Citizens Advisory Committee Report: Integrated Resource Plan

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Glossary

ORGANIZATIONS/ ENTITIES

BWL—Board of Water and Light

DOE—Department of Energy

EIA—Energy Information Administration

EPA—Environmental Protection Agency

FERC—Federal Energy Regulatory Commission

MISO—Midcontinent Independent System Operator

MPSC—Michigan Public Service Commission

NERC—North American Electric Reliability Council

PJM—Pennsylvania, New Jersey, and Maryland Interconnection

RTO—Regional Transmission Operator

UNITS

BTU—British thermal unit

Bcf—Billion Cubic Feet

Bcf/d—Billion Cubic Feet per Day

GW—Gigawatt

GWh—Gigawatt hour

kW—Kilowatt

kWh—Kilowatt hour

kV—Kilovolt

kVa—Kilovolt-amperes

Mcf—Thousand cubic feet

MMcf—Million cubic feet

MMBtu—Million British Thermal Units

MW—Megawatt

MWh—Megawatt hour

MVA—Megavolt-amperes

V—Volt

TERMS

CAA—Clean Air Act

CCR—Coal Combustion Residuals

CDD—Cooling Degree Day

CHP—Combined Heat and Power

CON—Certificate of Necessity

CPP—Clean Power Plan

DER—Distributed energy resources

DR—Demand Response

EE—Energy efficiency

EERS—Energy efficiency resource standards

EO—Energy optimization

HDD—Heating Degree Day

IPP—Independent Power Producer

IRP—Integrated Resource Planning

LNG—Liquefied Natural Gas

LSE—Load Serving Entity

LMP—Location Marginal Pricing

NCP—Non-coincident Peak

NOx—Nitrogen Oxide

NUG—Non Utility Generator

O & M—Operating and maintenance

OASIS—Open Access Same-time Information System

PPA—Power purchase agreement

PSCR—Power supply cost recovery

PV—Photovoltaic

TRC—Total Resource Cost

UCT—Utility Cost Test

MISO ACRONYMS

AGC— Automatic Generation Control

ARC— Aggregators of Retail Customers

ARR— Auction Revenue Rights

ASM— Ancillary Services Market

BA—Balancing Authority

BPM— Business Practice Manual

BTMG— Behind the Meter Generation

CIL—Capacity Import Limits

CEL—Capacity Export Limits

CONE—Cost of New Entry

CPS—Control Performance Standard

CRSG— Midwest Contingency Reserve Sharing Group

DCS—Disturbance Control Standard

DRR—Demand Response Resource

EDR—Emergency Demand Response

EEA—Energy Emergency Alert

EFORd—Equivalent Demand Forced Outage Rate

FTR—Financial Transmission Rights

GFA—Grandfathered Agreement

IA—Interchange Authority

ICAP—Installed Capacity

IMM—Independent Market Monitor

LBA—Local Balancing Authority

LMP—Locational Marginal Pricing

LMR—Load Modifying Resource

LOLE—Loss of Load Expectation

LRR—Local Reliability Requirements

LRZ—Local Resource Zone

LSE—Load Serving Entity

MCC—Marginal Congestion Component

MP—Market Participant

MVP—Multi-Value Project

OATT—Open Access Transmission Tariff

OMS—Organization of MISO States

PA—Planning Authority

PRMR—Planning Reserve Margin Requirement

PRA—Planning Resource Auction

PtP—Point to Point

RA—Resource Adequacy

RAC—Reliability Assessment Commitment

RAR—Resource Adequacy Review

RC—Reliability Coordinator

RTO—Regional Transmission Organization

SCUC—Security Constrained Unit Commitment

TLR—Transmission Loading Relief

TO—Transmission Owner

TSP—Transmission Service Provider

TSR—Transmission Service Request

UCAP—Unforced Capacity

Executive Summary

BACKGROUND

Like many other utilities in the United States, the Lansing Board of Water and Light (BWL), has depended predominately on energy from coal to provide safe, reliable, and affordable electricity to its customers in the Greater Lansing region for the past 100 years. This is set to change as age, environmental pressures, and low-cost natural gas generation drive BWL to shutter its largest and oldest coal-fired power plant—the Eckert Power Station. Since the mid-1950's, Eckert Station has played a prominent role in powering the region's economy, and its three smokestacks—Wynken, Blynken, and Nod—have been a defining feature of Lansing's downtown skyline. Planning for Eckert's closure is vital to BWL's future and the utility must also consider new environmental regulations that have already begun to profoundly change the electric power industry. The US Environmental Protection Agency's (EPA) Clean Power Plan (CPP), although currently stayed pending judicial review, would have profound effects on the nation's power supplies, especially in coal-dominated states like Michigan. If upheld by the courts, power producers would have to significantly reduce greenhouse gas emissions from power plants, and many coal fired plants will need to be retired to meet the Plan's reduction targets. Many utilities are planning to phase out some coal generation regardless of what happens with the CPP due to age and other issues.

