Lansing Board of Water and Light

2008 Integrated Resource Plan Update

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May 13, 2008

INTEGRATED RESOURCE PLAN UPDATE 2008

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Executive Summary

Introduction

In May of 2006, the BWL released its second integrated resource plan (IRP). The 2006 IRP was based on data through 2005 and examined the BWL's need for additional electric generating resources given the advanced age and the increasing difficulty of meeting air emissions regulations at the Eckert plant. The 2006 IRP recommended that the BWL "further evaluate the option of adding some new generating facilities over the next 10 years." This IRP follows up on that 2006 recommendation and also recognizes the unexpected strong increases in energy growth recently experienced by the BWL and the rapid changes occurring in the electric utility industry. These changes, along with additional information regarding the potential cost of maintaining the Eckert units, prompted staff to undertake this IRP update.

The overall goal of comprehensive electric energy planning is to assure that the BWL will have sufficient resources over the planning horizon to provide its customers with safe, reliable power at affordable rates while managing future risks and uncertainty. A reliable, affordable source of electric generation is essential to the economic vitality and welfare of the Lansing community. Electricity played a major role in development of manufacturing facilities that fueled Lansing's economic progress in the 20th century. Today, electricity continues to fuel the region's economic growth. Major data centers, financial firms, and other new service industry participants as well as traditional industrial customers make up Lansing's evolving twenty-first century economy. The recent sale of the BWL's Ottawa Street Generating Station exemplifies Lansing's economic transformation. Originally constructed to supply electric energy to Lansing's growing manufacturing economy in the 1940s and 1950s, it will soon be the home of the Accident Fund Insurance Company of America. Firms of the 21st century rely more than ever on a reliable and competitively priced supply of electric power. Major data centers can consume nearly as much electricity as an automobile assembly plant and new uses for electricity that could not have been anticipated even 15 or 20 years ago, like cell phones, plasma televisions, iPods, also contribute to the need for a growing and reliable supply of electricity. Although annual growth of electric use today is far from the 5 to 10% figure experienced in the 1940s and 1950s as Lansing's manufacturing base grew, growth continues at a modest rate. For example, the BWL’s annual electric sales growth was an unexpectedly rapid 4% in 2007 over 2006, despite a continued sluggish economy in the mid-Michigan region. By contrast, our long-term energy sales growth forecast is 1.4% annually.

IRP Methodology

This integrated resource plan update represents a comprehensive planning process, evaluating a broad set of resource options while analyzing future risks and uncertainties.

Extensive modeling served as the foundation for the plan’s recommendations. Modeling began with development of a Base Case, which encompassed forecasts of demand and energy growth, fuel price escalation rates, resource costs, air emission regulatory compliance costs, wholesale market prices and other important factors. Several sensitivities and scenarios that incorporate additional resource options, like energy efficiency, and that adopt alternate forecasts for important modeling variables, such as high fuel costs or low demand growth, were also developed and analyzed. In total, 37 separate scenarios and sensitivities were examined, and each one created over 1,000 possible future resource plans to meet the BWL’s generating requirements. From among all the plans produced by each scenario and sensitivity was a least-cost plan. Analyzing the resources in common among the least-cost plans from each scenario and sensitivity provides planners with valuable information on which resources can assure both affordable rates and minimize exposure to future risks. This best set of resources served as the basis for staff’s recommendation in this IRP.

Ventyx, a widely recognized energy consulting firm, was retained to perform the modeling for the plan. The Firm used its Strategist model, a powerful dynamic programming model, as its principal analytical tool. The Strategist model analyzed thousands of potential resource plans over a twenty-year period to identify the least cost plan for each scenario and sensitivity.

The planning process involved four steps:

1. (1) Determine the BWL's future resource requirements through a long-term forecast of the BWL's annual peak demand and energy sales, and an assessment of whether the BWL's generating assets can meet the future requirements
2. (2) Compile an inventory of resource options that can be used to meet future generating needs
3. (3) Develop scenarios and sensitivities to evaluate future risks and uncertainties, and perform electric generation modeling
4. (4) Recommend a resource plan to meet future BWL electric generating needs

Determine the BWL's Future Resource Requirements

For modeling purposes, we have adopted a 14% planning reserve margin. This margin has been adopted by the Planning Reserve Sharing Group (PSRG) as the planning reserve margin required for electric reliability in this region of the country.[1] All members of the PSRG, which includes the BWL, are required to maintain this reserve margin. The need to maintain this reserve margin, together with a long-term annual energy growth rate of 1.4% and a peak growth rate of 1.6% cause the BWL to need additional short-term generating capacity in 2016. Additional longer-term generating capacity is required to maintain electric reliability and stable electricity prices with the retirement of the Eckert Generating Station units, beginning in 2017.

The BWL's inventory of generating resources includes six units at the Eckert plant totaling 350 MW's of capacity, the Erickson generating station with 165 MW's of generating capacity, 150 MW's of capacity from Detroit Edison's Belle River generating station, and approximately 26 MW's of renewable energy and black start capacity owned or controlled by the BWL. The older Eckert units are now over a half-century in age and are operationally inefficient. These units were originally expected to be in service for 40 years, but have continued to serve the BWL long after their intended service lives. However, rising operation and maintenance costs along with the expense of complying with air emissions regulations have caused us to assume that units 1-3 will be removed from service in 2017. We have also assumed that units 4-6 will require

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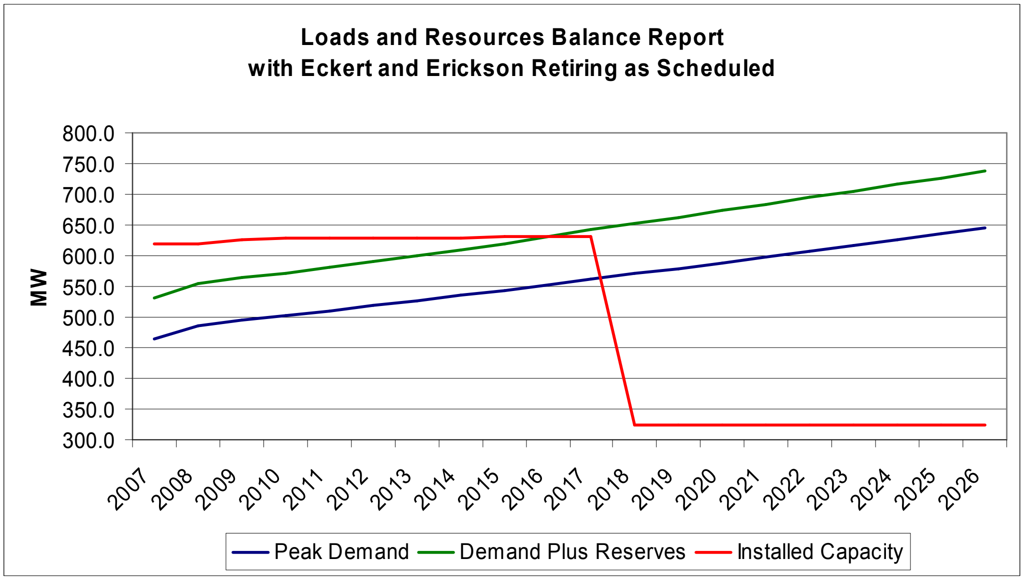
[1] The PSRG was created to meet Reliability First Standard Bal-502-RFC-01 and is administered by the Midwest Independent System Operator (MISO).

approximately $260 million (2007 dollars) in environmental investments by 2017 to remain in service.

The BWL's future needs are shown in Figure 1 below. From this chart, it is evident that additional generating capacity will be required beginning in 2016, when the BWL's generating capacity is expected to fall below required reserves.

Figure ES1 – Loads and Resources Balance Report



Compile Resource Options

To meet future needs, the BWL could construct a traditional central station generating plant, undertake energy efficiency and load management programs, acquire additional renewable energy, purchase capacity from the Midwest wholesale market, or acquire any combination of these options. For this study, we have undertaken a major modeling effort to forecast both capacity and energy prices in the Midwest wholesale market. Purchasing from this market is one alternative strategy to constructing generation. We have included all these options in this IRP in order to determine which set of resources best meets future BWL resource needs.

Develop Scenarios and Sensitivities

In order to investigate the cost and risk tradeoffs among various resource options, the staff developed several scenarios and sensitivities. The scenarios and sensitivities were intended to evaluate risks associated with (a) demand growth, (b) air emissions costs, (c) construction cost escalation, and (d) natural gas price escalation. We also included a scenario in which we assumed that other municipal utilities might partner with the BWL in a new generating plant. This type of partnership lowers the cost and risk of new plant construction for the BWL's customers. To accomplish this scenario, we have added hypothetical municipal loads and resources to the BWL's loads and resources. Scenarios were also included to estimate the impact of future greenhouse gas (GHG) regulations on the BWL and the cost of relying on market purchases of capacity and energy to meet future BWL generation needs.

The results of the scenarios and sensitivities indicate that energy efficiency options can lower the total cost of meeting generation needs. Numerous modeling efforts performed in Michigan have demonstrated the important role that this option can play in meeting customer needs and managing future risks.

All scenarios and sensitivities select additional baseload generation as the least cost method of replacing the Eckert plant. Reliance on natural gas generation results in costs that are more than 5%, or $120,000,000, higher than the baseload option over a twenty year period on a present value basis. This amount, however, masks the much larger cost differential that occurs after 2017. Because the higher cost of natural gas generation doesn't occur until after 2017, when a new unit is needed, the present value calculation makes the higher cost of natural gas generation appear more modest than it will actually be in those later years.

If the BWL does nothing and relies on market purchases of capacity and energy, the cost would be 15%, or $341,486,000, higher than building a baseload replacement for Eckert, over a twenty year period on a present value basis. As with the natural gas option, this present value number masks the larger cost impact of reliance on market purchases after 2017. In 2018, for example, the cost of relying on wholesale market purchases is projected to be 34% higher than constructing a baseload replacement for the Eckert units.

All scenarios and sensitivities, except one, include a greenhouse gas (GHG) tax beginning in 2013. Although it is difficult to predict the exact outcome of current GHG legislative initiatives, proposed federal legislation as well as Governor Granholm's support for GHG controls through the Michigan Climate Action Council make it likely that some form of GHG controls will be imposed within the planning horizon. Since the largest volume of greenhouse gas is emitted as CO_2, and electric generating plants comprise the largest stationary source of CO_2 in Michigan, it is prudent for the BWL to plan for this contingency. Carbon comprises approximately 70% of the coal burned in the BWL's generating stations.[2] Therefore, the impact of a GHG tax on the BWL could be substantial.

For comparison purposes, the analysis included one model run comprising all Base Case, conditions except no GHG tax was assumed to be imposed for CO_2 emissions during the planning period. The twenty-year present value revenue requirements of the no-GHG tax scenario was nearly $1 billion, or 55%, less than the Base Case with a GHG tax. While it is impossible to determine the precise financial impact of future GHG legislation on the BWL at this time, it is, perhaps, the most important planning contingency facing the BWL and the electric industry today.

Major Findings

- Annual electric energy growth is forecast to be approximately 1.4% annually
- Annual peak electric demand is forecast to be approximately 1.6% annually
- The BWL's resources are presently sufficient to maintain reliability and provide competitively priced electricity
- Additional electric generating capacity will be needed in 2016 to meet reliability requirements
- Total costs are lowest when energy efficiency programs are added to the resource mix
- All scenarios and sensitivities select new baseload construction with the retirement of the Eckert units
- It is not cost-effective to undertake a large investment program to keep Eckert units 4-6 in operation after 2017

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[2] On a dry weight basis

- Wholesale market prices are forecast to continue increasing over the planning horizon, and relying on this market raises the cost of providing electricity and exposes BWL customers to significant risks
- Future costs vary widely from scenario to scenario, but the most significant future cost exposure arises from potential greenhouse gas regulations, and proposed GHG legislation creates a strong disincentive to continue operating older units, like the Eckert plant.

Recommendations

The use of scenarios and sensitivities along with extensive modeling serve to provide valuable insight and information on the impact of likely future events on the BWL's electric operations. This information serves as a guide in formulating a plan to meet the BWL's future generation requirements.

Based upon the results of our planning process, we recommend a bold and innovative plan to provide competitively priced electricity and protect the BWL's ratepayers from future cost exposure resulting from GHG, other environmental cost increases, fuel cost increases, wholesale market prices and other planning risks.

In the near term, we recommend the BWL undertake comprehensive energy efficiency and load management programs to meet reliability needs, which should satisfy the need for short-term peaking generation or the purchase of short-term capacity from the market in 2016. Together with an expanded renewable energy program, we recommend that the BWL develop programs to meet all of its future electricity growth with energy efficiency and renewable energy options.

With the retirement of the Eckert units, we recommend that the BWL construct a replacement baseload plant. Further, we recommend the development of a hybrid biomass/coal baseload facility. Co-firing a new, more efficient generating plant with biomass will help reduce its GHG emissions, and limit the BWL customers' exposure to future GHG costs. This plan also protects customers from other air emissions regulations and future fuel cost escalation. The best technology for meeting this goal is a circulating fluidized bed (CFB) plant. A CFB plant can burn a wide variety of fuels, including biomass, to produce electricity. In order to realize economies of scale and minimize financial risk, we recommend inviting other municipal utilities to participate in the new baseload facility. Depending on how many municipal utilities may choose to invest in a new BWL plant, we anticipate a need for 350 MW's (250 MW's for the BWL, 100 MW's for other municipal utilities) of capacity at the new unit.

Given the long lead times necessary to permit and construct a baseload unit, we recommend that the permitting and pre-construction work begin immediately. Based upon current experience, a new plant would be operational approximately the same time that the Eckert units are retired from service.

