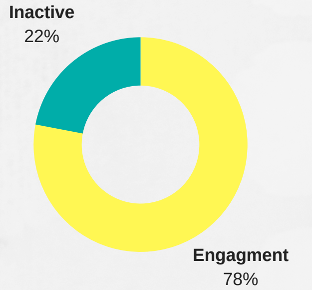


38
Responses

I understand that renewable energy options may cost more; I would be willing to pay...

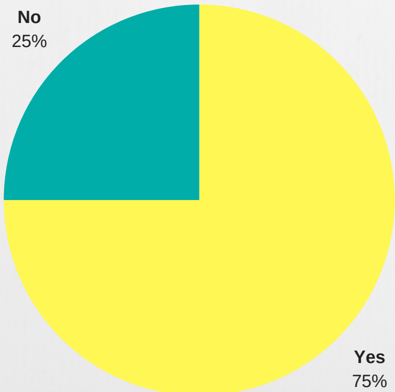


	Count	Percent
5% more	12	31%
10% more	6	15%
15% more	4	10%
20% more	6	15%
No more	11	28%

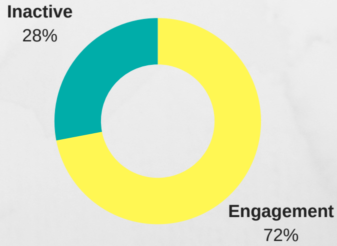


39
Responses

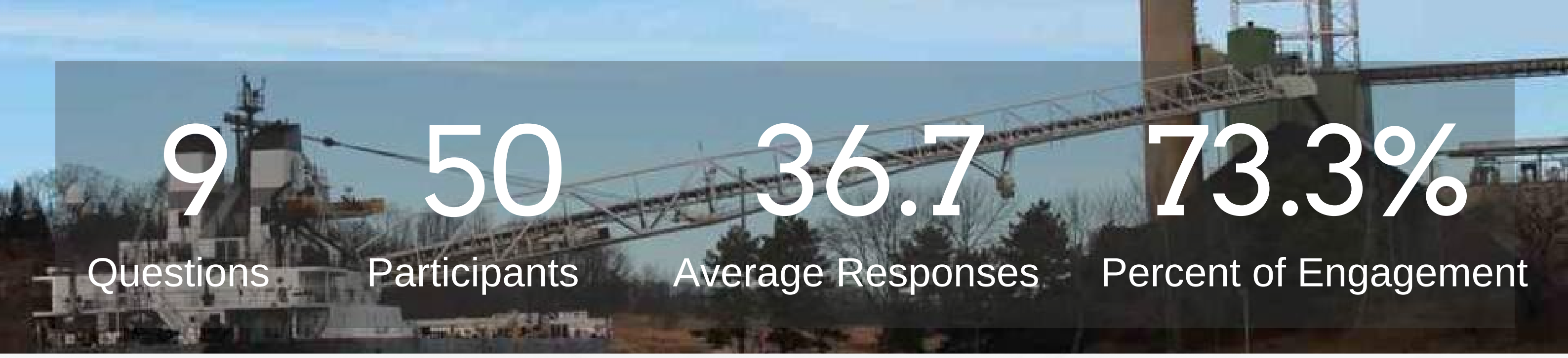
Is the BLP more reliable than surrounding areas?



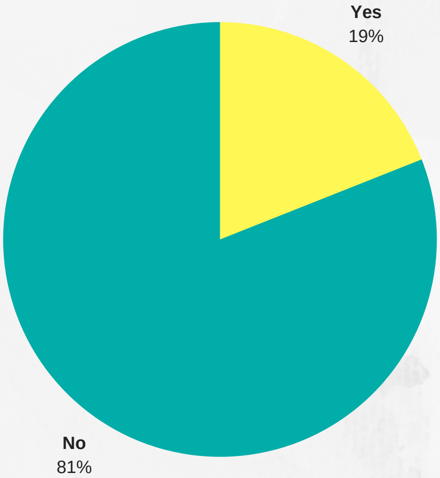
	Count	Percent
Yes	27	75%
No	9	25%



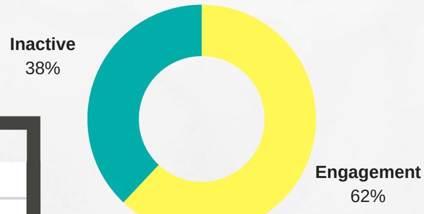
36
Responses



Is the BLP more affordable than surrounding areas?



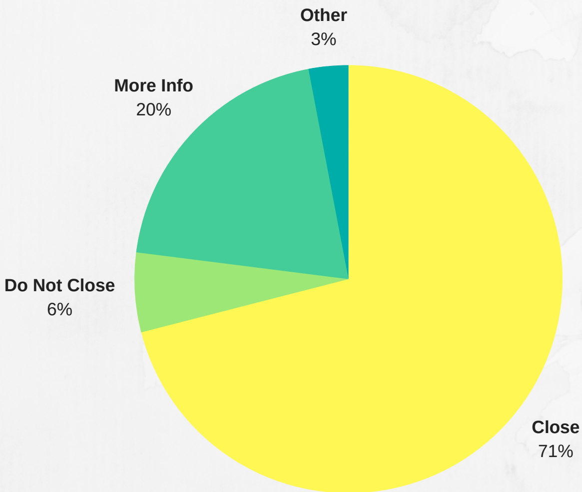
	Count	Percent
Yes	6	19%
No	25	81%



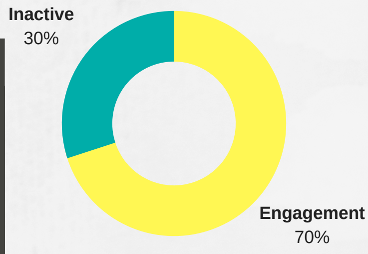
31

Responses

What is your vision for the future of the Sims Plant?



	Count	Percent
Close	25	71%
Do Not Close	2	6%
More Info	7	20%
Other	1	3%



35

Responses

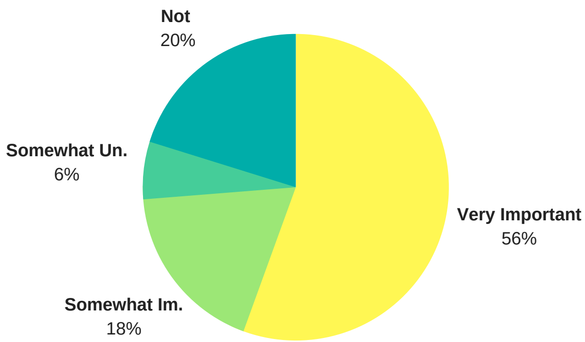
COMBINED RESULTS
8/15/18 8/16/18

Total Attendance:
116 residents/customers

COMBINED MEETING RESULTS

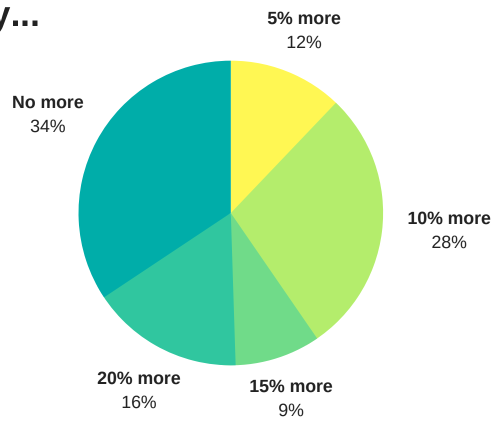
9	116	94.5	81.5%
Questions	Participants	Average Responses	Percent of Engagement

Is local energy important for Grand Haven?



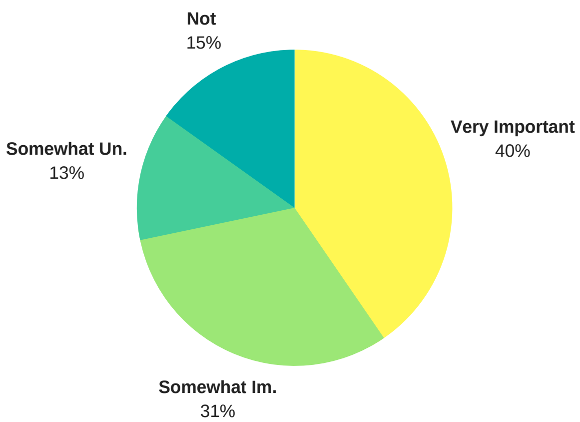
	Count 8.16	Count 8.15	TOTAL
Very Important	16	38	54
Somewhat Im.	8	10	18
Somewhat Un.	2	4	6
Not	12	8	20

I understand that local energy production may cost more; I would be willing to pay...



	Count 8.16	Count 8.15	TOTAL
5% more	6	6	12
10% more	3	24	27
15% more	2	7	9
20% more	7	9	16
No more	21	12	33

How important is it that the City preserve the Snowmelt System?