Eckert is important primarily for its size and location. The plant supplies a third of BWL's generating capacity and, until recently, a third of its energy. The plant also serves as the hub for about a third of the BWL's electric distribution system. The current system has been built up around Eckert and before it can be retired, the BWL must first upgrade its transmission system to accommodate its changing dynamics and maintain electric reliability once Eckert is removed from service. BWL has already begun taking steps to ensure that its transmission and distribution systems are prepared to accommodate Eckert's retirement, but there is still a need to replace the energy and capacity that will be lost.

To ensure that BWL can continue to meet the needs of its customers into the future, BWL has undertaken an integrated resource planning (IRP) process. IRP processes help utilities evaluate a broad set of resources, both demand and supply side, to determine how to best meet their expected needs while managing future risks and uncertainties at the lowest cost. The ultimate goal of BWL's IRP process is to craft a plan that balances costs for customers with ensuring a reliable energy source for the region while providing environmental stewardship, mitigating risks, meeting environmental regulations, maintaining local generation capacity, and supporting economic development.

The IRP process is complex; however, BWL has committed to making the IRP process inclusive and transparent by giving customers and stakeholders a voice in its development. To this end, the BWL formed a nine-member Citizens Advisory Committee (CAC) and tasked the group with guiding the IRP process and recommending an integrated resource plan to the BWL's Board of Commissioners.

PROCESS

The BWL began the IRP process by soliciting applications to serve on the Citizens Advisory Committee from the community at large. Nine members of the Greater Lansing community were selected, representing a cross section of the community that includes residential customers, business interests, utility expertise, environmental organizations, labor, and other constituencies.

Between October 2015 and February 2016, the CAC held six public meetings during which presentations were delivered on a comprehensive list of topics designed to provide as much information as possible to inform the Committee's decision-making process. Topics including an overview of BWL operations, industry trends, current energy and capacity requirements, projections for future energy and supply needs, and modeling inputs and assumptions used to develop several 20-year resource portfolios. These presentations, twenty in all, were provided by BWL staff as well as other experts and regional stakeholders.

Members of the public were also invited to address the CAC during the meetings, and several residents and interested parties did so. Written comments were also welcome, and the following website was created to provide information on the process and allow people to submit comments for the CAC's consideration, LansingEnergyTomorrow.com. The CAC received written and oral comments from 60 people.

In addition to gathering public comment at the meetings, the BWL also commissioned EPIC-MRA to conduct a public-opinion survey to gauge the priorities of BWL residential and business customers for Lansing's energy future. The survey revealed that BWL customers share four key objectives for planning the Lansing region's power portfolio:

- Affordability
- Reliability
- Generating energy while minimizing environmental impact
- Providing enough affordable energy to attract economic development and business

Collectively these presentations from a host of experts, input from citizens, and the public-opinion survey provided the Committee with a complete overview of the relevant facts, figures, issues and information needed to deliberate and develop a recommendation to be presented to the BWL's Board of Commissioners. Two CAC deliberation sessions took place during March 2016. At the first of these sessions the Committee settled on eight principles to guide their deliberations;

1. Provide affordable, reliable, secure, and sustainable electricity to customers.
2. Position BWL as a leader in the deployment of clean-energy technologies, such as renewable energy, energy efficiency, and distributed-energy resources.
3. Promote the creation of a healthy environment for customers and the Greater Lansing region.
4. Generate and maintain local employment.
5. Promote economic development in the Greater Lansing region.
6. Be adaptable and mitigate future risks related to resource/fuel availability, technological advances, and cost.
7. Emphasize the importance of local control and continue to seek input from the community when making major decisions.
8. Prioritize energy self-sufficiency by reducing BWL's reliance on outside energy markets.

With these guiding principles in mind, the Committee evaluated a variety of energy portfolios. Each portfolio included differing amounts of potential sources of generation (supply-side resources), such as natural gas turbines, solar power, wind turbines, and distributed generation, and also included sources of energy conservation, curtailment, or management (demand-side resources) such as energy efficiency programs, direct load control and time of use rates.