One goal of this plan is to set the BWL on a path to reduce its GHG emissions in order to comply with likely future GHG regulations. Our recommendations are expected to reduce the BWL's CO_2 emissions significantly by 2025. This plan will provide protection from GHG costs and may actually provide an opportunity to realize revenue through the sale of carbon credits, depending on the final form that GHG regulations may take. A reduction in GHG by 2025 will present a major challenge for the BWL. Nevertheless, considering the potential exposure presented by GHG regulations and the options available to the BWL, staff believes that this goal is realistic for planning purposes.

Integrated Resource Plan Report

Introduction

In May of 2006, the Board of Water and Light (BWL) released its most recent integrated resource plan (IRP). The IRP was based on data through 2005 and examined the BWL's need for additional electric generating resources given the advanced age and the increasing difficulty of meeting environmental regulations at the Eckert plant. The 2006 IRP recommended that the BWL "further evaluate the option of adding some new generating facilities over the next 10 years." This IRP follows up on that 2006 recommendation and also recognizes factors such as the unexpected strong increases in energy growth recently experienced by the BWL, the increased likelihood of greenhouse gas regulation, and the rapid changes occurring in the electric utility industry. These changes along with additional information regarding the potential cost of maintaining the Eckert units prompted staff to undertake this IRP update.

The overall goal of comprehensive electric energy planning is to assure that the Board of Water and Light (BWL) will have sufficient resources over the planning horizon to provide its customers with safe, reliable power at affordable rates while managing future risks and uncertainty. A reliable, affordable source of electric generation is essential to the economic vitality and welfare of the Lansing community. Electricity played a major role in development of manufacturing facilities that fueled Lansing's economic progress in the twentieth century. Today, electricity continues to fuel the region's economic growth. Major data centers, financial firms, and other new service industry participants as well as traditional industrial customers make up Lansing's evolving twenty-first century economy. The recent sale of the BWL's Ottawa Street Generating Station exemplifies Lansing's economic transformation. Originally constructed to supply electric energy to Lansing's growing manufacturing economy in the 1940s and 1950s, it will soon be the home of Accident Fund Insurance Company of America. Firms of the 21st century rely more than ever on a reliable and competitively priced supply of electric power. Many new uses exist today that could not have been anticipated even 15 or 20 years ago, including major data centers that can consume nearly as much electricity as an automobile assembly plant. Other new uses that also contribute to the need for a growing and reliable supply of electricity include cell phones, plasma televisions, and iPods. Annual growth of electric use today is more modest than the 5 to 10% annual increase experienced in the 1940s and 1950s as Lansing's manufacturing base grew. Yet BWL's annual electric sales growth was an unexpectedly rapid 4% in 2007 over 2006, despite a continued sluggish economy in the mid-Michigan region. By contrast, our long-term energy sales growth forecast is 1.4% annually.

This IRP update represents a comprehensive planning process, identifying the BWL's future generation needs and evaluating a broad set of resource options and planning contingencies through 37 separate scenarios and sensitivities. The plan concludes with a recommendation of the best set of resource options that minimize future costs and risks to BWL customers.

One of the major steps of this IRP is to analyze the BWL's exposure to future risks and uncertainties. Many of the issues that electric planners have dealt with over the past half-century remain active issues in this and contemporary plans. One example is the tradeoff between capital costs and fuel costs of different electric generating technologies. The uncertainty of future sales growth is another issue that continues to emerge as a planning issue. These on-going planning issues create significant risks that must be evaluated in a comprehensive plan, like this IRP update.

A more recent risk, however, looms above all others for electric generation planning. An anticipated regulatory program to curtail greenhouse gas (GHG) emissions could have a major impact on the electric industry. Coal based electric generation is a major stationary source of carbon dioxide emissions in Michigan, accounting for 40% of the State's total emissions.[3] All of the BWL's generation is fueled by coal, which is about 70% carbon.[4] Depending on the GHG regulatory regime that is adopted by the United States, the cost of new coal based generation could rise by 35%. Yet using other energy sources such as natural gas or purchasing energy from the Midwest wholesale market both expose the BWL's customers to even higher costs and risks.

This IRP's recommendation represents a bold and innovative plan that captures the long-term price advantages of solid fuel baseload generation and, at the same time, minimizes the BWL's customers' exposure to future GHG risks. The recommendations are the product of rigorous

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[3] Michigan 21st Century Energy Plan, January 2007, page 12

[4] On a dry weight basis.

analysis, sophisticated modeling, and detailed knowledge of regional, statewide, and BWL electric utility operations.

In order to meet all three goals and provide a basis for recommending a long term resource plan, this IRP followed a four step process:

1. **Identify future generation requirements**
   The initial step starts with a forecast of energy and demand over the next twenty years, compiles an inventory of BWL generation assets, and determines whether these assets can reliably and economically serve forecast loads.

2. **Compile available resource options**
   The second step identifies resource options that are available to meet any future BWL electric generation needs along with performance and cost characteristics of those resources. A broad set of resource options have been included in this IRP including traditional central station generation, energy efficiency programs, renewable energy options, reliance on the Midwest wholesale market, and major investment at the BWL's Eckert Plant.

3. **Perform comprehensive resource modeling**
   Step three determines the least-cost resource plan that meets the BWL's future generating needs. Activities include assessing the impacts of major planning contingencies and alternative resource options on resource plans through development of several modeling scenarios and sensitivities.

4. **Recommend a Resource Plan for Implementation**
   The final step is to recommend a resource plan that minimizes future generation related costs and minimizes exposure to future risks while maintaining generating reliability. Plans produced in step three include resources that contribute different costs and operating characteristics and result in exposure to varying risks in the future. In this final step, staff evaluated the modeling results to determine which resource plans minimize costs while managing future risks and uncertainties. This was accomplished by

examining which resource options were selected in common from the various scenarios and sensitivities.

The major analytical tool used in this IRP is a powerful dynamic programming model called Strategist. The program was developed and is maintained by Ventyx, the consultant that performed the economic modeling undertaken for this planning process. Strategist was used to identify the least-cost resource plans available to the BWL and to explore the tradeoffs incurred in selecting various resource options. This information allowed staff to assess the impact of future contingencies on future generation costs and recommend a balanced approach to meeting future generation needs.

1.0 Identify Future Generation Requirements

In order to determine whether additional generating resources will be needed by the BWL, a forecast of future electric requirements can be compared to the capacity of available resources. Overall, the BWL's retails sales totaled approximately 2.4 million megawatt hours in 2007 and this is expected to grow at a rate of approximately 1.4% annually. The BWL's available generation, on the other hand, is expected to decline with the retirement of the Eckert units.

1.1 Project BWL's Future Electric Capacity and Energy Needs

The first step in determining whether additional electric generating resources will be needed in the future is to forecast future electric energy consumption and peak demand in the BWL's service territory. The forecast provides a measure of how much generation will be needed to reliably serve all customers. Staff used econometric models to forecast future electric energy use over a twenty year period, then used weather parameters to convert annual energy sales into peak energy demand over the same period.

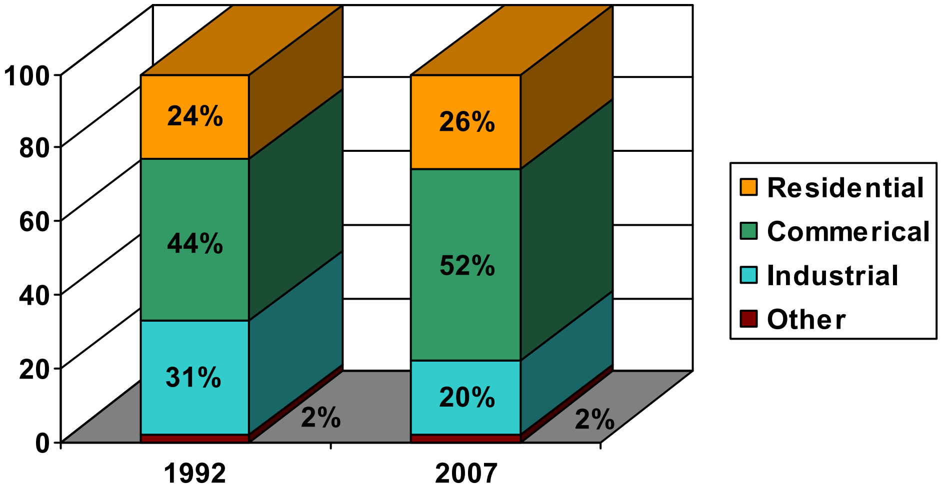
Historical Sales

Staff prepared forecasts for three customer classes: residential, commercial, and industrial. For analysis, the industrial class was further segregated into General Motors (GM) and non-GM sales. The forecast began with a review of historical data, from 1992 to 2007. During this time, the following changes occurred for each customer class:

- Residential sales increased an average of more than 1.0% annually
- Commercial sales increased an average of more than 1.7% annually
- Non-GM Industrial sales increased an average of 1.6% annually
- GM sales decreased -3.8%

The most significant change to the BWL's retail electricity sales over the period 1992-2007 was the decline in GM sales. The GM sales decline causes the Industrial class, as a whole, to experience a sales decrease while all other customer classes experienced increases. As seen in Figure 1 below, over the past fifteen years industrial sales have fallen from 31% of the BWL's total retail sales to 20% today. Commercial sales, on the other hand, have increased from 44% to 52% of the BWL's sales.

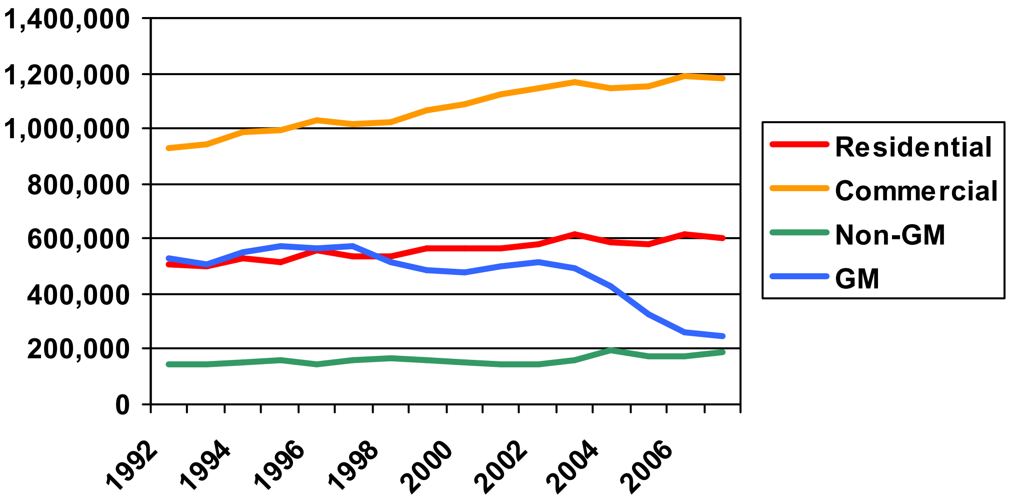
Figure 1 - BWL Retail Sales by Class



The primary reason for the shift from industrial to commercial has been the closure of four GM plants in Lansing over the past four years. In 1992, approximately 25% of the BWL's annual electricity sales were to GM. Today, GM sales represent approximately 12% of the BWL's annual sales. As seen in Figure 2 below, the decline of GM sales masks the consistent growth in the residential, commercial, and non-GM market sectors.

To help identify the impact of GM plant closures, industrial customer class sales were broken down into GM and non-GM sales. Over the period from 1992 to 2007, although GM sales decreased by an average of approximately 3.8% annually, non-GM industrial sales increased by an average of approximately 1.6% annually. This can be seen in Figure 2 below.

Figure 2 – Historical Energy Sales



Annual Energy and Peak Demand Forecast Methodology

Staff used a multiple regression analysis as the basis of its annual electric energy and peak demand forecasts. This methodology uses statistical relationships between independent variables (such as weather or the economy) and dependent variables (such as peak demand and annual energy sales) as the basis for forecasting the future values of the dependent variables. The statistical relationship was developed over the period from 1992 to 2007.

Using a series of econometric equations, staff prepared a twenty-year, 2008 to 2028, annual electric sales and peak demand forecast for the BWL's retail electric system. The econometric forecast model used in this IRP was originally developed by Sargent & Lundy for the BWL's 2006 IRP. Staff updated the original models using additional data.

Annual retail electric energy sales forecasts were then adjusted for transmission and distribution losses to determine net generation requirements in megawatt hours (MWh). The forecast for summer peak load, in megawatts (MW), was developed from a model that uses the annual energy sales forecast and other parameters as independent variables.

The econometric models used in this IRP were developed from statistically tested, historical relationships between electricity use and economic, demographic, weather, and other parameters, referred to as independent variables. This historical relationship was then used to forecast future electricity use, based on independent forecasts of the demographic, economic, and other independent variables used in the econometric model. The projections of the independent variables for Ingham County came from Woods and Poole Economics, a large, well-regarded forecast firm that provides detailed forecasts at the county level. Woods and Poole provide projections to 2030 for: number of households, government employment, non-farm employment, retail sales, and non-farm income.

In addition, other data sources were used for projections for independent variables. They included weather data, consisting of heating and cooling degree days, US Gross Domestic Product, Interest the 10-year Treasury Notes, BWL historic retail electric prices, and a calculated temperature-humidity index.