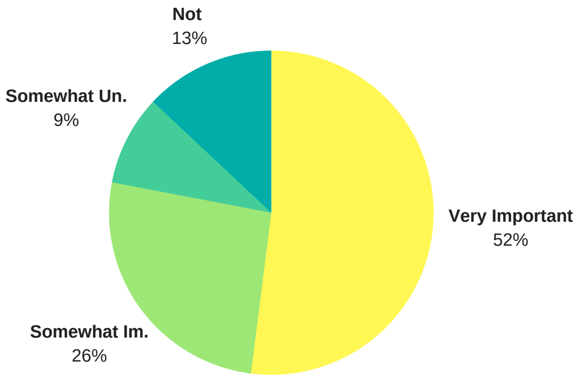


	Count 8.16	Count 8.15	TOTAL
Very Important	12	27	39
Somewhat Im.	12	18	30
Somewhat Un.	5	8	13
Not	8	7	15

COMBINED MEETING RESULTS

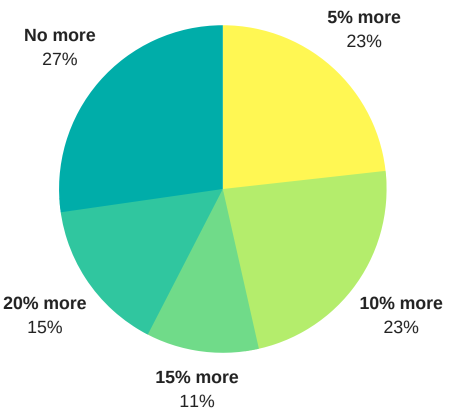
9	116	94.5	81.5%
Questions	Participants	Average Responses	Percent of Engagement

Do you feel renewable energy options are...



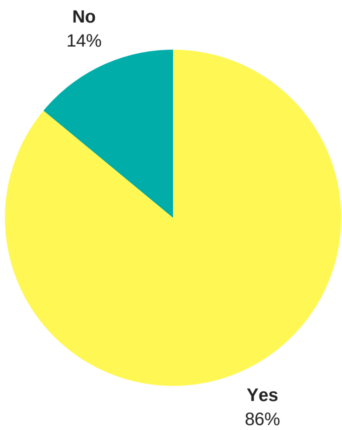
	Count 8.16	Count 8.15	**TOTAL**
Very Important	25	26	51
Somewhat Im.	6	20	26
Somewhat Un.	2	7	9
Not	5	8	13

I understand that renewable energy options may cost more; I would be willing to pay...



	Count 8.16	Count 8.15	**TOTAL**
5% more	12	11	23
10% more	6	17	23
15% more	4	7	11
20% more	6	9	15
No more	11	15	26

Is the BLP more reliable than surrounding areas?

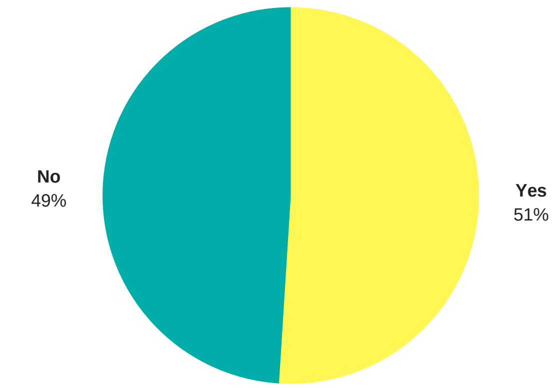


	Count 8.16	Count 8.15	**TOTAL**
Yes	27	52	79
No	9	4	13

COMBINED MEETING RESULTS

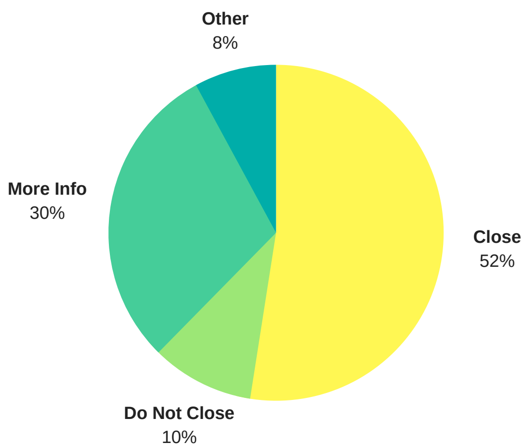
9	116	94.5	81.5%
Questions	Participants	Average Responses	Percent of Engagement

Is the BLP more affordable than surrounding areas?



	Count 8.16	Count 8.15	**TOTAL**
Yes	6	36	42
No	25	15	40

What is your vision for the future of the Sims Plant?



	Count 8.16	Count 8.15	**TOTAL**
Close	25	24	49
Do Not Close	2	7	9
More Info	7	21	28
Other	1	6	7

PUBLIC AND BUSINESS FORUM COMMENTS

NAME	COMMENT
DATE: MONDAY, NOVEMBER 5TH COMMUNITY FORUM	
	Can Sims plant can be converted to gas without destroying the structure and if new generators are installed where would they go.
	Asked if increasing our percentage of renewables will cost rate payers more.
	Asked if path 4 is selected, what will happen to the employees.
	Feels people are confused about the BLP as a provider versus a producer.
	If path 4 is selected and in year 20 it is decided a local plant is desired, can we build at that point.
	Stated that the group at the Town Hall meetings seemed to desire local generation out of fear of grid failure.
	Fears the possibility of the grid being attacked by a nuclear electromagnetic pulse.
DATE: TUESDAY, NOVEMBER 6TH BUSINESS FORUM	
	Asked if the mix of renewable purchases from the market combined with a RICE unit locally makes sense to Burns and McDonnell.
	Asked if a windmill is being used for generation and the wind stops, how long does it take for an alternate source to kick on.
	Asked if a RICE unit is cheaper than an aeroderivative unit.
	Asked if converting the Sims plant to gas is an option and if the current building structure could be used.
	Asked at what dollar value an option is classified as unviable.
	Stated the community wants to see local generation and asked if Burns and McDonnell would recommend that path.
	Asked if path 2 is selected, would the market purchases be around 80% or less.
	Asked what growth factor was used to estimate future load.

NAME	COMMENT
	Stated his concern over the way future load demand may be calculated due to job growth in the past month.
	RICE engine would also have fluctuations in cost depending on the percentage of capacity used.
	Asked how a RICE engine is instructed to turn on an off and how often the engines need rebuilt.
	Does not see a good case for having a local generating unit.
	Asked if the BLP could start with 2 RICE units and leave room for future expansion. She does not want to 4 units until it is known they will be needed and used.
	Stated if path 4 is the lowest cost he does not see why another option would be considered.
	Expressed her concern over the public's confusion regarding reliability.
	Stated the BLP should consider "distributed generation".
DATE: TUESDAY, NOVEMBER 6TH COMMUNITY FORUM	
	Asked if the existing oversized generator can be removed and replaced with a smaller gas generator and still utilize the steam system.
	Asked if the BLP needs permission from the Federal government to build a new plant.
	Asked to hit the 2023 date of a new plant to be running, when the decision needs to be made by.
	Stated the DDA should pay for snowmelt related costs. As a BLP customer who is not a resident of Grand Haven he does not want to pay for snowmelt.
	Asked with all of the proposed projects in the market, what are the chances of our project not getting approved by MISO.
	Asked why the BLP would build a gas plant if most projects in the market currently are wind and solar.
	Wants to see the comparison between aeroderivative engines vs RICE.

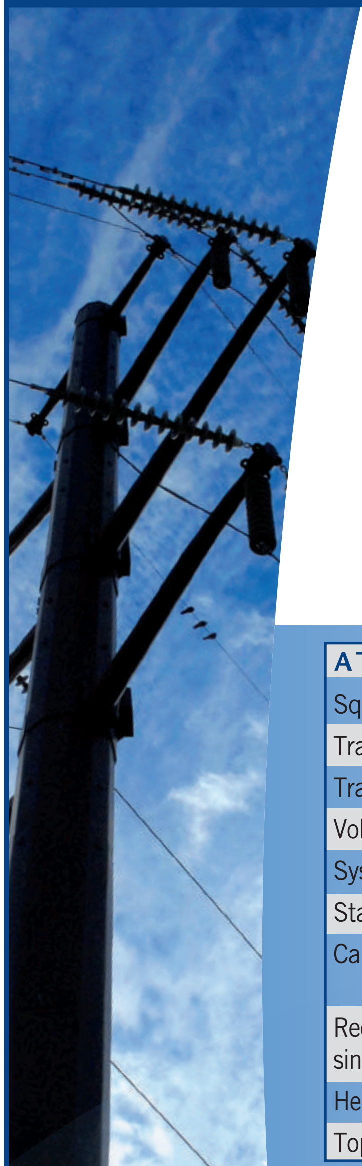
NAME	COMMENT
DATE: WEDNESDAY, NOVEMBER 7TH BUSINESS FORUM	
	Asked if the path for market purchases or a reciprocating engine unit are selected, will customers see lower rates.
	Stated the City Council is discussing a resolution to mandate the BLP to produce the majority of Grand Haven's energy locally. Asked how this resolution would change the path options.
	Stated several years ago there was a large transmission shutdown from New York to Detroit. Asked if reliability is better today
	Asked how reliable the transmission system is against electromagnetic pulse and cyber-attacks.
	Will a bond to build a new plant would cause an increase in rates.
	Asked why path 2 would be selected over path 4.
	Asked if the economics support the desire to have local generation.
	Asked if a new plant would be built to allow for future growth. Asked how low market prices will be passed to the customer in the future.
DATE: WEDNESDAY, NOVEMBER 7TH COMMUNITY FORUM	
	Wants to know the cost breakdown of building a new plant, how long it will take to recover costs, and cost for demolition of Sims.
	Wants to know the projected reliability of a new plant.
	Wants to know the cost comparison of a co-generation versus stand alone snowmelt system and what percentage cost increase the downtown merchants would expect. Asked if the RICE units have enough excess heat to run the system.
	Asked what happens to employees when market cost is low and the unit would not be running.
	Would like to see the following included in the final report: waterfront redevelopment and increasing renewables locally.
	Asked if a reciprocating engine can run on multiple fuels for increased flexibility.

NAME	COMMENT
	Would like final report to explore other location options for a new plant.
	Asked if noise from a RICE unit would be a concern.

ITC Michigan

ITC*Transmission* / METC

A FORTIS COMPANY

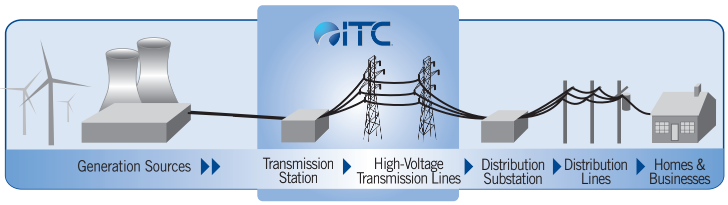


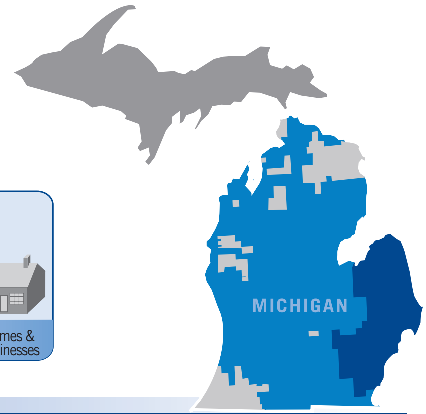
ABOUT ITC MICHIGAN:

ITC Holdings Corp. (ITC), the nation's largest independent electricity transmission company, has two operating subsidiaries in Michigan: ITC*Transmission* and METC (collectively, ITC Michigan). The systems comprise 8,700 circuit miles of transmission line serving the majority of Michigan's Lower Peninsula. ITC's focus on transmission and grid development drives operational excellence and delivers superior value for customers, communities and other stakeholders.

WHAT IS TRANSMISSION?

Transmission is the bulk delivery of electrical energy from power generating plants along high-voltage lines to the local distribution systems of utilities serving communities.





AT-A-GLANCE:	ITC*Transmission*	METC
Square miles of service territory	~7,600	~28,850
Transmission circuit miles	~3,100	~5,600
Transmission towers and poles	~18,700	~36,900
Voltage levels	120 kV to 345 kV	120 kV to 345 kV
System peak load	12,745 MW	9,469 MW
Stations and substations with ITC assets	182	101
Capital investments since assets acquired	~$2.4 billion since 2003	~$1.6 billion since 2006
Reduction in average number of outages on system since acquired by ITC	Down 49%	Down 32%
Headquarters	Novi, Michigan	
Top executive	Simon Whitelocke, President, ITC Michigan	

KEY PROJECTS:

- **Apex-Phoenix** – A new 3-mile, 120 kV underground line that will support service reliability in the Ann Arbor area. Scheduled for completion fourth quarter 2018.
- **Beecher-Samaria** – Reconstruction of a 22-mile, 138 kV line in southern Michigan to improve service reliability by replacing the current wood H-frames and steel lattice structures with double-circuit steel monopoles. Construction will take place in two phases: Morocco-Samaria in 2018, and Morocco-Beecher in 2019.
- **Amber-Donaldson Creek** – Reconstruction of a 20-mile line in western Michigan to improve reliability. Scheduled to begin in third quarter 2018.
- **Morocco Substation** – A new substation in Deerfield Township, Michigan. Completed in 2015.
- **The Thumb Loop** – A 140-mile, 345 kV line tracing Michigan's Thumb region, with four new substations.
Phase 1 entered service in 2013, phase 2 in 2014, and the remainder entered service in May 2015. It serves as the backbone of a system designed to meet the identified maximum wind energy potential of the Thumb region while being an important link in the high-voltage transmission system in Michigan and the region.

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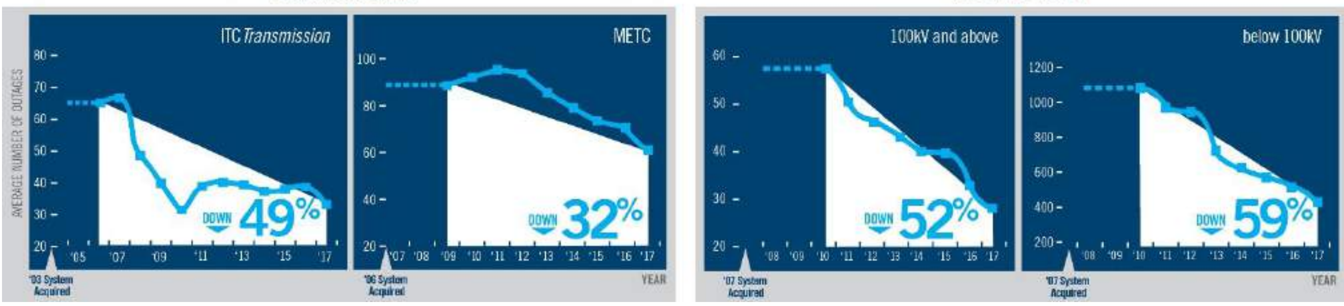
Reliability Performance of ITC's Transmission Systems

OUTAGE DECREASE UNDER ITC OWNERSHIP

3-year rolling averages

ITC MICHIGAN ITC MIDWEST



- ITC has steadily improved the performance of the three transmission systems we acquired beginning in 2003. Through 2017, we have reduced the average number of outages by 49% at ITCTransmission, 32% at METC, and 59% at ITC Midwest. ITC compares the most recent three-year rolling average number of all system outages with the first three-year average number of outages under ITC ownership as data points.
- These continuing improvements in reliability track with ITC's system investments over the years and our targeted capital and maintenance programs.
- ITC's transmission systems have routinely performed among the top 25% of utilities in national benchmark surveys.

ITC Michigan

Two systems: ITC*Transmission* serving southeast Michigan; Michigan Electric Transmission Company (METC) serving most of the remaining Lower Peninsula.

- ITC has steadily reduced the number of outages on its two Michigan systems since it acquired the assets in 2003 and 2006 as a result of our system investments over the years and ongoing operations and maintenance program.
  - **Through 2017, ITC*Transmission*** has reduced the average number of outages on its system by 49% since ITC acquired the system in 2003. The average outage reduction improved from the previous three-year rolling average of 40%. ITC*Transmission* has 3,100 circuit miles of line serving southeast Michigan at voltages ranging from 120kV to 345kV.

    Represented in actual outage numbers: ITC*Transmission* has reduced the number of outages from an average 65 in the first three years of ownership to an average 34 in the most recent three years, representing a 49% decrease in the rolling average.
  - **Through 2017, METC** has reduced the average number of outages on its system by 32% since ITC acquired the system in 2006. The average outage reduction improved from the previous three-year rolling average of 20%. METC has 5,600 circuit miles of line serving most of Michigan's Lower Peninsula at voltages ranging from 120kV to 345kV.

    Represented in actual outage numbers: METC has reduced the number of outages from an average 90 in the first three years of ownership to an average 61 in the most recent three years, representing a 32% decrease in the rolling average.

ITC Midwest

Serving most of Iowa, southern Minnesota, and parts of Illinois and Missouri

- ITC Midwest has reduced the average number of outages on its system by 59% since ITC acquired the assets in 2007, based on a rolling three year average. This comes as a result of system investments over the years and ITC's ongoing operations and maintenance program. The average outage reduction improved from the previous three-year rolling average of 49%. ITC Midwest has 6,600 circuit miles of line at voltages ranging from 34.5kV to 345kV.
    - **At voltages below 100kV** – the majority of the system – ITC Midwest has reduced the number of outages from an average 1,122 in the first three years of ownership to an average 456 in the most recent three years, representing a 59% decrease in the rolling average. The average outage reduction improved from the previous three-year rolling average of 50%. Approximately 68% of the circuit miles in ITC Midwest are below 100kV.
    - **At voltages of 100kV and above**, ITC Midwest has reduced the number of outages from an average 58 in the first three years of ownership to an average 28 in the most recent three years, representing a 52% decrease in the rolling average. The average outage reduction improved from the previous three-year rolling average of 43%.
        - Note: *The 59% overall outage reduction percentage for ITC Midwest is tabulated by combining the outage numbers of each voltage class (below 100kV and 100kV and above, treating ITC Midwest as one system), versus averaging the percentage decreases of the two systems (52% and 59%).*

Methodology

ITC compares the most recent three-year rolling average number of all system outages with the first three-year average number of outages under ITC ownership as data points. Fluctuation in outages from year-to-year is expected. ITC's methodology removes potentially misleading single-year distortions, such as those marked by heavier weather events. ITC believes this approach is the most meaningful way to illustrate outage reductions.

Definition of Outages

Two types of automatic outages comprise ITC's reliability data: momentary and sustained outages. A momentary, or transient outage, is generally under 60 seconds in duration and automatically restored with no human intervention. Reclosing schemes reenergize the affected circuit, usually after a fault clearing period and in an established order. A sustained circuit outage is one having a duration greater than 60 seconds and usually requiring human intervention to resolve.

Generally, transmission circuit outages do not equate to end-use customer outages.

Outages outside the control of ITC equipment and resources can be caused by other utilities, customer equipment, generation, instability or under-frequency, and distribution through-faults and are excluded from the statistics.

After an Outage

ITC tracks all momentary and sustained outages as well as customer restoration time after an outage, if applicable. Tracking and determining a cause for each event and any prudent follow up actions helps to reduce the occurrence of future outages. Restoring power quickly after an outage is one of ITC's core competencies and strategic advantages. A prudently designed and maintained transmission system is not impervious to all weather conditions.