Peak Demand and Annual Energy Forecast Results

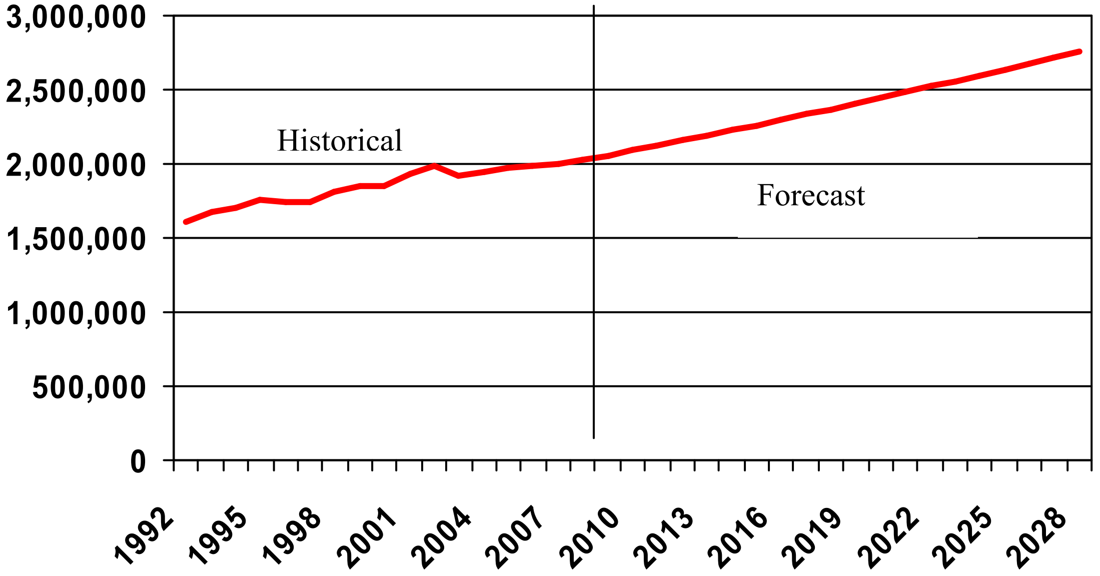
Economic setbacks have not reduced the growth of electric energy sales in the BWL's service territory. The overall historical increase in retail sales has occurred despite major economic challenges for the Lansing area, including budget cuts by State government, the closure of GM plants, and the impact of the closure of the GM plants on other businesses. While some regions within the State may experience lower load growth in the future, the Lansing area is anticipated to grow at about approximately 1.4% between 2008 and 2028. This is nearly the same as the projected electric energy sales increase forecast in the State's 21st Century Energy Plan of 1.3%. The 1.3% percent statewide amount, however, masks major regional differences in Michigan's expected electric energy use. For example, Southeast Michigan is expected to grow at a slower rate, but the northern and western portions of the Lower Peninsula are expected to grow at rates closer to 2.5%. The reasons for the Lansing area growth rate being higher than the state average include:

- Increase in commercial development within the City of Lansing
- Increase of auto parts suppliers moving to the Lansing area to meet the production requirements of GM's two newest assembly plants
- The remaining GM plants served by the BWL are relatively new, so further decline in GM sales is not anticipated
- Historically lower energy costs attracting commercial and light industrial customers to the area

- New products that use electricity are continually being developed and marketed to consumers and businesses

Figure 3 shows staff's annual electric energy sales forecast and the historical sales, excluding GM sales. GM sales were removed from Figure 3 because the extraordinary impact of declining GM sales over the 1992 – 2007 period is unlikely to continue in the future. Including GM sales would distort the relationship between historical and forecast sales. GM sales, which played a major role in the BWL's historical growth, now play a much smaller role with correspondingly less impact on BWL's total future sales. The declining GM sales have historically been replaced by consistent growth in other sectors, and staff anticipates that this growth will continue.

Figure 3 - Historical & Forecast Energy Sales



Peak demand in Michigan and in this region of the United States is largely driven by air conditioning load. To forecast peak demand, temperature and humidity data were used to convert energy sales to peak load estimates. Staff used thirty year average weather related data to forecast future peak demands, which are expected to increase at 1.6% annually over the forecast period.

1.2 Existing Generation Resources

BWL owns two conventional baseload electric generating plants consisting of a total capacity of 515 MWs. Of the total of seven production units, six of them, ranging in size from approximately 40 MW to 80 MW in capacity, are located at Eckert Station. The remaining unit has a 165 MW capacity and is located at Erickson Station. All of these units are fueled by low sulfur Powder River Basin (PRB) coal. The BWL also has a power purchase agreement for approximately 150 MW of capacity from two units at Detroit Edison's Belle River plant, which is also fueled by PRB coal.

In addition to the baseload units, BWL currently owns 10 MWs of "black start" emergency generation and has available for planning purposes approximately 16 MW of renewable energy.

Not all of the baseload units now in operation are likely to remain in operation over the planning horizon. Many of the Eckert units, for example, are operating well past their originally designed service lives. Units 1 through 3 at Eckert are comparatively small and inefficient, with heat rates above 12,500 BTU's.[5] The lower a unit's heat rate (BTU's per kWh), the more efficient the unit. Greater efficiency means that less fuel is necessary to produce a kWh of electricity. If less fuel is used to produce a kWh, then air emissions from the unit are lower as well. Figure 4 below shows the heat rates of new generating units and the BWL's existing units. A new pulverized coal unit is 25% more efficient than the BWL's Eckert 2 unit. This means that for each kWh produced, a new unit uses 25% less fuel. It also produces 25% less carbon dioxide, a greenhouse gas. Other air emissions from a new plant (e.g. SO_2 and NO_x), are also less than the emissions from the older, less efficient Eckert units.

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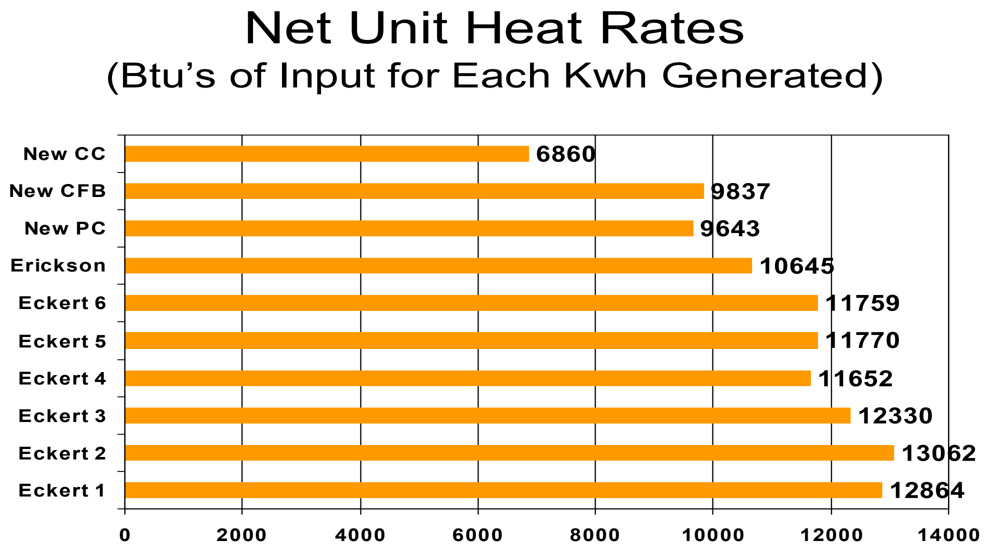
[5] Heat rate is a measure of plant operating efficiency. It represents how many British Thermal Units (BTU's) are needed to produce one kilowatt hour of electricity.

Figure 4 – Net Unit Heat Rates



The Eckert plant site itself is unusually small for a baseload power station, and this makes construction of new emission control technologies difficult and expensive. The Eckert site has six pulverized coal electric generation units and four Stoker steam units, all on nine acres. Costs incurred in control technologies to meet new mercury emission standards would add significant capital costs to units that are now reaching 60 years of age and are comparatively inefficient. If new source review is triggered or closed loop cooling is required at the plant, capital costs of keeping just units 4-6 operating could rise to more than $260 million.

The continued economic viability of the Eckert units is a major planning issue. Cost and performance challenges, the units' advanced ages, the site's small footprint, the units' poor efficiencies and the possibility of large capital expenditures for environmental retrofits are all future risks that the IRP must consider.

1.3 Adequacy of Existing Generation Resources

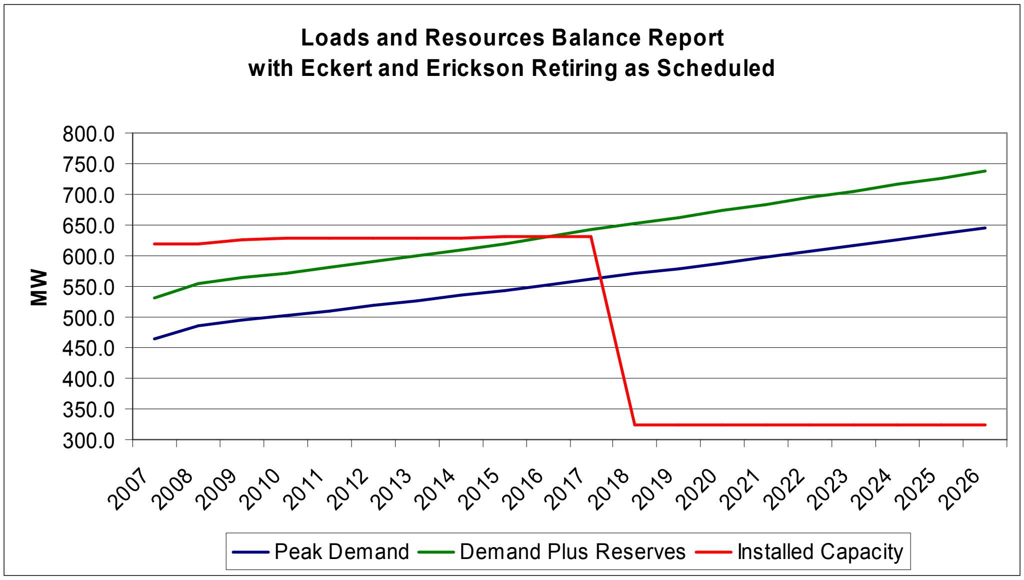
The modeling Base Case removed units 1 through 3 at Eckert from operation at the end of 2017. Generally, plants are removed from service when the costs to maintain and operate the units are greater than replacing the units or purchasing power from the wholesale market. Units 1 and 2 of the 6 Eckert units will have been in service for 60 years or more by 2017. The Eckert units were originally designed for 40 years of service. Maintaining these units beyond 60 years is an increasingly difficult and expensive task as many of the parts for the units are no longer available from vendors and must be fabricated from original designs. A modeling alternative to retiring units 4 through 6 at Eckert was to assume that the plant would be required to meet NSR standards. Meeting those standards was assumed to require an initial $260 million (2007 dollars) investment to allow Eckert units 4-6 to remain operational after 2017.

Electric generating units are large, complex machines. Like all machines, they will occasionally be inoperative or be forced off-line. To account for those times when a unit may be forced off line due to a mechanical problem, back-up generation must be available to fill in for the unit. This back-up generation is referred to as “planning reserve”. Planning reserves are also needed to meet unexpected increases in demand, like unanticipated growth in the economy or unusual weather.

The requirement to maintain planning reserves was established by this region’s electric reliability organization, Reliability First Corporation (RFC). RFC was designated by the Federal Energy Regulatory Commission as this region’s electric reliability agency. The actual planning reserve ratio, 14%, was adopted by the Planning Reserve Sharing Group (PSRG) which was created pursuant to RFC Standard Bal 502-RFC-01. The Midwest Independent System Operator (MISO) administers the PSRG’s work. Load serving utilities, like the BWL, must maintain sufficient electric generating capacity to meet expected peak load and an additional amount of 14% for planning reserves.

The graph in Figure 5 compares the BWL’s generation with a forecast of demand including planning reserves. To be consistent with the Base Case, the Eckert units have been removed from service beginning in 2017. As seen in the graph, the BWL’s available generation is projected to be insufficient to meet generation need beginning in 2016. Additional generating resources are forecast to be needed at this time to ensure the BWL's electric reliability needs are met.

Figure 5 – Forecast of Demand including Reserves



2.0 Compile Available Resource Options

A major goal of the planning process was to evaluate a broad set of resource options to meet the BWL's future electric generating needs. This was accomplished by compiling cost and operational information on renewable energy options, energy efficiency programming, traditional central station generating options and wholesale market purchases.

2.1 Renewable Energy Options

BWL Renewable Portfolio Standard (RPS)

On January 23, 2007, the BWL adopted a Renewable Energy Portfolio Standard (RPS), the first for any Michigan-based utility. The RPS set in place the following goals for acquiring electricity from renewable energy sources:

- Generate or purchase 2% of the BWL's retail electric sales by December 31, 2008.
- Generate or purchase 5% of the BWL's retail electric sales by December 31, 2012.
- Generate or purchase 7% of the BWL's retail electric sales by December 31, 2016.

The BWL's RPS serves as the Base Case amount of renewable energy included in this IRP.

Proposed Legislation regarding RPS

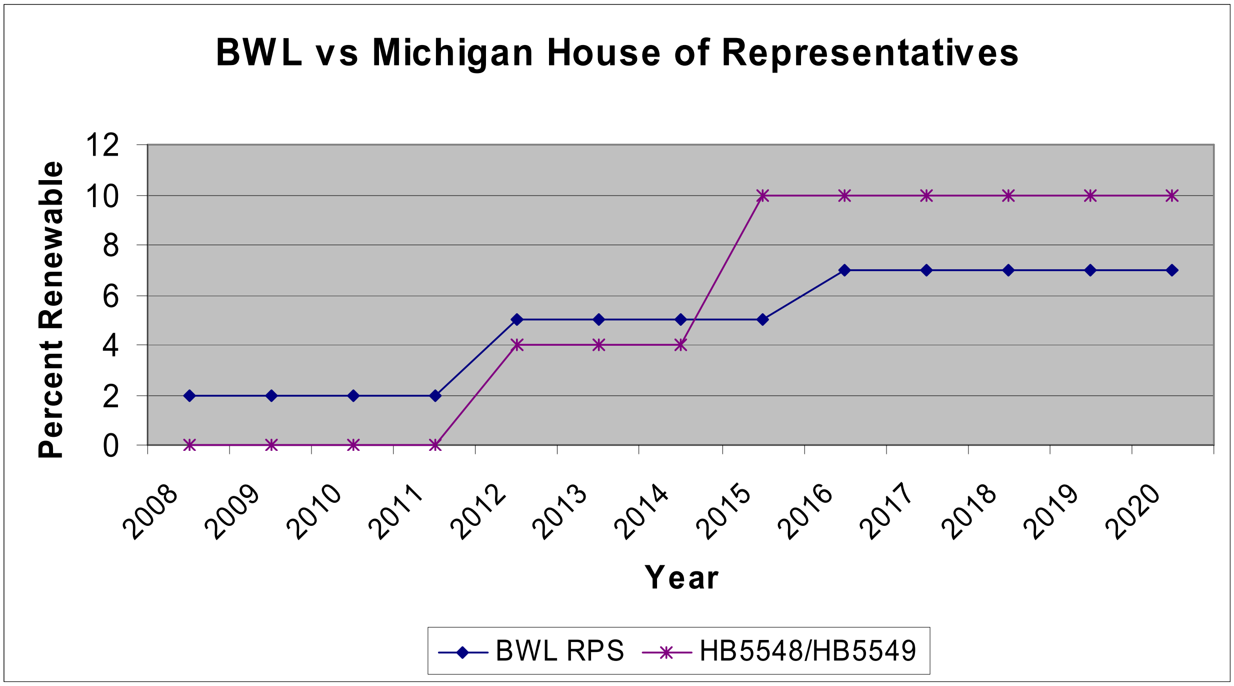
Proposed legislation has been introduced at both the federal and state level to require adoption of an RPS. Since many states have already moved forward with an RPS, staff has assumed that a state-level RPS would be more likely than federal legislation.

The Michigan House recently adopted an RPS standard that requires electric utilities to meet 10% of their electric energy needs through renewable energy by 2015.

To test the impact of renewable energy in a carbon constrained operating environment, staff have developed a "high" renewable energy scenario based on the Michigan House of Representatives 10% portfolio standard. This scenario assumes that 10% of the BWL's electric energy will originate from renewable sources by 2015.

A comparison of the BWL's renewable standard and the Michigan House standard is shown in Figure 6.

Figure 6 – Comparison of Renewable Standards



Renewable Energy Source Options

The BWL currently owns 0.6 MW of hydro generation at Moores Park and is considering rehabilitating another hydro unit of similar size at the same site. The BWL also contracts for approximately 1.7 MW of hydro from a facility located in northern Lower Michigan. Most of the BWL's renewable energy, however, is anticipated to come from landfill gas generation. The BWL has one contract for 6 MW of capacity (growing to approximately 12 MW over the life of the contract) from the Granger - Wood Road landfill and is nearing the end of negotiations for another 3 MW of landfill gas energy from another site.

Renewable energy necessary to meet the RPS and beyond that which the BWL owns or for which it contracts was assumed for modeling purposes to come from wind energy at an estimated cost of 10.5 cents per kWh.

2.2 Energy Efficiency Programs

The use of energy efficiency programs can cost-effectively defer the need for additional electric generation. Energy efficiency programs vary from utility to utility, but typically include:

- Educational campaigns encouraging customers to use energy efficiently
- Audit programs to help customers identify cost-effective options to lower their energy costs
- Rebate and incentive programs to encourage the adoption of energy efficient appliances, lights, and other energy use devices
- Intra-utility programs to identify and correct losses in transmission and distribution systems
- Energy efficiency modifications to utility owned facilities
- Energy efficiency modifications to public facilities such as State, City, County or even public schools

Customer focused energy efficiency programs are designed to allow customers the same or a higher level of comfort or service but at a lower cost through use of more energy efficient equipment. These programs have been used throughout the United States and, when designed and implemented properly, can lower the overall cost of providing electric energy services.

Although estimates vary and comparisons with traditional generation technology are not straightforward, the national experience indicates that a cost of conserved energy of about 3.0 to 3.5 cents/kWh can be expected from energy efficiency programs over time. This cost is based on Energy Information Administration (EIA) from the most recent data (2006)[6]. For calculating the impact of energy efficiency programs, staff used 3.25 cents per kWh as the cost of the conserved energy.

The actual cost of conserved energy will vary depending on program start-up costs, the maturity of existing energy efficiency programming, the type of end use products prevalent in the market, and other factors. The BWL has not made extensive use of energy efficiency programming in the past. This lack of experience means that significant program start-up costs could initially

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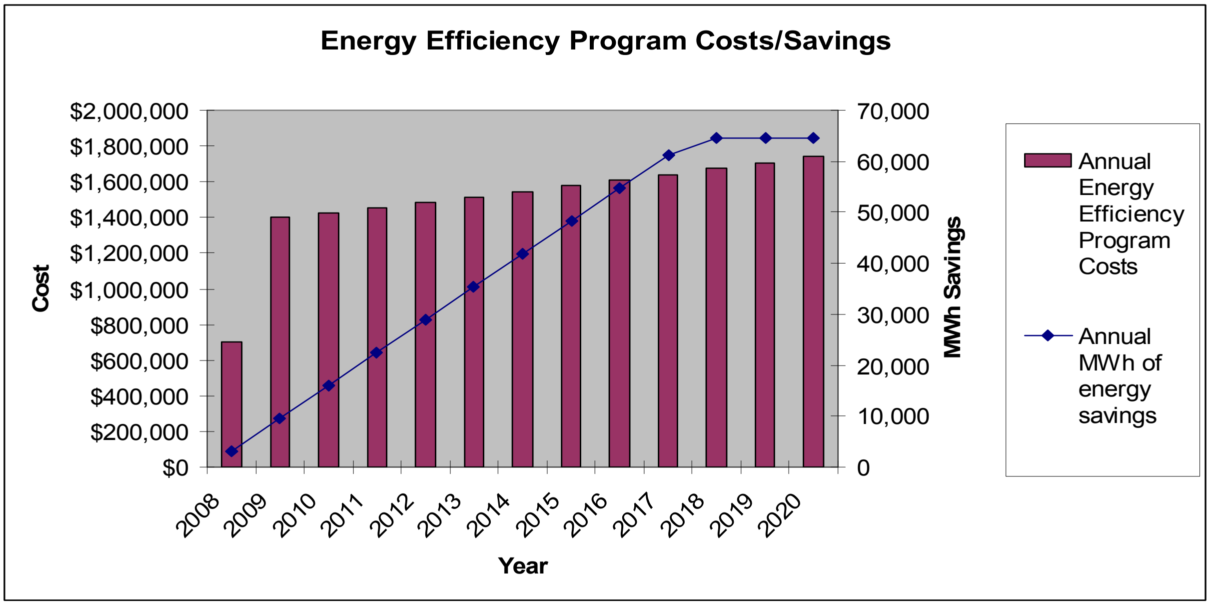
[6] From EIA form 861 and includes direct program administrative costs, indirect costs and incentives and is compiled by EIA from data submitted by electric utilities.

result in costs higher than the national average. However, since the BWL's service territory has not experienced extensive programming in the past, there is likely to be correspondingly significant levels of cost-effective energy savings available in the Lansing area.

In order to evaluate the impact of energy efficiency programming on the BWL's future resource needs, staff adopted a target energy efficiency budget of $1.4 million annually, in 2008 dollars. This amount represents 1% of the BWL's gross operating revenue from retail operations. The 1% amount is considered a program that is large enough in scope to materially benefit the planning process. Energy efficiency proponents frequently advocate program funding of at least 1% of gross operating revenues. The plan assumes a phase-in of half of the annual $1.4 million in the first year and the full amount escalated by inflation thereafter.

Based upon a program size of $1.4 million annually and a cost of conserved energy of 3.25 cents/kWh, energy savings are forecast to be about 3,000 MWh the first year (2008) - roughly 1/3 of a percent of annual retail sales. This is the equivalent of about half a MW of baseload energy at an 85% capacity factor. This energy savings quickly rises, however, because these savings persist over multiple years. Although savings persistence varies with the type of program that may be implemented, industry statistics indicate that savings typically persist for 8 to 12 years. Based on this observation, staff has adopted an average 10 year period of energy savings when modeling the impacts of energy efficiency. Using the ten years as a basis, by 2018 the BWL will be saving nearly 65,000 MWh annually of energy due to proposed energy efficiency programs. This equates to nearly 9 MW of baseload energy. Equally important, much of the 9 MW of savings carries through during peak load times. This reduces the peak requirements of the BWL. Energy efficiency programming provides several advantages to a resource portfolio. These programs are frequently less expensive then generation options, they do not emit pollutants into the air or water, they are not subject to fuel cost escalations and the programs can be ramped up or down quickly to meet generation needs. The principal disadvantage of these programs is that even though they may lower total utility costs, they tend to increase unit costs, or rates. Projected savings from energy efficiency programming are shown in Figure 7.

Figure 7 – Energy Efficiency Programs



2.3 Traditional Electric Generation Options

Traditional baseload technologies included in this IRP were:

- Pulverized Coal – Subcritical and Supercritical
- Circulating Fluidized Bed
- Integrated Gasification Combined Cycle
- Combustion Turbine Combined Cycle

A brief discussion of each technology follows:

Pulverized Coal (PC) – Subcritical and Supercritical

The term PC refers to the process used to prepare coal as fuel for an electric generation furnace. This technology uses pulverizers to crush coal into the consistency of talcum powder and then burns the powdered coal on the combustion side of the boiler. Powerful fans are used in PC's to blow the coal dust from the pulverizers into the boiler. The furnace temperature is hot enough to combust the coal dust while it is suspended in the air. The flow of the air and coal dust is carefully regulated to optimize the combustion process. Inside the furnace and the upper portions of the boiler are tubes filled with water that absorb the heat from the burning coal dust.

As the burned coal and air mixture (flue gas) flows through the boiler, energy is transferred to the water tubes and produces steam. In the process, energy is transferred to the steam, dropping the temperature of the flue gas. The flue gas then passes through pollution control equipment, located between the furnace and the stack, which removes pollutants suspended in the exhaust gases.

After steam is generated, it passes through the high-pressure steam turbine section dropping in pressure and is then given additional heat (reheat) in the boiler before being returned to the remaining intermediate and low pressure turbine sections. To improve plant efficiency, water is warmed by feedwater heaters before the water enters the boiler.

PCs are the dominant form of coal based electric generation in the United States and have proven to be reliable and affordable. PC technology comes in two broad types, subcritical and supercritical. Supercritical plants operate at elevated temperatures and pressures producing higher efficiencies than subcritical plants. PC technology can be constructed in a wide range of sizes. This technology has also proven to be operationally flexible with a turn-down capability in the 30- 35% range (turn-down is an industry term used to indicate the minimum percent of total gross capacity at which a unit can still operate). This turn-down range helps to manage load during low load periods. New supercritical PC units represent an efficiency improvement of approximately 10% over the last generation of Michigan based PCs, which came into service in the 1980's. All of the existing generating units at the BWL are sub-critical pulverized coal units that range in size from 40 to 165 MW.

Over the past 30 years, emission regulations have tightened for coal based technologies. To meet emission requirements, staff assumed that any new PC would require an FGD - Flue Gas Desulferization equipment to remove SO_2, SCR - Selective Catalytic Reduction to remove NO_x, baghouse and/or electrostatic precipitator to remove particulates, and sorbent injection for mercury control.

Circulating Fluidized Bed

Circulating Fluidized Bed (CFB) boilers are similar to the PC boilers with respect to the steam/water cycle, but vary significantly in furnace operation. Instead of powdered coal being burned in the combustion air at very high temperatures, a CFB boiler uses relatively large fuel particles that are burned in a stable air bed suspended in the furnace. As a result, fuel in a CFB boiler burns at a lower temperature than a PC boiler. The fuel in the furnace is held in suspension by pressurized air provided by fans. The force of the air and the separation between particles of fuel cause the fuel bed to act like a fluid; hence the term "fluidized bed."

The circulating characteristic of this technology results from the fuel size. Many of the fuel particles, either initially or after partial combustion, become small enough to get entrained in the air flow that suspends the fuel bed. These particles are transported out of the furnace by the flue gas. In order to maintain the mass of the bed, the flue-gas enters high-efficiency cyclones that cause the heavier particles to fall out of the air stream. The heavier particles are returned to the furnace for continued combustion. Also, within the turbulent bed, particles combine into larger groups and then break apart as they rise and fall.

In order to stabilize the bed, a comparatively inert material must be added to the coal. Typically, limestone is used for this purpose. The limestone also reacts with the sulfur in the fuel, reducing SO_2 emissions. In utility boilers firing 100% PRB coal, sand or similar materials have been used along with limestone.

Numerous CFBs are in operation around the world and have proven to be reliable electric generators. Although CFBs are only now exceeding 300 MW in size, these boilers can make use of a wide array of fuels. CFBs are operationally somewhat more constrained than PCs, with a turn-down capability of about 40-50%.

Like other coal based technologies, staff assumed that a new CFB plant would require a polishing scrubber to remove SO_2, SNCR – Selective Non-Catalytic Reduction for NO_x, a baghouse and/or electrostatic precipitator, and sorbent injection for mercury.

Integrated Gasification Combined Cycle

IGCC technology includes several distinct major processes: air separation unit (ASU), gasification, coal unloading and preparation, syngas cleanup, combined-cycle power block, and sulfur removal and recovery.

The ASU, or oxygen plant, is designed to provide large quantities of oxygen to the coal gasifier, which produces the fuel for the combustion turbine. The process begins with the coal preparation plant, which prepares a slurry that is injected into the gasifier along with the oxygen from the ASU. The coal is partially burned with insufficient oxygen. This process forms a gas that is composed primarily of carbon monoxide and hydrogen. These combustible gases exit the gasifier, along with particle matter, sulfur (as hydrogen sulfide), and other byproducts (primarily carbon dioxide). The gas produced in this process is referred to as synthetic gas, or syngas. The syngas passes through various filters to remove particulates. It then undergoes chemical washing to remove most of the sulfur from the gas. The cleaned syngas is then supplied to the combustion turbine.