National Benchmarking

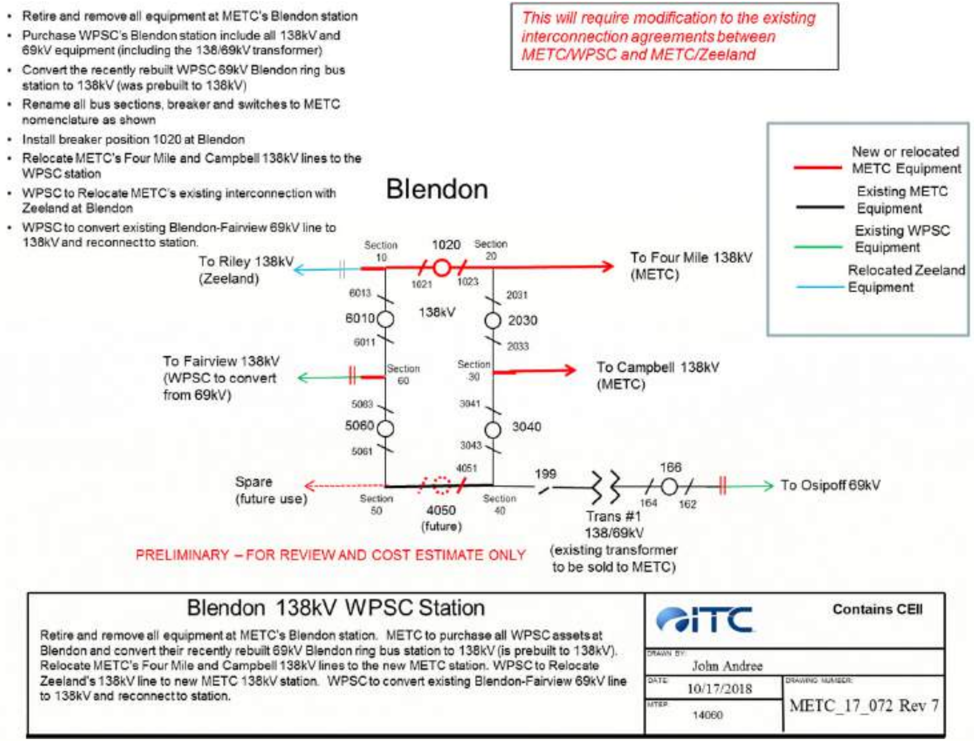
Each of ITC's high voltage transmission systems performed among the top 25% of utilities for reliability performance in the North American Transmission Forum (NATF) annual benchmark survey measuring sustained outages per circuit in 2017. The most recent NATF dataset covered 85 companies representing 74% of line miles at 100kV and above in the U.S. and Canada.

Revised June 2018

Blendon Interconnection

Blendon (MTEP18 id 14060, 2020)

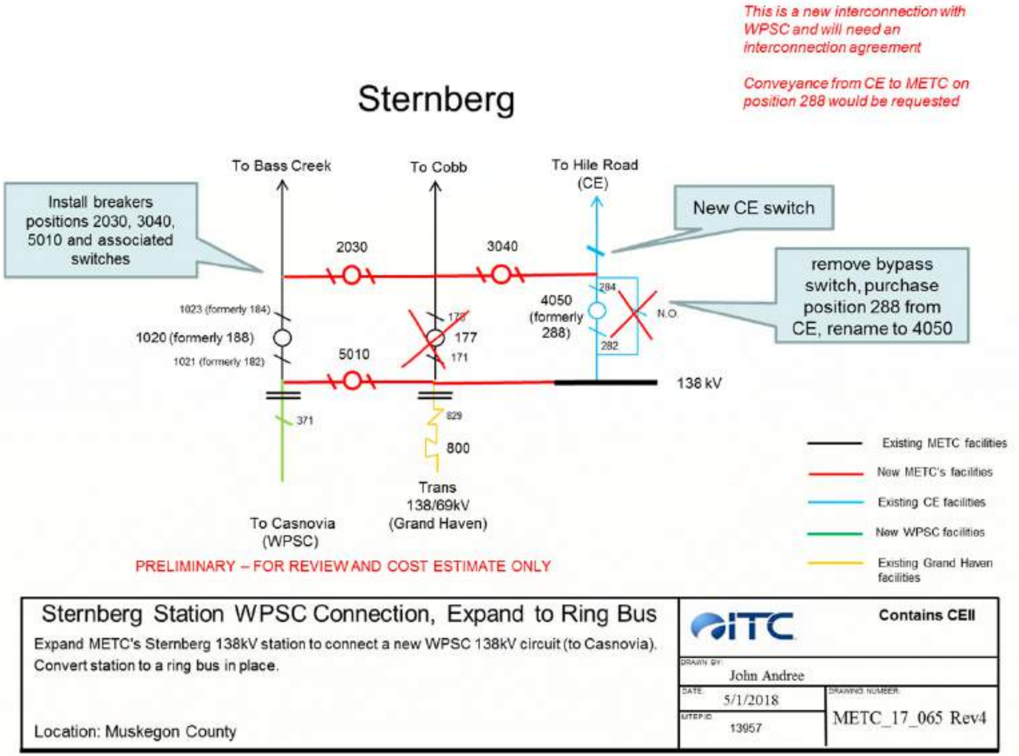
- Purchase WPSC's 69kV ring bus station, convert to 138kV
- Retire existing METC Blendon station.
- Reconnect all METC, Zeeland and WPSC lines to station (WPSC to covert Blendon-Fairview to 138kV)
- Brings extra 138kV source to Blendon
- Supports area post Grand Haven unit retirement.



Sternberg Interconnection

Sternberg (MTEP18 id 13957, 2020)

- Convert existing station to ring bus
- Connect converted 138kV WPSC line to Casnovia to Sternberg ring bus
- Improves Sternberg connection reliability to CE, WPSC and Grand Haven.



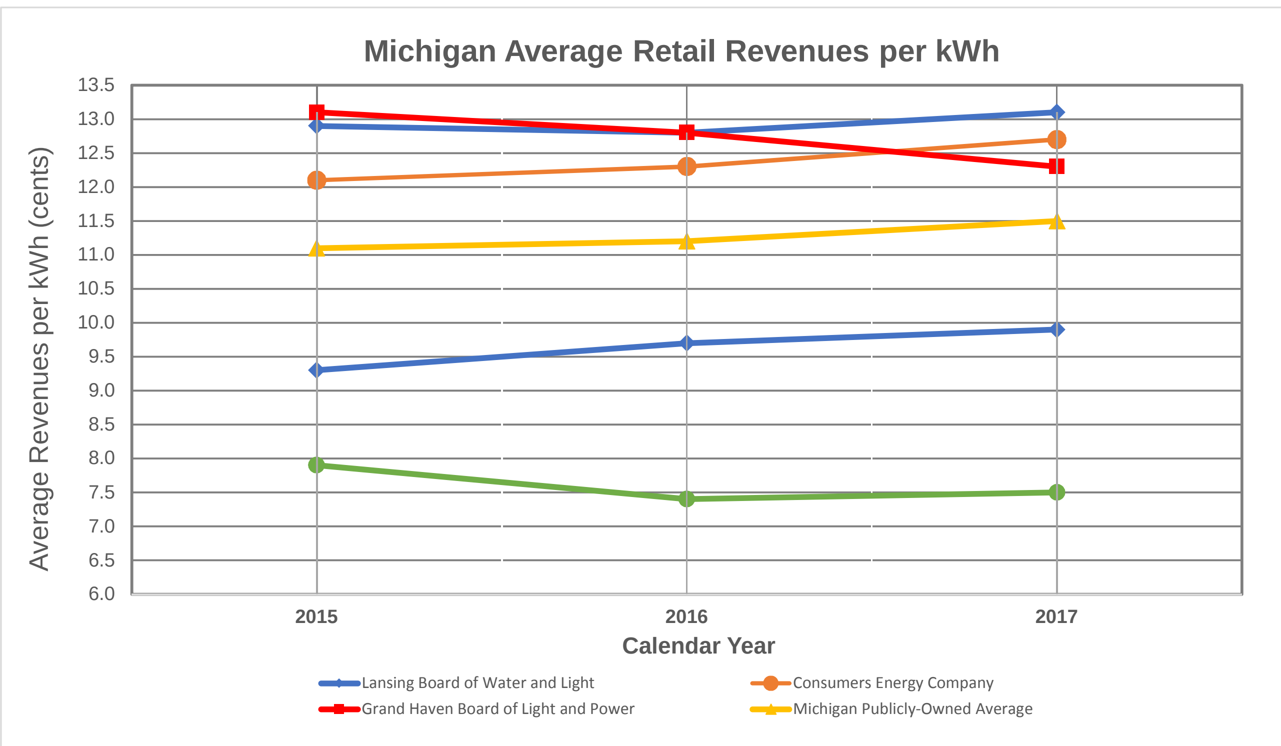
Average Revenue per kWh
(in cents)
Michigan

	Calendar Year **2015**	Calendar Year **2016**	Calendar Year **2017**
Lansing Board of Water and Light	12.9	12.8	13.1
Consumers Energy Company	12.1	12.3	12.7
Grand Haven Board of Light and Power	**13.1**	**12.8**	**12.3**
Michigan Publicly-Owned Average	11.1	11.2	11.5
Holland Board of Public Works	9.3	9.7	9.9
Zeeland Board of Public Works	7.9	7.4	7.5

Note: Average revenue per kilowatt-hour information was prepared by the Ameican Public Power Assoication (APPA) from data reported by each utility to U.S. Energy Information Administration (EIA) on Form EIA-861