The electric generation component of an IGCC plant, including a heat recovery steam generator, is identical to a combustion turbine combined cycle process. That process is described below in the CTCC discussion.

While there are a number of gasification facilities around the world, only four (with one more coming on-line soon in Japan) gasify coal to produce syngas for a combustion turbine. There are two IGCC facilities currently operating in the United States: Polk County (250 MW) in Florida and Wabash River (262 MW) in Indiana.[7]

Combustion Turbine Combined Cycle (CTCC)

The CTCC configuration has been used in the power industry for many years. The first step of the CTCC process is to fuel a combustion turbine with natural gas and recover the heat from the exhaust gases in a heat recovery steam generator (HRSG). The steam is then used to drive a steam turbine to produce additional power and to improve overall efficiency of the plant. The

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[7] Duke Energy is currently in development work on an IGCC project proposed for their Edwardsport Station. In November 2007, the Indiana Utility Regulatory Commission granted permission to proceed with this project.

plant efficiency is a combination of the combustion turbine efficiency and the steam turbine cycle. CTCC plants are among the most efficient electric generation units in commercial operation today. However, the high cost, availability, and infrastructure to supply natural gas limits the value of these plants.

Figure 8 summarizes the characteristics of the various technologies.

Figure 8 – Electric Generation Technology Characteristics

Technology	Status	Size Range MW	Heat Rate BTU/kWh	Fuel Flexibility	Technical Risk	Turn Down%
PC – Subcritical	Proven	200 – 1000	9,400 – 10,200	Limited to the designed coal type	Minimal performance risk	30 – 35%
PC - Supercritical	Proven	500 – 1000	9,100 – 9,600	Limited within specific coal rank	Minimal performance risk	30 – 35%
CFB – Circulating Fluidized Bed	Proven	< 300 single boiler	9,800 – 10,800	Broader than PC plus “opportunity” fuels to 50%	Minimal performance risk	40 – 50%
IGCC – Gasification Combined Cycle	Only two operating in U.S.	250-260 (existing)	8,800 - 11,341	Limited after construction	High	70% - 1 gasifier 35% - 2 gasifiers
CTCC	Proven	50 – 750	8,000 – 8,500	Low – Gas or Oil	Minimal performance risk	25%

2.4 Unit Options at Erickson Plant Site

One of the principal planning issues analyzed in this IRP is the expected service life of the BWL’s Eckert plant. An option studied in this IRP is the replacement of Eckert with a new generating unit at the BWL’s Erickson generating station. Although the Erickson site was originally designed for multiple units, only one was built. Much of the infrastructure needed for a new unit's operation is already in place at the site. To assess which generating options could be constructed at the Erickson site, the engineering firm of Sargent & Lundy (S&L), L.L.C. evaluated the five generating technologies identified in Section 2.3 above. Unit sizes included in the study were 160MW, 400MW, and a maximum size based on site limitations. Not all generating technologies were analyzed for all sizes, since some technologies are not commercially available in each size selected for analysis. This phase of the study was intended to determine the available generating options at the site, should the IRP indicate the need for new baseload generation.

In determining which generating technologies and unit sizes could be constructed at Erickson, S&L examined several factors that could limit the size and type of unit that Erickson could host. The factors are listed below:

- Fuel Delivery and Handling
- Water Supply Availability and Wastewater Disposal
- Solid waste disposal
- BWL 138kV Transmission System Limitations
- Capital and Operating and Maintenance Cost Estimates
- Unit levelized Busbar Cost Estimates

According to S&L's analysis, the site could accommodate a baseload facility up to 550 MW in size.

Figure 9 shows capital and variable cost estimates prepared by S&L for each generating technology and each unit size. The capital costs identified are "all in costs", consisting of equipment and material, construction labor, design engineering, construction management, startup, financing, and owner's costs.

Figure 9 - Electric Generating Technology Costs

Technology	Unit Capacity (MW, Gross)	Total Capital Cost $/KW (2007 Dollars)	Net Fixed O&M $/KW (2007)	Net Variable O&M $/MWh (2007)	Net Heat Rate BTU/KWh
PC - Subcritical	550	$2,580	$24.36	$4.13	9,623
	400	$2,980	$28.60	$4.14	9,643
	160	$3,380	$49.68	$4.16	9,682
PC – Supercritical	550	$2,650	$25.16	$3.99	9,269
CFB	550	$2,690	$27.56	$4.27	9,812
	400	$3,070	$31.82	$4.28	9,837
	160	$3,890	$55.65	$4.45	10,269
IGCC	550 (net)	$4,710	$23.41	$4.25	9,301
CTCC	525	$800	$12.09	$3.53	6,860
	160	$1,230	$23.85	$3.49	7,470

2.5 Wholesale Market Purchases

A major programming component of the Strategist model is the Market Power module. This module is used to forecast wholesale capacity and energy prices over the entire Eastern Interconnection.[8] The Eastern Interconnection is made up of numerous utility control areas, all of which are interconnected and provide capacity and energy trading opportunities. In the Great

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[8] The Eastern Interconnection refers to the integrated electric transmission and distribution system that runs from northeast New Mexico to the Canadian Maritime Provinces and comprises most of North America east of the Rocky Mountains.

Lakes region, the Midwest Independent System Operator (MISO) and PJM operate day ahead and real time wholesale electric markets. In addition to these organized markets, longer term contracts are also available for capacity and energy through bilateral contracts.

Power in the day ahead and hourly wholesale markets is priced on an incremental cost basis. This means that all prices in the market at any one time are based on the highest cost generating unit that must be brought on-line to serve load. Irrespective of any generator's actual cost of production, the price paid to all generators called on to provide power in the market is equal to the highest cost paid to the last unit that is brought on-line. In this market, prices have grown steadily and can be very volatile. On-peak (6 A.M to 10 P.M.) market prices frequently track natural gas prices, which have increased approximately 50% since last summer. Off-peak electric energy has also been increasing as excess baseload generation within the MISO region becomes fully utilized.

In addition to energy, the Market Power module provides a forecast of market capacity costs. Figures 10 and 11 display the Market Power forecast of Midwest wholesale capacity and energy prices over the planning horizon. The Strategist model compares the option of purchasing capacity and/or electric energy from the Midwest wholesale market with the cost of the BWL constructing and operating a generating plant.

Figure 10 - Wholesale Market Capacity Price Forecast

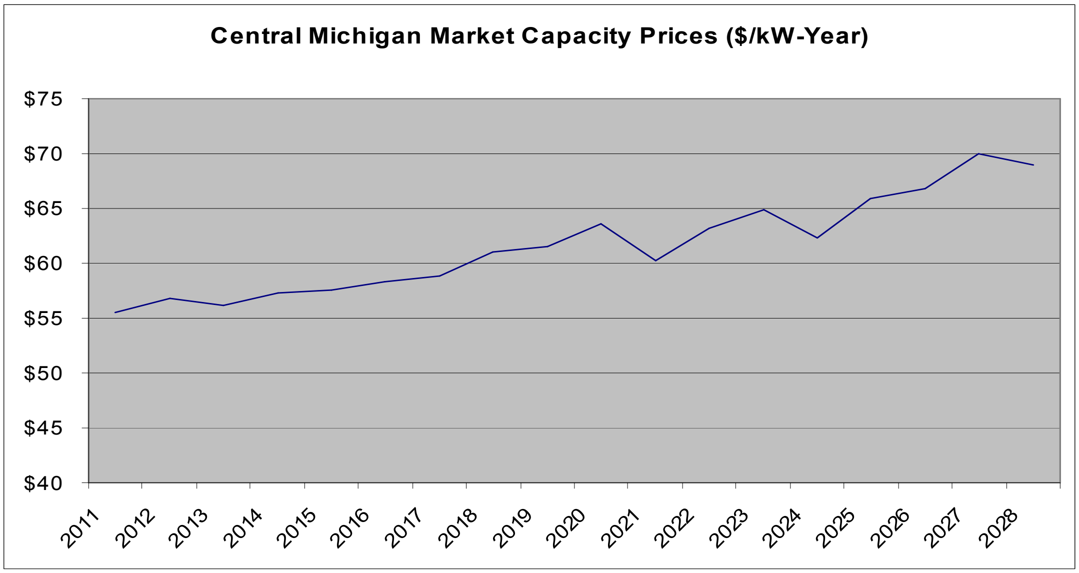
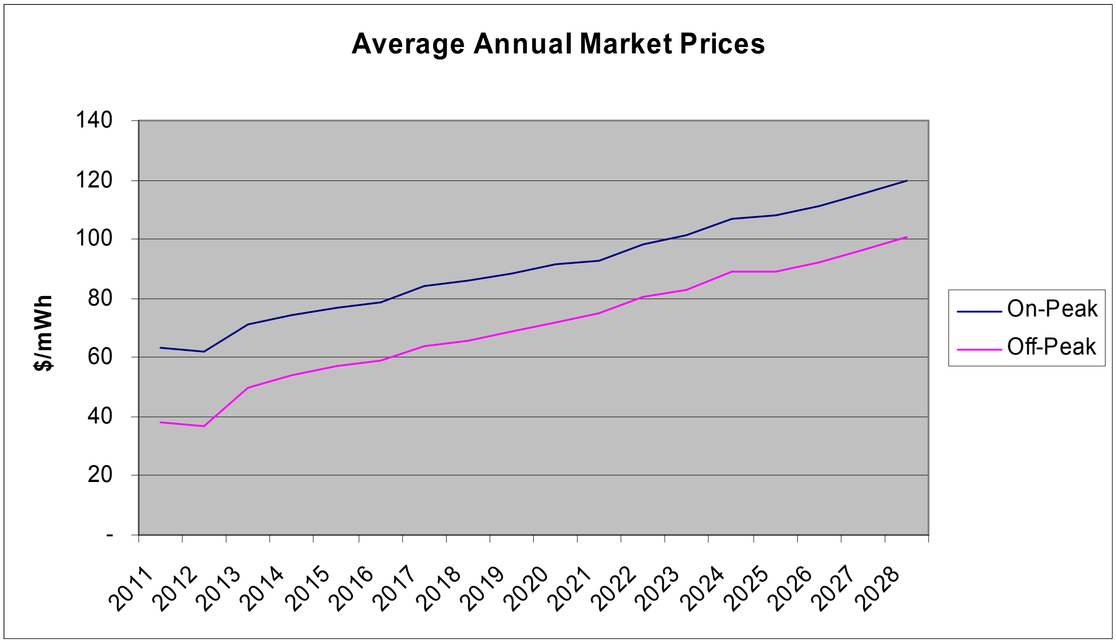


Figure 11 - Wholesale Market Energy Price Forecast



3.0 Perform Comprehensive Resource Modeling

Over a planning horizon of twenty years, forecasts must be prepared for important planning variables like fuel costs or demand and energy growth. These "base" forecasts represent our best estimates of the future costs for these planning variables.

Forecasts of this duration rarely turn out to be precisely correct. Over time, economic and demographic characteristics of the service territory change, new regulations are adopted, new production technology is developed and deployed, and new uses for electricity are found. All of these circumstances, as well as many more, will cause today's forecast to vary from future experience. The inability to precisely predict important variables creates a risk that plans developed today may not be suitable for the future.

To manage this uncertainty, staff identified four major planning parameters which create significant planning uncertainty and are sufficiently important to materially impact planning results. These parameters consist of: peak demand and annual energy sales, fuel costs, environmental compliance costs, and capital cost escalation rates. Each of these served as the basis of a modeling scenario or sensitivity. In addition, staff created an additional scenario to evaluate the cost of relying exclusively on Midwest wholesale markets.

This Section 3 describes base forecasts for the modeling variables and the scenarios and sensitivities developed to account for all forecast uncertainties.

3.1 Base Case for economic modeling

A principal task in economic modeling is to establish a "base" case for major model parameters like demand and energy growth and fuel costs. Base Case generation plant capital costs were taken from a study performed by S&L for the Erickson site. The Base conditions also include the BWL's current plan to acquire 7% of its sales to retail customers from renewable energy by 2015, with all of the BWL's units remaining operational through 2017.

After 2017, the Base Case removed units 1 through 3 at Eckert from operation. Generally, plants are removed from service when the costs to maintain and operate the units are greater than replacing the units or purchasing power from the wholesale market. Units 1 and 2 of the 6

Eckert units will have been in service for 60 years or more by 2017. The Eckert units were originally designed for 40 years of service. Maintaining these units beyond 60 years is an increasingly difficult and expensive task as many of the parts for the units are no longer available from vendors and must be fabricated from original designs. A modeling alternative to retiring units 4 through 6 at Eckert was to assume that the plant would be required to meet NSR standards. Meeting those standards was assumed to require an initial $260 million (2007 dollars) investment to allow Eckert units 4-6 to remain operational after 2017.

Base Case assumptions include the base energy & demand forecasts, SO_2, NO_x, and CO_2 allowance cost forecasts, and base natural gas and coal price forecasts.

Base Case conditions also adopted the wholesale market prices discussed in section 3.5. The model was not restricted from purchasing capacity and energy from the wholesales markets, if cost-effective.

3.2 Delivered Fuel Costs Forecasts

Natural Gas

The base natural gas forecast began with the 18 month Henry Hub forward price. These monthly observations were then escalated at the long-term escalation rates in the 2007 U.S. Department of Energy's Energy Information Agency (EIA) long-term Annual Energy Outlook (AEO). The 2007 AEO forecast the declining real prices for natural gas through 2015, and then a modest annual increase thereafter.