Lansing is the largest municipal electric system in Michigan and represents approximately 29% of total publicly-owned retail sales
Holland is second largest municipal electric system in Michigan and represents approximately 15% of total publicly-owned retail sales
Ottawa County contains three municipal electric systems (Holland, Zeeland, and Grand Haven)
0.8 cent reduction in average revenues per kWh represents approximately $2.3 million dollars in the Grand Haven economy
Zeeland's average retail rate was the lowest overall in the State of Michigan in 2017
If GHBLP would have had Zeeland's average retail rate in 2017, GHBLP customers would have saved almost $14 million dollars in that year

GHBLP goal is to hold rates steady for next four years and **be below the Michigan Publicly-Owned Average in 2021**
(goal assumes Michigan publicly-owned average will increase 2% per year over this period)



Average Revenue per kWh, 2017
(in cents)
Michigan

	Residential Rev/kWh	Commercial Rev/kWh	Industrial Rev/kWh	Total Rev/kWh
Michigan				
Publicly Owned	13.8	12.4	9.0	11.5
Investor-Owned	15.6	11.3	7.4	11.8
Cooperative	14.8	11.0	8.6	12.7

Michigan
Publicly Owned

Baraga, Village of	13.1	12.6	-	12.7
Bay City, City of	13.1	12.4	10.8	12.4
Coldwater Board of Public Utilities	12.4	10.5	8.0	8.8
Crystal Falls, City of	15.9	13.8	-	14.8
Escanaba, City of	11.6	9.4	8.1	9.4
Gladstone, City of	13.0	11.4	-	12.3
Grand Haven Board of Light & Power	14.0	12.8	10.9	12.3
Hillsdale Board of Public Utilities	14.0	11.7	9.2	11.6
Holland Board of Public Works	12.4	10.8	8.8	9.9
L'Anse, Village of	14.5	13.0	-	13.6
Lansing Board of Water & Light	14.8	13.0	10.6	13.1
Marquette Board of Light & Power	17.1	15.6	-	16.1
Marshall, City of	13.2	11.8	10.3	11.5
Negaunee Dept. of Public Works, City of	17.6	13.4	-	15.6
Niles Utilities Department	11.7	12.0	8.6	11.0
Norway, City of	15.0	13.4	-	14.3
Petoskey, City of	11.3	9.9	11.5	10.3
South Haven, City of	13.6	11.7	8.9	11.8
Sturgis, City of	13.9	16.1	10.4	12.1
Traverse City Light & Power	10.8	10.7	7.8	9.6
Wyandotte Municipal Services	14.7	12.4	8.5	11.1
Zeeland Board of Public Works	8.6	8.6	7.0	7.5

Michigan
Investor-Owned

Alpena Power Co	13.9	11.9	6.2	9.7
Consumers Energy Co	15.9	12.7	8.2	12.7
DTE Electric Company	15.5	10.3	6.7	11.3
Indiana Michigan Power Co	11.3	10.2	8.6	10.2
Northern States Power Co - Wisconsin	12.6	11.7	7.4	11.2
Upper Michigan Energy Resources Corp.	14.8	14.2	6.7	11.3

	Residential Rev/kWh	Commercial Rev/kWh	Industrial Rev/kWh	Total Rev/kWh
Upper Peninsula Power Company	24.3	17.0	6.7	14.8
Wisconsin Electric Power Co	-	-	5.8	5.8

Michigan
Cooperative

Alger-Delta Coop Electric Assn	20.6	15.6	13.2	17.8
Bayfield Electric Coop, Inc	29.4	-	-	29.4
Cherryland Electric Coop Inc	13.9	10.5	13.7	12.9
Cloverland Electric Co-op	12.8	10.5	8.2	10.8
Great Lakes Energy Coop	15.1	13.0	8.2	12.8
Midwest Energy Cooperative	15.6	9.9	-	12.6
Ontonagon County R E A	NA	NA	NA	25.5
Presque Isle Elec & Gas Coop	16.2	11.1	11.5	14.7
Thumb Electric Coop of Mich	13.3	10.6	-	12.7
Tri-County Electric Coop	14.4	15.1	9.4	13.3

Michigan
Publicly Owned - Small Utilities

	Total Rev/kWh
Charlevoix, City of	11.1
Chelsea Light and Power	8.5
Clinton, Village of	9.9
Croswell Municipal Light & Power Dept.	9.7
Daggett Electric Department	9.7
Dowagiac, City of	12.3
Eaton Rapids, City of	9.3
Harbor Springs, City of	9.0
Hart, City of	10.5
Lowell Light & Power	11.2
Newberry Water and Light Board	14.6
Paw Paw, Village of	9.8
Portland, City of	10.9
Sebewaing Light & Water	9.6
St. Louis, City of	10.3
Stephenson, City of	11.5
Union City Electric Department	12.9
Wakefield, City of	10.6

Source: U.S. Department of Energy, Energy Information Administration, Form EIA-861, 2017 data.
Prepared October 2018 by the American Public Power Association, Regulatory Affairs Department.
Revenue per kilowatt hour data represent full-service sales only.
See final tab, "Unbundled Sales," for unbundled rates.

* Note: State revenue per kilowatt-hour totals include only utilities that report data on Form EIA-861, long form.

		2015 Sales				2017 Rev per kWh	
1	Lansing	2,126,192	29.1%			12.9	
2	Holland	1,061,445	14.6%	Largest Two Municipal Systems	43.7%	9.3	
3	Coldwater	400,527	5.5%			8.8	
4	Zeeland	361,466	5.0%			7.5	
5	Bay City	318,810	4.4%			12.4	11.4 Weighted Average
6	Traverse City	314,874	4.3%	**Eight Larger Municipal Systems**	**34.2%**	9.6	**Approx. 78%**
7	Marquette	297,863	4.1%			16.1	
8	Grand Haven	290,217	4.0%			12.3	
9	Wyandotte	290,088	4.0%			11.1	
10	Sturgis	218,705	3.0%			11.4	
11	South Haven	139,834	1.9%				
12	Escanaba	139,569	1.9%				
13	Niles	127,092	1.7%				
14	Hillsdale	121,037	1.7%				
15	Marshall	105,691	1.4%				
16	Petoskey	101,628	1.4%				
17	Chelsea	96,515	1.3%				
18	Eaton Rapids	94,779	1.3%	**Next Fifteen Municipal Systems**	**17.8%**		
19	Lowell	75,753	1.0%				
20	Dowagiac	65,496	0.9%				
21	Charlevoix	59,944	0.8%				
22	Hart	45,288	0.6%				
23	Sebewaing	45,190	0.6%				
24	Paw Paw	42,821	0.6%				
25	St. Louis	40,112	0.5%				
26	Croswell	39,865	0.5%		**22.1%**		
27	Harbor Springs	38,218	0.5%				
28	Portland	34,363	0.5%				
29	Galdstone	30,947	0.4%				
30	Norway	24,496	0.3%				
31	Clinton	24,032	0.3%				
32	Negaunee	21,795	0.3%				
33	Baraga	18,340	0.3%	**Fifteen Smallest Municipal Systems**	**4.3%**		
34	Newberry	18,252	0.3%				
35	Crystal Falls	16,305	0.2%				
36	Union City	15,211	0.2%				
37	Wakefield	12,710	0.2%				
38	L'Anse	11,609	0.2%				
39	Stephenson	6,063	0.1%				
40	Dagget	1,657	0.0%				
		7,294,799	100.0%				

Repowering & Renewing Harbor Island

A Strategic Approach to Power Plant Decommissioning, Utility Infrastructure Upgrades, Brownfield Cleanup & Green Space Revitalization

The City of Grand Haven and Grand Haven Board of Light & Power (GHBLP) will be working together to plan the decommissioning and replacement of the coal-fired J.B. Sims Generating Station on Harbor Island, as well as decommissioning and redevelopment of the obsolete Grand Haven Diesel Plant (GHDP) on the downtown waterfront. GHBLP is proposing to replace Sims' generating capacity by constructing a 35MW natural gas-powered RICE facility and a new heat source dedicated to providing hot water for the downtown snowmelt system. Grand Haven will be conducting environmental assessments and cleanup on the Sims site and will be developing plans for a "buffer" zone around the facility, with a focus on green space, and potentially park expansion. The Sims site, and Harbor Island generally, is part of the greater regional "Grand River Greenway" project. Resources that could potentially support this Harbor Island effort include:

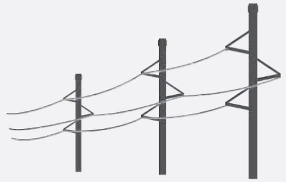
OBJECTIVE	NEXT STEPS	FUNDING SOURCE(S)
Decommission Old Plants: Decommission Sims Generating Station & Grand Haven Diesel Plant.	Execute Sims decommissioning plan with 2020 target closure date. Investigate potential for Diesel Plant redevelopment and reuse.	Budgeted GHBLP funds, with potential support from Michigan Economic Development Corporation.
New Power Plant: Replace some of the lost power generating capacity for GHBLP service territory.	Design, engineer & construct new 35MW natural gas-powered RICE generating facility.	Financed through proceeds from utility bond issue.
Snowmelt System: Support Downtown Snowmelt System and Potential Future Expansion	Design, engineer & construct a new heat source, potentially with expandable capacity, to produce hot water for the snowmelt system.	Seek $1.25M U.S. Economic Development Administration (EDA) Public Works grant, with 50% local match.
Environmental Assessments, Cleanup & Reuse Planning: Resolve environmental contamination issues on Harbor Island to protect public health & the environment, and support future reuse.	Conduct brownfield assessments and cleanup related to coal ponds and legacy municipal landfill on Harbor Island, and plan for remediation and future reuse.	Seek $100,000 U.S. Environmental Protection Agency (EPA) Targeted Brownfield Assessment from EPA Region 5. Can also seek $200,000 EPA Brownfield Assessment grant. When environmental assessments are complete, seek $500,000 EPA Brownfields Cleanup grant, $800,000 EPA Brownfields Cleanup Revolving Loan Fund grant, and/or EPA Great Lakes Restoration grant.
Green Space Revitalization: Create a buffer zone around new plant on the Sims site for greenspace, wetlands or other purposes consistent with community priorities.	Secure funds for community-based reuse planning & design process.	Seek EDA Local Technical Assistance Grant for reuse planning; Land & Water Conservation Fund, and/or NFWF Sustain Our Great Lakes grants.

WOLVERINE POWER COOPERATIVE

Transmission Grid Modernization = High Reliability

Sam Hogg
Director of Business Origination

About Wolverine



1,600 Mile
Transmission Network

1,200 MW
Generation

$760M
In Assets

WOLVERINE
POWER COOPERATIVE

Primary mission:
Provide reliable, cost-competitive power to our members.

Wolverine believes a robust transmission network achieves both mission objectives:

1. Keeps the lights on under extreme conditions.

2. Allows broad access to competitive power markets.

Wolverine's Modern Transmission Structure

- Taller, stronger poles
- Bigger conductors
- Bigger insulators

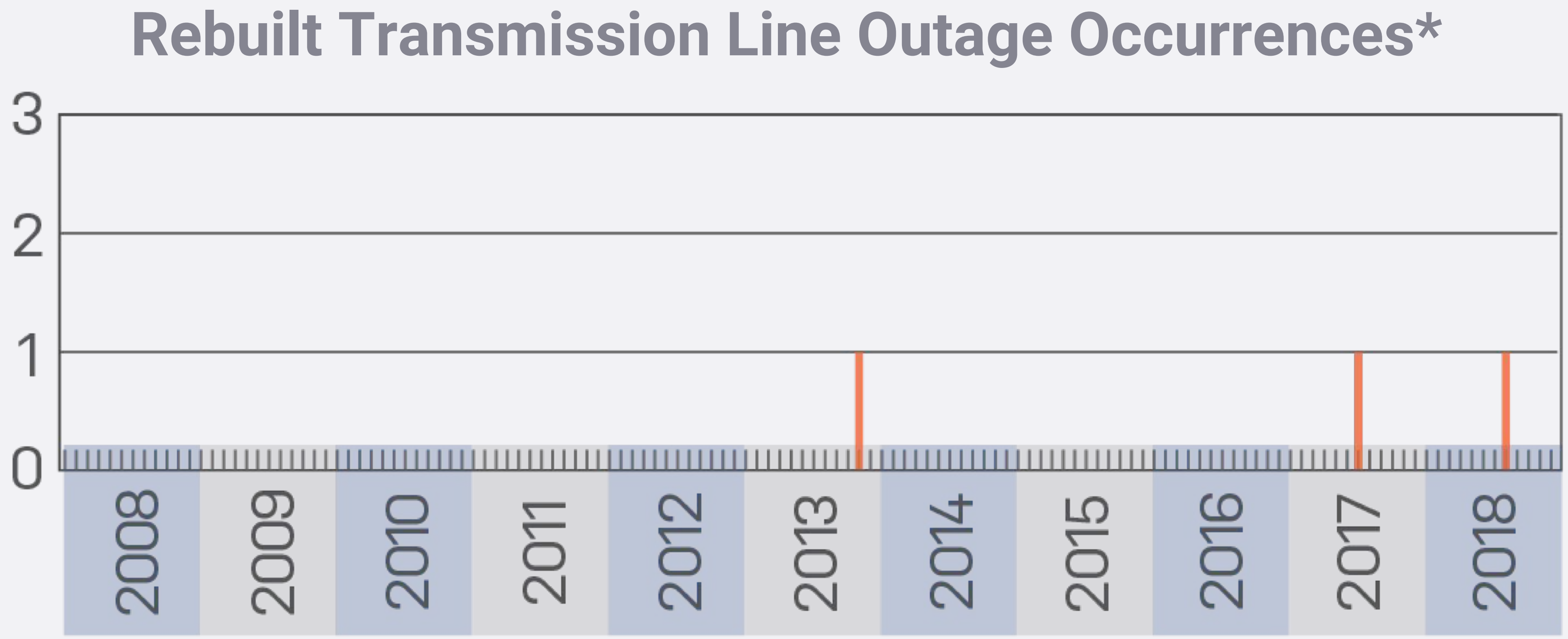
WOLVERINE POWER COOPERATIVE

Wolverine's Transmission Network Upgrades

1,200 miles rebuilt by 2023.

Majority of transmission in GHBLP service area will complete rebuilds in 2019.

Wolverine's Rebuilt Transmission is Highly Reliable



*Sustained line outages lasting longer than 5 minutes

WOLVERINE POWER COOPERATIVE


August 28, 2018
Storm in Lake County passes
through Wolverine Transmission.
The network withstood
the storm without
incident.

Wolverine's Transmission
Fast Facts

- Wolverine Power Cooperative's current MISO-submitted plans call for a rebuild of 1,200 transmission miles by 2023.
- Planned transmission upgrades represent nearly half a billion dollars in capital investment.
- Specifically in response to planned generation retirements, Wolverine will complete rebuilding the majority of the transmission in the GHBLP service area in 2019.
- Modern standard transmission rebuilds are taller and stronger with no cross arms, and upgrades voltage to 138kV.
- In the last ten years, Wolverine's modern rebuilt transmission experienced only three sustained outages (outages lasting longer than five minutes).

For More Information

Contact Information

10125 W. Watergate Rd.

Cadillac, MI 49601

231-775-5700

Wolverinepowercooperative.com

APPENDIX E – SOLAR-ENERGY STORAGE RESILIENCY STUDY

December 14, 2018

Mr. Erik Booth, P.E.
Power Supply Manager
Grand Haven Board of Light & Power
1700 Eaton Drive
Grand Haven, MI 49417

Re: Solar-Energy Storage Resiliency Study

Dear Mr. Booth,

As part of the Power Supply Plan, Grand Haven Board of Light & Power ("GHBLP") requested that Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") conduct an evaluation of GHBLP's ability to meet customer demand in the event of large-scale electric grid failure. This was requested due to feedback received during the public forums. The current power supply planning efforts aim to determine a preferred path for GHBLP's future power supply. Throughout the planning process, concerns have been raised regarding the resiliency of GHBLP's power supply in the wake of a large grid outage caused by an electromagnetic pulse ("EMP") or other terrorist attack event. While there are currently no industry standards to prepare for such a catastrophic event, the objective of the solar-energy storage resiliency study was to meet GHBLP's average load during a terrorist attack event while natural gas fuel supplies would not be available for delivery.

The analysis focused on determining the amount of solar photovoltaic ("solar") generation and battery storage ("storage") that would need to be built on the GHBLP system to provide reliable electric service to GHBLP customers in the event of grid failure and disruptions in natural gas supply. The pairing of solar generation and battery storage would allow GHBLP to generate and store electricity to meet customer demand. To achieve the goal of meeting electrical demand following an EMP event, the evaluation must focus on meeting customer requirements in the month with the least amount of solar generation (winter months in the northern hemisphere). In Michigan, the month of December typically has the least amount of solar generation, and thus was the target month of this analysis. In 2017, GHBLP load in December was smaller than the annual average load (4 percent smaller than the annual average). Designing this system to meet December electrical demand will safeguard that the utility would be able to meet customer load over the remaining months of the year.

Assumptions

The following assumptions were used in this analysis:

- Typical Meteorological Year ("TMY") data from the National Solar Radiation Database ("NSRDB"), specifically data from the TMY3 station at the Muskegon County Airport
- GHBLP's 2017 hourly load profile
- The solar system had fixed panels with an azimuth of 172 degrees and a tilt of 34 degrees
- The solar system had an annual capacity factor of 19.04 percent

- In the month of December, the solar system had a capacity factor of 8.48 percent
- Installed solar photovoltaic ("PV") panel costs were assumed to be $1 per watt ("W") per industry averages
- Installed battery storage costs were assumed to be $400 per kilowatt-hour ("kWh") per industry averages
- The battery storage system was assumed to be fully charged upon installation
- Battery storage system was assumed to have a round-trip efficiency of 90 percent
- 7.5 acres of land per megawatt ("MW") of installed PV panels
- Land costs were assumed to be $5,000 per acre
- Costs associated with upgrading the distribution system, device hardening, microgrid costs were not included
- Life-cycle costs related to operations and maintenance, battery degradation, inverter replacement, property taxes, insurance, and other recurring expenses were not included
- Solar generation was assumed to first meet GHBLP customer load, then excess energy was used to charge the on-system batteries