With likely greenhouse gas legislation, however, it is probable that demand for natural gas to fuel power plants will increase. Natural gas-fueled combined cycle generating plants emit approximately one-half the carbon dioxide of coal fueled power plants, so regulations that constrain carbon emissions will increase the demand for natural gas relative to other fuels. Currently, about 41% of the U.S. electric generating capacity is fueled by natural gas[9]. Most electric generation added in the U.S. over the past 10 years has been natural gas fueled plants. Like other states in the Great Lakes region, additions to Michigan's electric generation capability

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[9] Based on nameplate ratings for 2006 from EIA "Existing Capacity by Energy Source"

over the past 18 years have been predominately natural gas fueled generation. Michigan's last major coal fired plant, Detroit Edison's Belle River plant, came into service in 1985.

Recently, proposals to build approximately 59 new coal fueled power plants have either been denied permits or abandoned.[10] Although these suspensions are due to more than one factor, the recent uncertainty regarding GHG legislation and the difficulty of securing an air permit for new coal fueled power plants has played a major role in the suspensions. With growing concern for future generating capacity deficiencies in various parts of the country, this is likely to further increase the demand for new natural gas fired generation and for natural gas. The uncertainty related to acquiring permits necessary to build baseload coal and nuclear plants coupled with the lower carbon content of natural gas could result in a resurgence of new natural gas fueled plants.

Considering the likely growth in natural gas demand, staff believes that an asymmetrical forecast risk exists for future natural gas prices. Relative to the base natural gas forecast, it appears more likely that actual deviations from the base forecast will be higher, not lower. To account for this risk, staff created a high natural gas price forecast sensitivity. The high natural gas price sensitivity adjusts the base forecast upward to account for observed historical variations in natural gas prices. The adjustment is based on the standard deviation of historical prices over the period 1994 to 2005.

As a final review, staff compared the 2007 EIA data used for the IRP with the 2008 EIA data just released in March of 2008. In general, the 2008 data reflects a slight increase in the forecast cost of gas, so to be conservative the IRP continued to use the 2007 data.

Coal

The BWL's existing units are fueled by low sulfur western, Powder River Basin (PRB), coal. For planning purposes, we have assumed that any new baseload generating plant would be fueled by PRB coal as well. The PRB coal price forecast comes from the EIA's 2007 AEO. The price forecast, on a dollar per MMBTU basis, includes delivery costs to Lansing. The forecast of delivered coal cost to Lansing along with the forecast for natural gas prices is shown in Figure 12.

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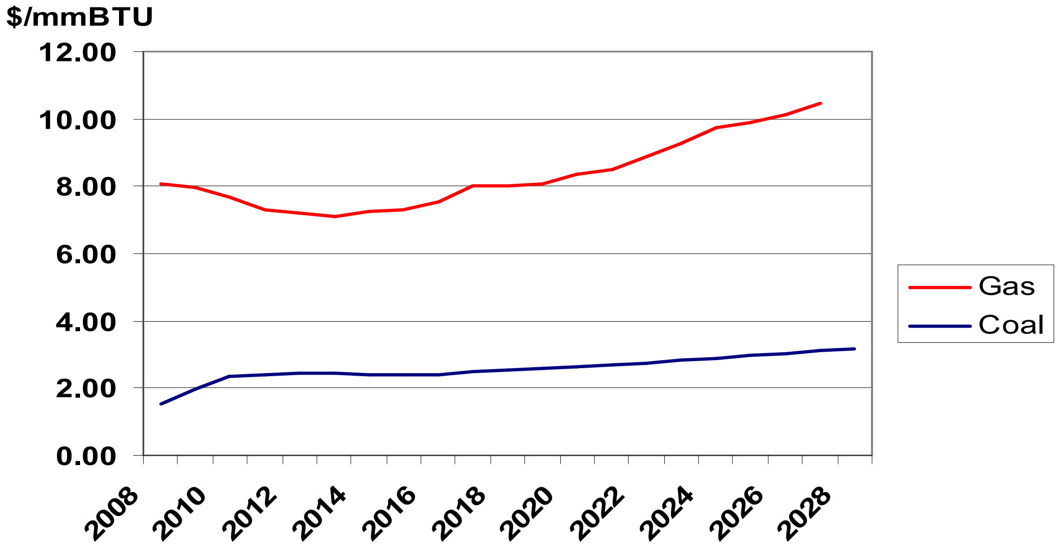
[10] February 14, 2008, Earth Policy Institute, "U.S. Moving Toward Ban on Coal-Fired Power Plants."

Figure 12 - Base Coal and Natural Gas Price Forecasts



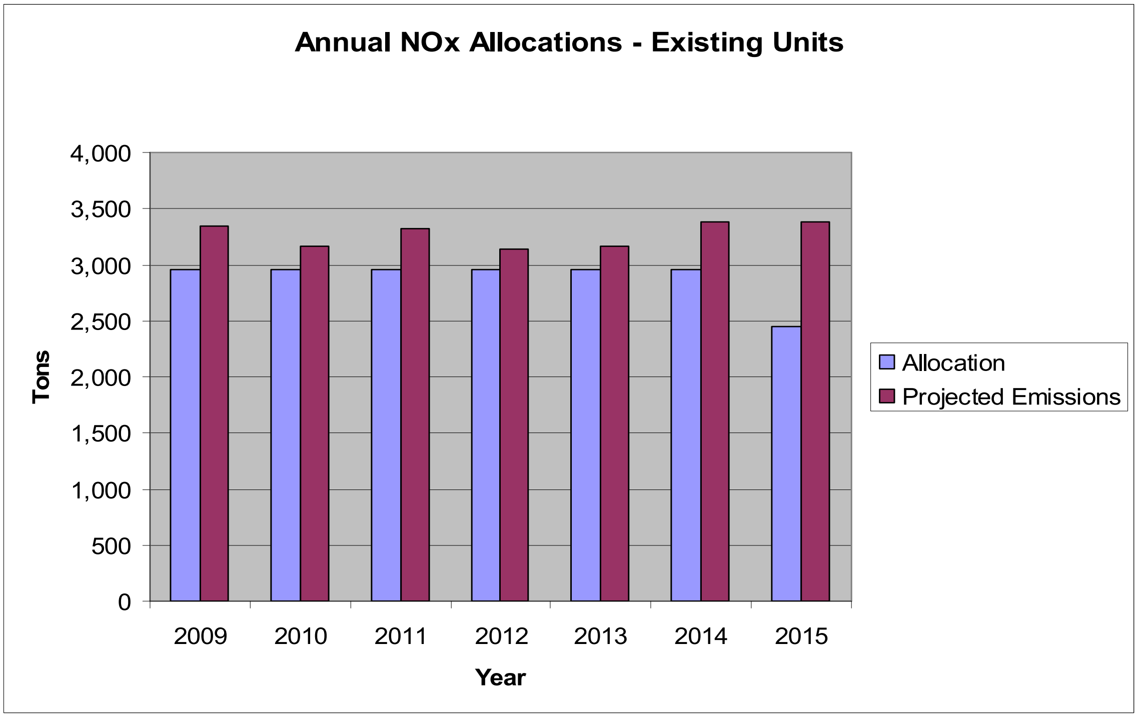
3.3 Environmental Costs and Potential Risks

Environmental compliance requirements play one of the most significant roles in electric generation planning. Compliance requirements related to nitrogen oxides (NO_x), sulfur dioxide (SO_2), and mercury all present major environmental planning issues. Possible GHG controls have an enormous potential to increase the cost of electric generation. Aside from air emissions, exposure to possible New Source Review (NSR) requirements at older generating plants and the potential impact of new legislation, including those intended to regulate water usage, could also have a significant impact on future generation costs. Much of the IRP process was devoted to evaluating the BWL's exposure to future compliance requirements and identifying the best set of resources to meet future generation needs and minimize the costs of compliance with future environmental standards.

NO_x and SO_2

A major goal of the Clean Air Act (CAA) is to protect the public's health by establishing and achieving lower concentrations of certain pollutants in the air. The 1990 Amendments to the Clean Air Act (CAAA) were intended to reduce emissions of SO_2 and NO_x, formed during the combustion of coal in electric generating plants. These original 1990 air emissions programs, the Acid Rain Program (for SO_2) and NO_x Budget Program (for NO_x), were recently combined into new, more stringent standards called the Clean Air Interstate Rule (CAIR). CAIR is a cap-and-trade program that is intended to reduce NO_x and SO_2 emissions in two phases. Cap-and-trade programs "cap" the emissions for the country and allocate emission "allowances" to each unit based on its historical heat input. Over-complying units can then "trade" or sell their excess to under-complying units. This strategy allows a unit to comply through the installation of additional control equipment, the purchase of additional allowances, or both. The first phase of CAIR will further reduce NO_x and SO_2 emissions in 2009 and 2010 respectively. The second phase, effective in 2015, further reduces NO_x and SO_2 emissions. The impact of CAIR was evaluated as a part of the IRP update. Figure 13 shows the projected allocations to existing Eckert and Erickson units along with their projected NO_x emissions.

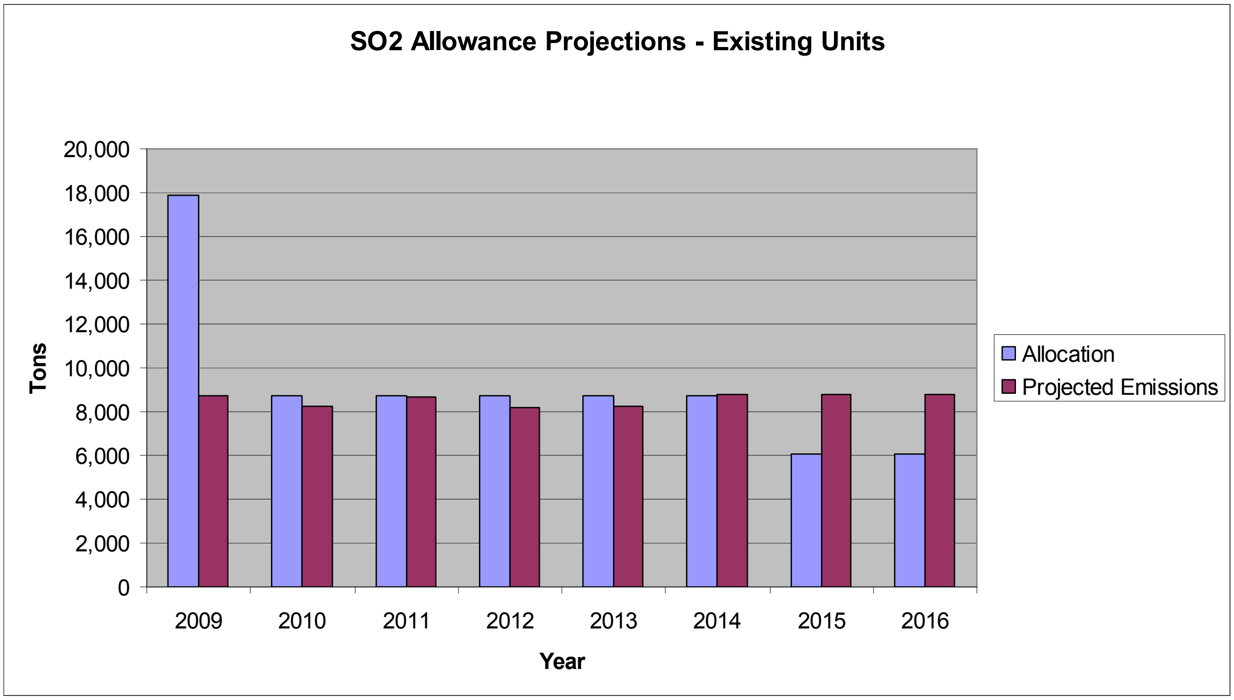
Figure 13 – BWL NO_x Emissions



Emissions of NO_x from the Eckert plant could be reduced by installation of an SCR or SNCR unit at the plant. The capital cost to add an SCR and related equipment is approximately $48 million with an annual operating cost of about $3 million. The IRP evaluated the cost-effectiveness of installing the next level of NO_x controls, Selective Reduction, as opposed to purchasing allowances.

To comply with phase two of CAIR in 2015, staff projects that the Eckert units will either need to install SO_2 control equipment such as flue gas desulfurization (FGD) or begin purchasing allowances. To evaluate the cost of installing an FGD (scrubber) or purchasing allowances, the IRP includes the cost of adding a scrubber at the Eckert plant. The cost of adding a scrubber to units 4-6 only is estimated to be about $150 million. Staff does not project SO_2 compliance issues related to the Erickson plant primarily due to the low sulfur coal it burns. Figure 14 shows the projected allocations to existing Eckert and Erickson units along with their projected SO_2 emissions.

Figure 14 – BWL SO_2 Emissions



<u>CO_2</u>

Currently there are no regulatory restrictions on the amount of GHG (primarily CO_2) that can be emitted by power plants, but there is a growing interest in mandated caps and reductions. [11] According to industry data from Electric Power Research Institute (EPRI), the U.S. is

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[11] Although there are a number of gases that comprise GHG emissions, the largest in volume is Carbon Dioxide (CO_2)

responsible for 25% of the worldwide CO_2 emissions, and electric utilities are responsible for 33% of the U.S. CO_2 emissions.

There are a number of Federal legislative initiatives currently aimed at reducing GHG emissions in the United States. These initiatives include a number of proposed bills in the U.S. Congress to regulate emissions of $CO_{2,}$ including those from electric generating plants. Prominent proposals include those from McCain-Lieberman, Bingaman-Specter and Lieberman-Warner. All three of these proposals are similar in their overall target reduction amounts, but each addresses different sectors, handles offsets differently, sets a different cap for offsets and sets different limits.[12] Other proposals such as Kerry-Snowe, Sanders-Boxer and Waxman proposals are less well supported and their economic impact, although not well analyzed, is anticipated to be substantial. At the State level, Michigan's Governor Granholm signed the Midwestern Regional Greenhouse Gas Reduction Accord in November 2007. The Accord is a regional strategy to reduce GHG emissions under a market based cap-and-trade program, with an initial goal of establishing reduction goals and timeframes by November 2008.