Analysis

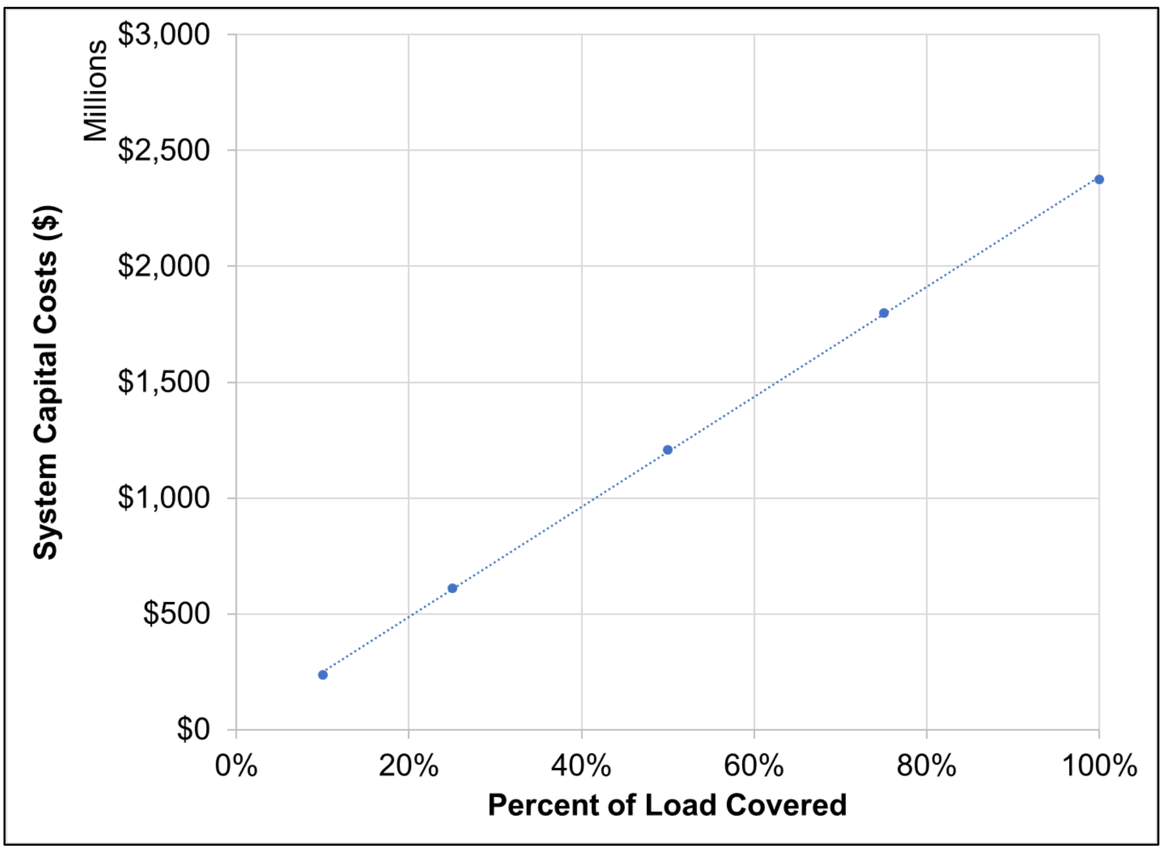
Based on modeling of GHBLP's load profile and an expected solar generation profile, approximately 1.036 gigawatt ("GW") of solar panels along with a 3.257 gigawatt-hour ("GWh") battery storage system would be required to meet 100 percent of GHBLP's load in a typical December month. The capital cost of this system would be over $2.37 billion and require over 7,700 acres (12 square miles) of land, which is an area over twice the land area of the City of Grand Haven. As previously stated, this cost estimate does not include costs associated with upgrading distribution system assets, installing a microgrid capable of isolating GHBLP from the electric grid, or costs associated with hardening system equipment from a potential EMP attack. If the distribution system is not designed to withstand an EMP attack, power generated by these resources will not be deliverable to end use customers.

In the event of an EMP attack, any electrical equipment that does not have electromagnetic shielding would be rendered inoperative. Due to the prohibitive cost of hardening consumer electrical equipment, a large portion of electric load would disappear after an EMP attack. Due to this, sensitivities on the proportion of annual load served were performed as part of this analysis. At each level of load coverage, the system capital costs were minimized using a Generalized Reduced Gradient ("GRG") nonlinear solver. This method finds the optimal combination of PV system size and battery storage size to cover GHBLP electric load while minimizing costs. Table 1-1 includes the solar system size, battery storage system size, and overall system capital costs. Figure 1-1 shows the system capital costs as a function of load coverage.

Table 1-1: Load Coverage Sensitivity

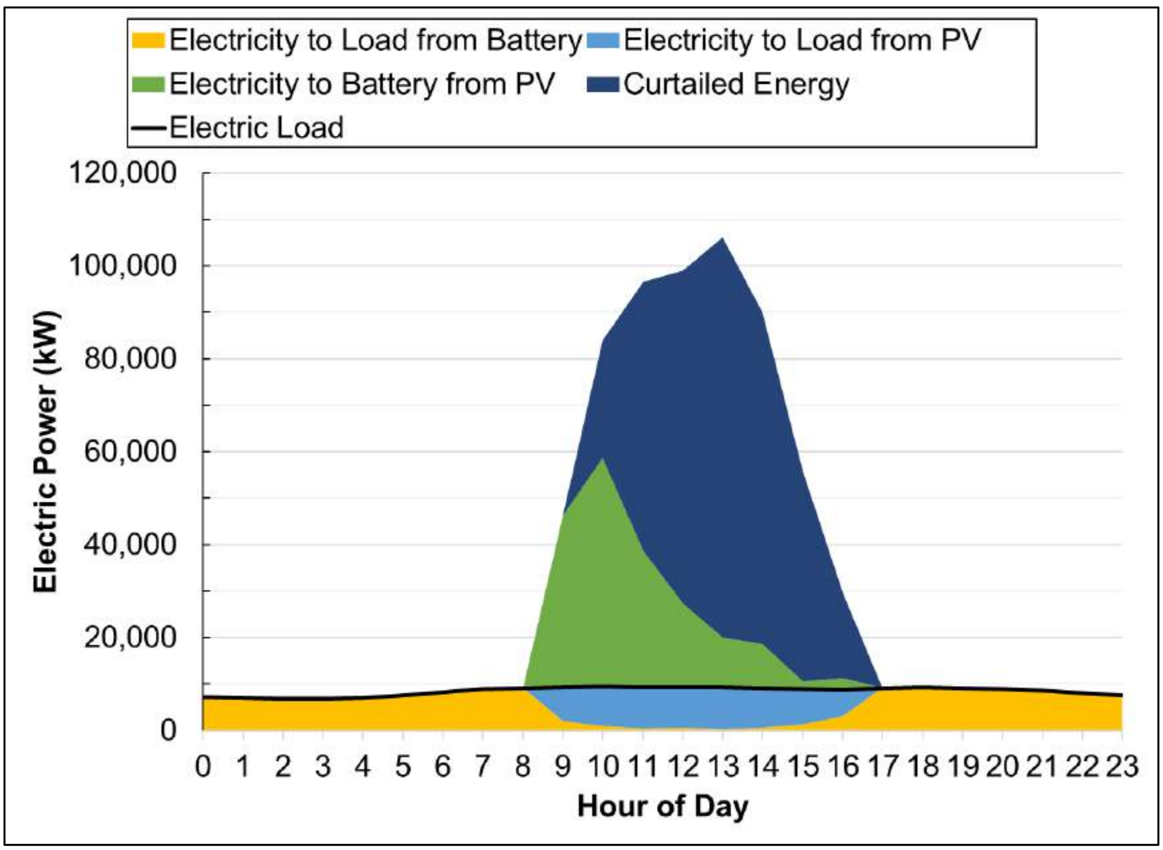
Load Coverage Sensitivity				
Percent of Load Covered	Solar PV System Size (kW)	Land Requirement (acres)	Battery Storage System Size (kWh)	System Capital Costs ($Million)
10%	94,000	700	346,000	$236,000,000
25%	294,000	2,200	764,000	$611,000,000
50%	569,000	4,300	1,549,000	$1,210,000,000
75%	827,000	6,200	2,355,000	$1,800,000,000
100%	1,036,000	7,800	3,257,000	$2,377,000,000

Figure 1-1: Load Coverage versus System Costs



As presented in Figure 1-1, the incremental cost of covering each "block" of load becomes more expensive. This is due to the low capacity factor of solar generation in December (around 8 percent). This problem is best visualized below in Figure 1-2. Figure 1-2 shows the average hourly profile of the solar and battery system operation for 25 percent load coverage. It is important to note there are hours where the batteries are supplying energy and solar generation is curtailed. This is due to the profile being an average of the entire month of December; an overcast day in December would require energy from the batteries, while an extremely sunny day could curtail energy if the batteries are fully charged. Enough solar capacity must be built to fully charge the system's batteries and meet GHBLP load during the eight hours of sunlight. This requires the system to be "overbuilt" because energy must be "banked" due to the large number of overcast days in December. The magnitude of overbuilding increases with higher load coverage.

Figure 1-2: Average December System Operation – 25 Percent Load Coverage



Conclusions

Assuming only 25 percent load coverage, approximately 294 MW of solar generation coupled with 764 MWh of battery storage would be required. A project of this magnitude would cost over $611 million ignoring any additional costs required to upgrade distribution assets, system hardening, or microgrid costs. Additionally, life-cycle costs related to operations and maintenance, battery degradation, inverter replacement, property taxes, insurance, and other recurring expenses were not included in this study, these costs would only increase the total cost associated with maintaining such a system. A point of reference, GHBLP's power supply costs plus capital to cover 100 percent of load over the last 10 years was approximately $207 million. Presently the largest lithium-ion battery installation is 129 MWh[1] (16.8 percent of GHBLP's potential requirement under an EMP attack scenario). A project of this magnitude is unprecedented, and the cost estimates of building a system of this size are highly speculative.

There are standards and policies in place from the North American Electric Reliability Council ("NERC") that both the transmission owners and grid operators must follow to harden the overall transmission system against threats. Furthermore, the Federal Government agencies such as the Department of Homeland Security, Federal Bureau of Investigation, and Central Intelligence Agency are charged with preventing terrorist attacks against the United States. GHBLP should focus its power supply planning efforts on providing low cost, reliable energy to its customers assuming access to the grid is available.