Analysis of the potential economic impact of the different CO_2 proposals on the BWL is difficult to make at this time. The various legislative proposals are structured differently, for example one has a cap-and-trade program and another proposes a carbon tax. Likewise, some legislation provides for more liberal purchases of GHG offsets, for example planting trees, while other legislation restricts the use of offsets. The effects on the BWL and other utilities could vary widely, depending on whether cap and trade or a tax is imposed on generating plants, or whether offsets will be allowed. Carbon Dioxide capture and sequestration technology is not commercially available at this time, which limits technology options for mitigating carbon regulations on both existing and new plants.

The likely impact of GHG regulation on the utilities in general, and the BWL specifically, could be substantial, depending on what form the legislation may take. Market prices could rise very substantially with the passage of GHG legislation. GHG restrictions will not only increase the cost of producing electricity from the BWL's units, but will also significantly increase the

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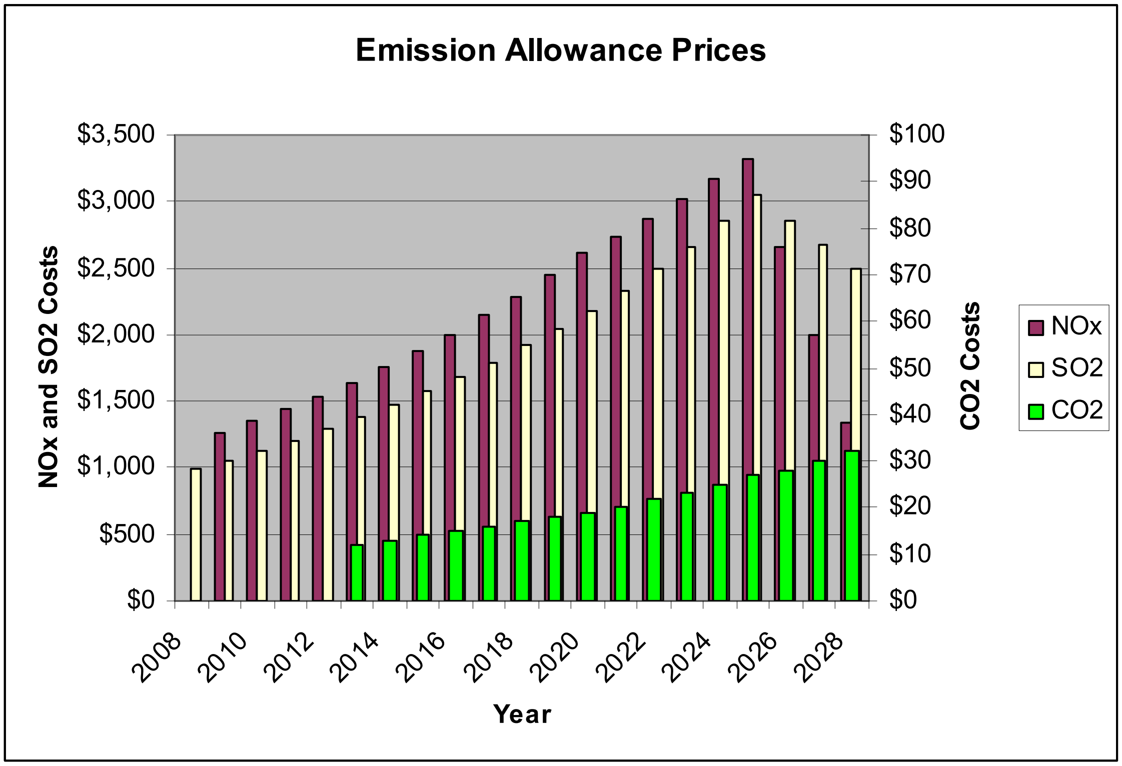
[12] Offsets are actions that capture or offset GHG emissions, like planting trees or reducing energy consumption. Proposed bills intended to regulate carbon treat total offsets and domestic versus international offsets differently.

wholesale price of electricity in the Midwest markets and throughout the country. The implications of GHG legislation were analyzed carefully in this IRP.

For all emissions cost variables used in the modeling sensitivities, staff used the ICF International U.S. Emission & Fuel Markets Outlook - 2007 Edition. All ICF costs are in 2006 dollars. Figure 15 shows the base price forecast for NO_x, SO_2 and CO_2 emission allowances.

Figure 15 - Emission Allowance Price Forecast



Mercury

In 2005 EPA issued the Clean Air Mercury Rule (CAMR) to reduce mercury emissions from coal-fired power plants through a cap-and-trade program. Michigan opted out of the Federal cap and trade program for a stricter state level program. Michigan's program called for a 90% mercury reduction from a 1999 calculated baseline by 2015. The Federal cap and trade program called for a 70% reduction in mercury emissions by 2018.

In early 2008 the US Court of Appeals in Washington D.C. ruled that the EPA did not properly follow required procedures in its CAMR rulemaking process. This procedural violation resulted in the court invalidating the Clean Air Mercury Rule. Since Michigan previously elected to opt out of CAMR, the Michigan Department of Environmental Quality (MDEQ) has continued its process of developing their more stringent rule for Michigan. The installation of mercury monitoring systems on all of the BWL's units is nearing completion and a mercury control system has been installed at Erickson. Under the draft State mercury rules, it appears that it will be necessary to either make major capital expenditures at the Eckert plant before 2015 or do a partial shutdown after 2015 in order to achieve compliance.

New Source Review (NSR)

New Source Review (NSR) is a provision of the Federal Clean Air Act (CAA) and its Amendments that requires pre-construction permitting for large new facilities that will emit pollutants into the air. New units must meet significantly tougher emission requirements than older units. In addition, if a "major modification" is made to an older unit, for example replacement of a turbine, the CAA requires the older unit to also go through NSR. Depending on the interpretation of "major modification", NSR could significantly affect Eckert and Erickson. As the Eckert and Erickson Stations age, it is likely that increasingly more expensive and extensive maintenance projects will be required to keep the plants operating. As these maintenance projects are undertaken, the probabilities grow that one of these projects will trigger NSR. The cost of retrofitting Eckert to meet NSR would be approximately $260 million for units 4-6. NSR was evaluated as a part of the IRP update.[13]

Water

The federal Clean Water Act (CWA) contains many requirements applicable to power plants, but two of them have the potential for significantly impacting the BWL's Eckert plant. These are Sections 316(a) and 316(b) of the CWA. Section 316(a) requires, among other things, that new and existing sources shall not discharge heated water into the waters of the United States in excess of state water quality standards. This is particularly important to the Eckert plant since

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[13] Modifications or maintenance programs that could trigger NSR on existing units are not well defined at this time. However, this issue is currently being debated and clarified through the court system.

the Moores Park Dam was originally built to create a cooling water impoundment for Eckert. Water is drawn from the impoundment to condense steam back into water in the final phase of the turbine cycle. The water that is used to condense steam is heated in this process and then returned to the impoundment. Future water discharge standards under 316(a) may include thermal limits.

Under 316(b) of CWA, the design and operation of cooling water intake structures was regulated to minimize impingement and entrainment of aquatic organisms. In 1974, the EPA adopted rules to implement section 316(b). A successful appeal by a consortium of environmental organizations to the Supreme Court resulted in the EPA being directed to re-write several sections of the regulation. One major provision in the original rule would have allowed for restoration of aquatic organisms that may be entrained by diversion of cooling water and for cost benefit analysis in lieu of installation of expensive closed cycle cooling towers or reconstructed intake structures. However, restoration and cost-benefit options were specifically stricken by the courts and will likely be omitted in the new rules. No draft regulations have been promulgated since the Supreme Court decision, therefore a compliance strategy has been difficult to craft. Erickson Station has closed a cycle cooling system using cooling towers already in place and will likely be unaffected by 316(b). The Eckert plant, however, could be significantly impacted by this rule, depending on its final provisions. The impact of 316(b) on Eckert was evaluated as part of the IRP update.

As of June 2008, the BWL's National Pollutant Discharge Elimination System (NPDES) permit for both Eckert and Erickson stations requires monitoring to establish a baseline of mercury in water effluent. It is not yet know what potential impact this could have on BWL facilities.

3.4 Scenarios

Once the Base Case was completed and base forecasts prepared, scenarios representing future contingencies were examined, along with model sensitivities. Scenarios developed for this IRP include:

- High and Low Energy and Demand Growth Forecasts
- Energy Efficiency Program
- 10% Renewable Energy portfolio standard

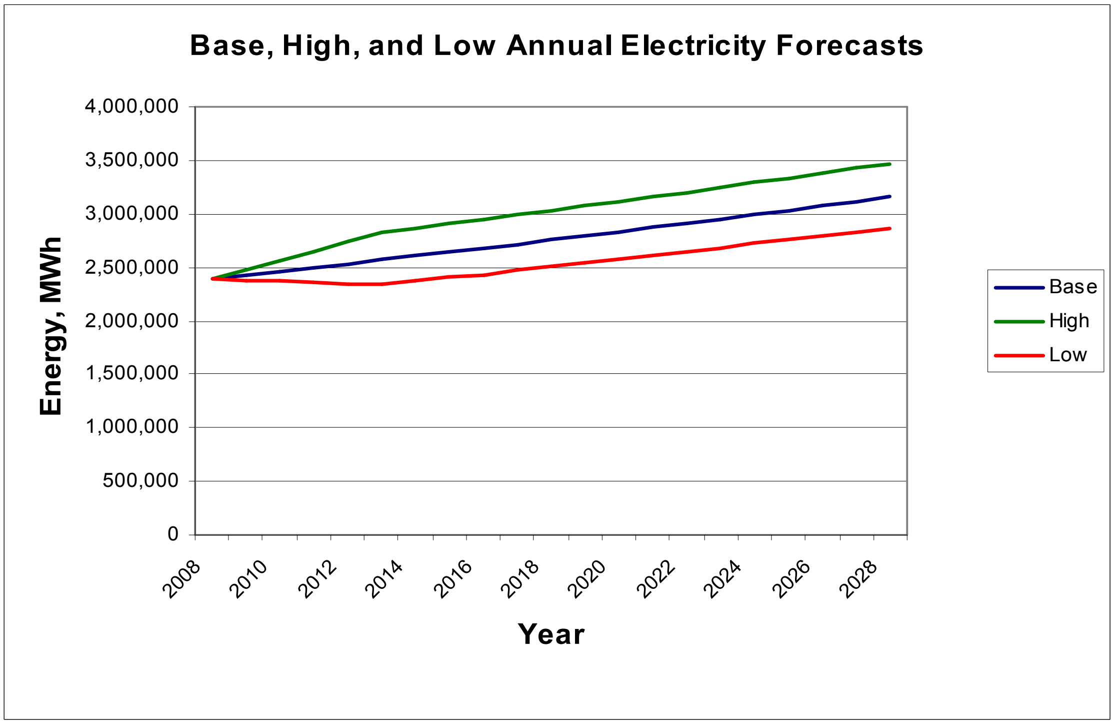
- Energy Efficiency together with 10% Renewable Energy Standard
- Joint unit construction with other municipal utilities
- No GHG controls
- Reliance on Market Purchases

Scenario 1 – High and Low Demand and Energy Growth Forecasts

Numerous assumptions must be made in forecasting demand and energy growth over a twenty-year period. These assumptions include weather, population growth, economic growth, appliance efficiencies, uses for electricity, etc. For example, as battery technology improves the adoption of electric automobiles may become more widespread. If this were to occur, the demand for electricity would likely increase faster than anticipated. For many reasons, it is likely that actual experience will deviate from the assumptions needed to make a long-term forecast. If actual growth exceeds forecast growth, the BWL would be faced with providing more generation than it would have available. This would force the BWL to rely on wholesale markets or bilateral contracts. On the other hand, if growth is actually slower than forecast, the need for additional generation or a long-term contract for power could be deferred into the future, avoiding near-term capital costs.

To account for the uncertainty surrounding the demand and energy forecast, staff has created two forecast sensitivities. One sensitivity is a high growth sensitivity. The high growth sensitivity is calculated by increasing the forecast sales by 2% in each of the first five forecast years until the high sensitivity is 10% greater than the base forecast. The high sensitivity then remains 10% above the base forecast for the remainder of the forecast period. The other sensitivity, the low growth sensitivity, reduces the base forecast sales by 2% per year for the first five forecast years until it is 10% below the below the base forecast. It then remains below the base forecast through the remainder of the forecast period. The base, high, and low growth sensitivities for annual energy sales, in megawatt hours (MWh) are shown in Figure 16 below.

Figure 16 - Base, High, and Low Energy Forecasts



Scenario 2 – Implementation of Energy Efficiency Program

This scenario incorporates the energy and cost savings of the energy efficiency program described in Section 2.2. The energy efficiency program is based upon a program size of $1.4 million annually (2007 dollars) and a cost of conserved energy of 3.25 cents per kWh. The program is projected to reduce energy use in the BWL's service territory by 2.4% in 10 years.

Scenario 3 – Increased Renewable Energy

The BWL currently has a renewable energy goal of 7% of its retail sales by 2016. The BWL has 16 MW of renewable energy under contract, is discussing additional projects with developers, is examining constructing its own projects, and is on course for meeting its 7% goal. Sufficient renewable energy to meet the BWL's 7% goal is already incorporated into the BWL's generation in the Base Case.

The Michigan House of Representatives recently adopted a renewable energy standard of 10% by 2015. To incorporate this expanded requirement to use of renewable energy into the planning process, this scenario was developed. Renewable energy beyond the BWL's 7% commitment was assumed to be provided by wind energy.

The proposed state legislation of SB 0213 (Birkholz) and HB 4562 (Accavitti) requires:

- 4% by 12/31/2008
- 5% by 12/31/2010
- 6% by 12/31/2012
- 7% by 12/31/2015
- 10% after 12/31/2015

These levels of renewable energy were incorporated into the increased renewable energy scenarios.

Scenario 4 – Increased Energy Efficiency AND Renewable Energy to Meet Future Growth

This scenario combines the Energy Efficiency detailed in Scenario 2 with the increased Renewable Energy from Scenario 3. In addition, it increases the cost of both programs at an average rate sufficient to offset future energy growth for at least the first ten years.

Scenario 5 – Joint Unit Construction

The BWL is currently a member of the Michigan Public Power Agency (MPPA) power pool, along with 6 other municipal utilities. The BWL is the largest member of the pool and provides its excess baseload generation to the other municipalities on a cost basis. In 2007, the BWL provided approximately 550,000 MWh of electric power to the pool members. The BWL also uses its baseload generation to make sales to power brokers and to sell into hourly wholesale markets. Non-pool third party sales totaled approximately 600,000 MWh in 2007. On December 31, 2010, the MPPA pool will terminate and any excess BWL generation will be available to sell to electric power brokers, hourly wholesale markets, or to a successor municipal power pool. Base Case conditions assume sales to the pool until the end of 2010 and, thereafter, purchases and sales will be to the wholesale economy energy and capacity markets.

Construction of a new generating unit, especially a baseload unit can cause financial stress on a utility. One way to relieve this financial stress is to invite other utilities that also need generation to become partners in the new unit. The financial risk to any one utility is reduced through the participation of other utilities in the new unit. The BWL has been and is a partner with other municipal utilities in various industry projects, including the MPPA power pool. Continuing this partnership by inviting other utilities to participate in a new plant can lower the financial risk of constructing a new plant and will lower the cost of a new plant through economies of scale. Based on this reasoning, staff developed a scenario that includes participation by other municipal utilities in a new unit.

This scenario assumes the creation of a new coordination agreement with other municipal utilities and includes both load and generation data for other municipals. In total, 188 MW's and 908,000 MWh's of demand and energy for 2007 from other municipal utilities were included with the BWL's load data. The municipal loads were then increased in the future for load growth. Additional generation from these same municipalities was also added to the BWL's generation inventory. Approximately 38 MW of baseload and approximate 66 MW's of peaking capacity were added to the BWL's own generation to model this scenario.

Scenarios 6 and 7 – No GHG controls and Exclusive Market Purchase

These scenarios were developed as special "impact" scenarios to estimate the effect of GHG and wholesale markets on Base Case results alone; additional sensitivities were not used with these scenarios. All scenarios include the effect of GHG controls in the future. In order to estimate the potential financial effect of GHG controls, staff developed a special scenario to incorporate all Base Case conditions, but without any GHG controls. Currently, there are no limits on GHG emissions from power plants and to estimate the full impact of GHG controls, staff developed an "as is" scenario.

The second special scenario was designed to evaluate the impact of exclusive reliance on Midwest wholesale markets alone. This scenario measures the cost of relying on market purchases and not constructing needed generation.

3.5 Sensitivities

Sensitivities are used to examine the influence of parameter changes on the results of each planning scenario. Generally, sensitivities do not require model re-optimization since changes in parameter values do not impact each plan's feasibilities.

Sensitivities examined in this IRP include:

- High Natural Gas Prices
- High Construction Cost Escalation
- Low CO_2 Cost, with corresponding SO_2 and NO_x costs
- High CO_2 Cost, with corresponding SO_2 and NO_x costs

Sensitivity 1 – High Gas Prices

Due to expected Carbon Legislation impacts among other things, assumed to begin in 2013, the demand for natural gas generation is expected to increase relative to coal generation. To account for this possibility, staff developed this high gas price sensitivity to calculate the high natural gas prices. Staff first calculated the standard deviation of monthly Henry Hub prices from 1992 to 2005, and then increased natural gas prices 1 Standard Deviation above the current expected forward price forecast. The transition to the higher price trajectory was phased in by blending in +20% of the standard deviation per year from 2011 to 2015.

Sensitivity 2 – High Construction Cost Escalation

The economics of electric generation technologies represent tradeoffs between high capital cost of solid fuel facilities like coal, nuclear, or biomass generators versus the high operating costs of natural gas or fuel oil fueled generators.

As shown in Figure 9, the construction costs, $/kW of capacity, are much higher for coal facilities when compared to natural gas fueled facilities. This higher capital cost must be offset by lower operating costs (principally fuel costs) over the plant's service life in order for the solid fuel plant to be the lower cost production option.

This sensitivity used the Base Case assumptions, except that staff "bumped up" unit capital costs by 15% for 2009 and 10% for 2010 to account for the recent rapid escalation of capital costs. After 2010, the capital escalation rate is expected to resume a long-run rate of 4%.

Sensitivity 3 – Low CO_2 Cost

Using the Base Case assumption for all factors except used the ICF Low Market price projections for CO_2, ranging from $8/ton in 2013 to $22/ ton in 2028.

Sensitivity 4 – High CO_2 Cost

This Sensitivity also used the Base Case assumptions for all factors except used the ICF High Market price projections for CO_2, ranging from $15/ton in 2013 to $39/ ton in 2028.

3.6 Resource Expansion Modeling

The principal analytical tool used in this study was a dynamic programming model. The model's criteria included identification of least cost resource plan for each scenario and subject to a reliability constraint. The least cost plan is that group of options that results in the minimum present value revenue requirement over the twenty-year planning horizon. The reliability constraint was maintenance for 14% planning reserve margin. In order to analyze the effect on BWL costs of various resource options and forecast uncertainties, scenarios and sensitivities were used in addition to the Base Case.

In total, seven scenarios and five sensitivities were modeled to represent a broad set of future contingencies and future events. The dynamic programming model used in this IRP evaluated over 1,000 possible resource plans for each scenario and sensitivity. From among these many plans, for each scenario and sensitivity, it selected a least cost plan. Resources that were selected in common among all the scenarios and sensitivities serve to lower costs over a wide range of possible contingencies and form part of staff's recommended plan. The least cost plan for each scenario and sensitivity is shown in Figure 17.

Figure 17 – Present Value Costs (in $1,000,000)

	Base	**High Construction Escalation**	**High Environmental Allowance Costs**	**Low Environmental Allowance Costs**	**High Natural Gas Costs**
Base Case	$2,226	$2,270	$2,389	$2,014	$1,867
High Load Growth	$2,475	$2,529	$2,665	$2,265	$2,171
Low load Growth	$2,004	$2,046	$2,160	$1,800	$1,601
Energy Efficiency	$2,202	$2,245	$2,363	$1,991	$1,835
Expanded Renewables	$2,260	$2,304	$2,420	$2,050	$1,888
Energy Efficiency & Expanded Renewable	$2,235	$2,278	$2,394	$2,025	$1,856
Additional Municipal Load	$3,171	$3,220	$3,388	$2,917	$2,985
No GHG controls	$1,206				
Exclusive reliance on Market	$2,567				

The costs shown in Figure 17 include fuel, variable and fixed operations and maintenance costs (O&M), and incremental capital costs over the twenty-year planning horizon, aggregated for all existing and new generating plants selected by the planning model for the BWL.

Additional modeling data, explanation of modeling methodology, and modeling results are included in the IRP Appendix.

3.7 Modeling Results

The Base Case model run selects short-term capacity additions beginning in 2016 to meet reliability requirements. By the end of 2016, demand and energy growth cause the BWL's projected reserve margin to fall below the 14% standard adopted for this IRP. To meet this need, the various scenarios and sensitivities select either peaking type natural gas capacity or a short-term market capacity purchase. However, as soon as the first three Eckert units are retired, in 2017, the model adds a baseload coal plant to the BWL's generation inventory.

A new baseload unit is selected in all scenarios and sensitivities when Eckert is retired. This finding is the latest in a series of modeling efforts, which include the Michigan Public Service Commission's Capacity Needs Forum and 21st Century Energy Plan, that select additional baseload generation options for this region. The modeling scenarios and sensitivities demonstrate that both natural gas and wholesale market options are significantly more expensive than a baseload generation option.

For example, replacement of the Eckert units with natural gas fueled generation is projected to be $120,000,000, or more than 5% more expensive over the next twenty years on a present value basis than baseload generation.

The present value calculation, however, masks the future cost differential between natural gas and baseload generation. Because the higher cost of natural gas generation doesn't occur until after 2017, when a new unit is needed, the present value calculation makes the higher cost natural gas generation appear more modest than it will actually be in those later years.

One important finding of this planning effort is that building a new unit to replace the Eckert units results in significantly lower costs, if major investments must be made at Eckert to remain in compliance with environmental regulations. Investments necessary to comply with current and future environmental standards resulted in significantly more fixed costs being incurred at the plants with no gain in efficiency. As a result, costs can be lowered by a new, more efficient unit. Continuing to operate the Eckert units assuming additional investment is needed for air emission compliance, results in twenty-year present value costs that are over $170,000,000 higher than replacing the units.

If the BWL does nothing and relies on market purchases of capacity and energy, the cost is projected to be 15%, or $341,486,000 greater over the next twenty years on a present value basis than building a new baseload replacement for the Eckert units. Again, this relative cost differential is masked by the present value calculations. In 2018, for example, the cost of relying on wholesale markets is projected to be 34% higher than the cost of building and operating new baseload generation.

The BWL's largest cost exposure arises from potential GHG regulations. Coal fueled electric generation plants are the largest stationary source of CO_2 emissions in Michigan, and CO_2, by volume, is the largest component of GHG emissions. The BWL's electric generating units emit approximately 4 million tons of CO_2 annually. GHG controls are included in all the scenarios and sensitivities shown in Figure 17. To determine the impact of GHG regulations, one additional model run was made under Base Case conditions, except no GHG related regulatory costs were included. A comparison of these scenarios indicated that our Base Case GHG assumption raises the twenty-year present value revenue requirement from $1.2 billion to $2.2 billion. Based on this comparison, future GHG controls represent the BWL's largest potential cost exposure.

The high gas cost sensitivity results in the lowest revenue requirements. Though seemingly counterintuitive, this finding is consistent with other modeling efforts. On-peak Midwest wholesale market prices were highly influenced by natural gas prices. When baseload power plants have excess generation available, it is sold into these high-priced markets. The revenue from these sales is used to offset the BWL's expenses, lowering the total present value cost over the twenty-year planning period.

The overall costs to the BWL's ratepayers can be reduced through the use of energy efficiency programs. Again, this is a common finding of electric energy planning. Well conceived and implemented energy efficiency programs lower the total cost of providing electric energy services. Energy efficiency also eliminates the need for peaking capacity or, alternatively, short-term market purchases to meet the reserve margin deficiency in 2016. Although energy efficiency programs can lower total costs, they can cause rates to increase, even as they lower total costs. This phenomenon occurs because the BWL's fixed costs are spread over a smaller amount of sales.

4.0 Recommendations

Energy efficiency programming produces the lowest total cost resource plan. This type of programming also adds flexibility to the BWL's planning process; energy efficiency investment can be increased or decreased quickly in response to customer needs. Adding load management options to an energy efficiency program will eliminate the need for short-term capacity in 2016. Together, these programs produce the lowest cost resource plans, help meet reliability needs and help lower future GHG emissions.

Likewise, renewable energy options lower future costs by avoiding future GHG emissions. Based upon proposed GHG legislation, GHG emission costs could increase the cost of a new baseload generating unit by up to 35%. Although there is no certainty regarding what form GHG legislation may take, renewable options provide valuable protection from this future cost.

The selection of additional baseload generation as the least cost method to replace the Eckert units occurs in all scenarios and sensitivities modeled in this IRP. Modeling indicates that it is far less expensive to replace Eckert than to invest in the plant to meet potential environmental regulations. Compliance requirements may be avoided for some time, but it seems likely that a major investment in the plant will be needed to keep it operational. The large investment needed for compliance on a 60 year old plant is not cost-effective.

It is clear from the various scenarios and sensitivities that GHG regulations represent the largest potential risk to the BWL's customers. GHG causes costs to rise in all scenarios and sensitivities. Even in the high carbon tax case, however, the model selected a baseload unit. The cost of compliance with GHG can be lowered substantially through the use of energy efficiency and renewable energy options.

To lower future costs and manage future risks, we recommend that energy efficiency and renewable energy options play an important role in the BWL's plans. In fact, our recommendation is to meet all load growth through at least the first ten years with a combination of energy efficiency programming and renewable energy production.

With the retirement of the Eckert units, no later than 2017 for units 1-3, we recommend that the BWL construct a replacement baseload plant. Further, we recommend the development of a hybrid biomass/coal baseload facility. Co-firing a new, more efficient generating plant with biomass will help reduce its GHG emissions, and limit the BWL customers' exposure to future GHG costs. This plan also protects customers from other air emissions regulations and future fuel cost escalation. The best technology for meeting this goal is a circulating fluidized bed (CFB) plant. A CFB plant can burn a wide variety of fuels, including biomass, to produce electricity. In order to realize economies of scale and minimize financial risk, we recommend inviting other municipal utilities to participate in the new baseload facility. Depending on how many municipal utilities may choose to invest in a new BWL plant we anticipate a need for about 350 MW's (250 MW's for the BWL, 100 MW's for other municipal utilities) of capacity at the new unit.

Given the long lead times necessary to permit and construct a baseload unit, we recommend that the permitting and pre-construction work begin immediately. Based upon current experience, a new plant would be operational approximately the same time that the Eckert units are retired from service.

One goal of this plan is to set the BWL on a path to reduce its GHG emissions in order to comply with likely future GHG regulations. Our recommendations are expected to reduce the BWL's CO_2 emissions significantly by 2025. This plan will provide protection from GHG costs and may actually provide an opportunity to realize revenue through the sale of carbon credits, depending on the final form that GHG regulations may take. A reduction in GHG by 2025 will present a major challenge for the BWL. Nevertheless, considering the potential exposure presented by GHG regulations and the options available to the BWL, staff believes that this goal is realistic for planning purposes.