Based on this analysis, Burns & McDonnell would not recommend this as an appropriate power supply solution to serve Grand Haven's future electrical needs.

Sincerely,

Mike Borgstadt, P.E.
Project Manager

[1] https://www.tesla.com/blog/tesla-powerpack-enable-large-scale-sustainable-energy-south-australia?redirect=no

APPENDIX F – LOCAL SMALL-SCALE SOLAR EVALUATION

BURNS & McDONNELL

December 14, 2018

Mr. Erik Booth, P.E.
Power Supply Manager
Grand Haven Board of Light & Power
1700 Eaton Drive
Grand Haven, MI 49417

Re: Local Small-Scale Solar Evaluation

Dear Mr. Booth:

As part of the Power Supply Plan, Grand Haven Board of Light & Power ("GHBLP") requested that Burns & McDonnell Michigan, Inc. ("Burns & McDonnell") conduct an evaluation of a potential small-scale solar project on the GHBLP system. This analysis was performed for a small-scale solar project with a net capacity of five megawatts ("MW").

The analysis focused on determining the Levelized Cost of Capacity ("LCOC") of the project and comparing the resulting LCOC to options explored within the Power Supply Plan. For intermittent generation, the effective load carrying capability ("ELCC") is a measure of a resources ability to meet load-serving needs. The ELCC is equivalent to the amount of "accredited capacity" intermittent generation receives and was used in the calculation of LCOC. The ELCC is defined by the Midcontinent Independent System Operator, Inc. ("MISO" or "MISO Energy"), which is the independent transmission system operator within GHBLP area.

Assumptions

The following assumptions were used within the analysis:

- Typical Meteorological Year ("TMY") data from the National Solar Radiation Database ("NSRDB"), specifically data from the TMY3 station at the Muskegon County Airport
- The solar system had fixed panels with an azimuth of 172 degrees and a tilt of 34 degrees
- The solar system had an annual capacity factor of 19.04 percent
- Installed solar photovoltaic ("PV") panel costs were assumed to be $1.20 per watt AC ("W") per industry averages
- 7.5 acres of land per MW of installed PV panels
- Land costs were assumed to be $5,000 per acre
- Annual operating and maintenance costs were assumed to be $90,000 annually
- Inverter replacement was assumed to occur in year 10 with a cost of $280,000
- Total system costs were approximately $5.9 million
- Plant revenue requirements were calculated using a 20-year financing term with GHBLP's financing assumptions
- Investment Tax Credits were not included in this analysis as this facility was assumed to be owned locally by GHBLP (GHBLP is not eligible for tax credits being a non-profit organization).

BURNS McDONNELL

- Hourly system avoided costs were used from the "Low Gas/Low Capacity" sensitivity in the "Market Only" Power Supply Plan scenario
- Solar generation was assumed to have an ELCC of 50 percent per current MISO guidelines.

Analysis

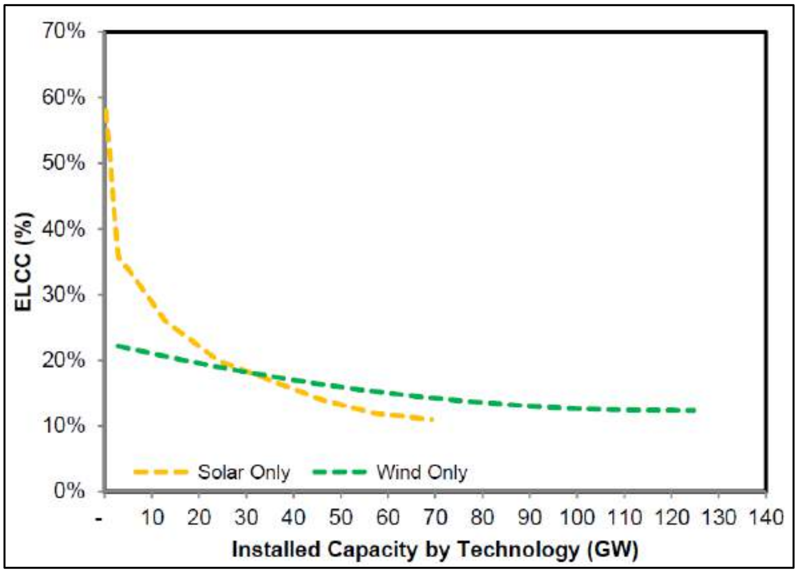
Based on modeling an expected solar production profile and GHBLP avoided costs, a 5 MW small-scale solar plant on GHBLP's system would have an LCOC of approximately $104 per kilowatt-year ("kW-year"). This is in comparison to the LCOC of $137 per kW-year for the 36 MW reciprocating engine plant in the Power Supply Plan.

It is important to note the LCOC is heavily dependent on the ELCC assumption used in the analysis. Presently, solar generation in MISO has an ELCC of 50 percent. As the amount of solar generation within MISO increases, the ELCC declines. A figure of this effect is included below in Figure 1. Figure 2 includes the LCOC for the small-scale solar project and for GHBLP's existing solar power purchase agreement ("PPA") over varying levels of ELCC. MISO currently has approximately 300 MW of solar installed and over 35 gigawatts of solar generation in the generation interconnection ("GI") queue[1]. It should be noted that not all of the projects in the GI queue will be constructed, but this dictates that ELCC for solar resources in MISO will inevitably decline in the future.

---

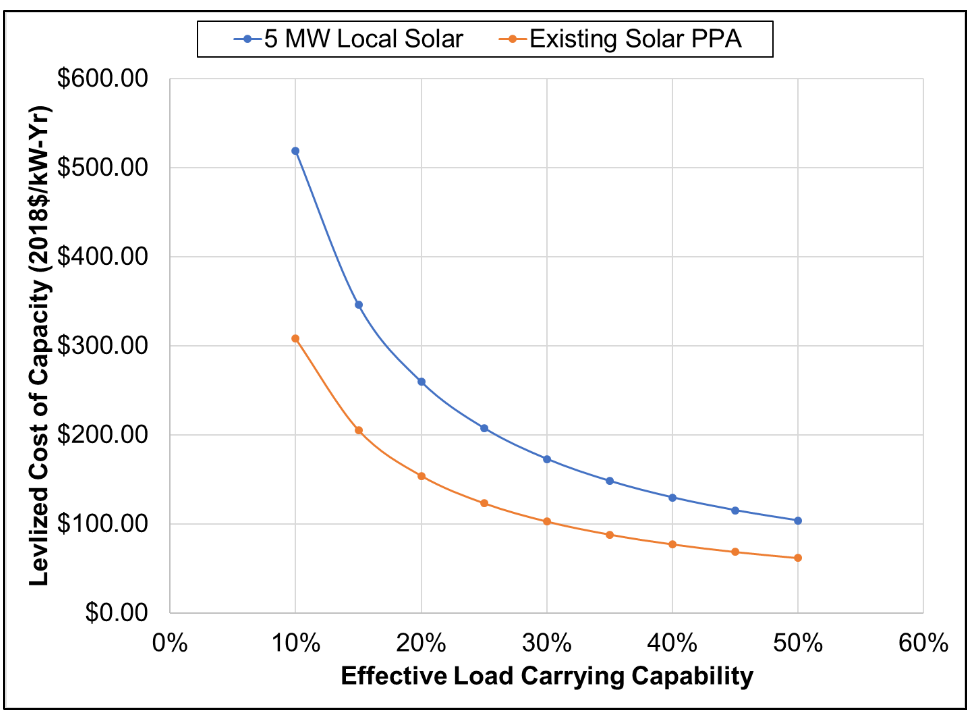
[1] https://www.rtoinsider.com/miso-solar-capacity-elcc-99713/

Figure 1: Effective Load Carrying Capability (ELCC) versus Installed Capacity



Source: MISO Renewable Integration Impact Assessment

Figure 2: Five (5) MW Local Solar LCOC versus ELCC



Notice that GHBLP's existing Solar PPA is approximately 30 percent lower than the LCOC of a 5 MW solar installation. This is roughly equal to the 30 percent Investment Tax Credit available to third-party developers and illustrates the relatively high "premium" associated with GHBLP financing a solar installation under the existing tax codes. As with the small-scale solar project, the LCOC of the existing Solar PPA is heavily dependent on the ELCC.

Conclusions

As part of the Power Supply Plan, three of the four paths evaluated included market capacity purchases from MISO. The results of this analysis show a small-scale solar installation would come with a high premium over other large-scale power purchase agreements with entities that can take advantage of the Investment Tax Credits. A more attractive approach if GHBLP desires to pursue a local solar project would be through a local, small-scale community solar installation that could complement the installation of a 36-MW reciprocating engine project within the overall power supply portfolio. This option would provide GHBLP the opportunity to provide a local solar component that could be expanded based on the level of participation. A community solar project would likely have even more competitive pricing as the participants could be eligible for Investment Tax Credits.

Lastly however, Burns & McDonnell recommends that GHBLP should first determine a power supply plan with respect to the local, natural gas-fired resource and then evaluate local solar as part of that plan; a local solar project should not be a guiding factor in deciding a power supply path forward. The reciprocating engine plant is sized appropriately within Path 2 to provide GHBLP the ability to add additional renewables, or other power supply resources, to the portfolio to meet energy and capacity requirements. Additionally, starting with a small, local community solar facility would allow GHBLP to gain further experience and also allow for future expansion if desired by the community.

Sincerely,

Mike Borgstadt, P.E.
Project Manager

BURNS & McDONNELL

CREATE AMAZING.

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