These supply-side and demand-side resources were configured in a variety of ways with the widely used energy modeling software program, Strategist (ABB, formerly Ventyx). Some of the portfolios were designed by BWL staff, and others were directed by the Committee, but all of the scenarios were designed as a means of considering as many energy options as feasible, with the guiding principles setting some parameters on the breadth of the options to be considered. Starting with the *Reference Portfolio*, which allowed the Strategist software program to select the least costly option, eight separate portfolios were evaluated:

- *Reference Portfolio*
- *Clean-Energy Goal Portfolio*
- *Market-Based Portfolio*
- *Belle River Early Retirement Portfolio*
- *85MW Wind Project Portfolio*
- *Expanded Energy Efficiency Portfolio*
- *Clean-Energy Goal with 85MW Wind Project Portfolio*
- *Clean-Energy Goal with 85MW Wind Project & Expanded Energy Efficiency Portfolio*

Each portfolio was also further analyzed by applying four additional sensitivities that represent potential risks and unknowns that could have a significant impact on the cost: (1) higher-than-anticipated gas prices, (2) lower-than-anticipated load growth, (3) higher-than-anticipated load growth, and (4) higher-than-anticipated natural gas infrastructure supply cost.

RECOMMENDATIONS

After months of meetings, many hours of study, and much deliberation, the CAC concluded the *Clean-Energy Goal with 85MW Wind Project Portfolio* is the portfolio that aligns best with their guiding principles, satisfies customers' desires, and positions BWL for the future. This portfolio includes a progressive renewable energy schedule starting with the addition of an 85 MW wind project in 2018, and 120 MW of solar between 2020 and 2030. This will mean that the BWL will meet its energy demand from approximately one-third clean energy by 2020 and 40 percent clean energy by 2030. The portfolio will also position the BWL to reduce its emissions profile to a level compliant with the Clean Power Plan under each of the four sensitivity analyses. The renewable energy investments will be made in conjunction with the development of 250 MW of gas turbine generation between 2020 and 2030, as well as an additional 150 MW of gas turbine generation in 2030. While not the lowest-cost portfolio, the Committee believes that the additional clean energy investment under this portfolio is the right choice to balance affordability, sustainability, and reliability for BWL now and into the future.

Lastly, because innovation in electric utility business is expected to progress at a steady pace, and because of the risks and uncertainties that may or may not come to fruition between now and the final construction phase of the portfolio in 2030, the Committee also recommends that the IRP be reviewed every four years to make any changes needed to address the ever-changing energy landscape in a manner that continues to comport with the guiding principles selected by the CAC.

Integrated Resource Planning Process

BACKGROUND

Like many other utilities in the United States, the Lansing Board of Water and Light (BWL), has depended predominately on energy from coal to provide safe, reliable, and affordable electricity to its customers in the Greater Lansing region for the past 100 years. This is set to change as age, environmental pressures, and low-cost natural gas generation drive BWL to shutter its largest and oldest coal-fired power plant—the Eckert Power Station. Since the mid-1950's, Eckert Station has played a prominent role in powering the region's economy, and its three smokestacks—*Wynken*, *Blynken*, and *Nod*—have been a defining feature of Lansing's downtown skyline. Planning for Eckert's closure is vital to BWL's future and the utility must also consider new environmental regulations that have already begun to profoundly change the electric power industry. The Clean Power Plan (CPP), although currently stayed pending judicial review, would have profound effects on the nation's power supplies, especially in coal-dominated states like Michigan. If upheld by the courts, power producers would have to significantly reduce greenhouse gas emissions from power plants, and many coal fired plants will need to be retired to meet the Plan's reduction targets.

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To ensure that BWL can continue to meet the needs of its customers into the future, BWL has undertaken an integrated resource planning (IRP) process. IRP processes help utilities evaluate a broad set of resources, both demand and supply side, to determine how to best meet their expected needs while managing future risks and uncertainties at the lowest cost.

> The ultimate goal of BWL's IRP process is to craft a plan that balances costs for customers with ensuring a reliable energy source for the region, while providing environmental stewardship, mitigating risks, meeting environmental regulations, maintaining local generation capacity, and supporting economic development.

The IRP process is complex; however, BWL has committed to making the IRP process inclusive and transparent by giving customers and stakeholders a voice in its development. To this end, the BWL formed a nine-member Citizens Advisory Committee (CAC) who were tasked with guiding the IRP process and recommending an integrated resource plan to the BWL's Board of Commissioners.

WHAT IS AN INTEGRATED RESOURCE PLAN?

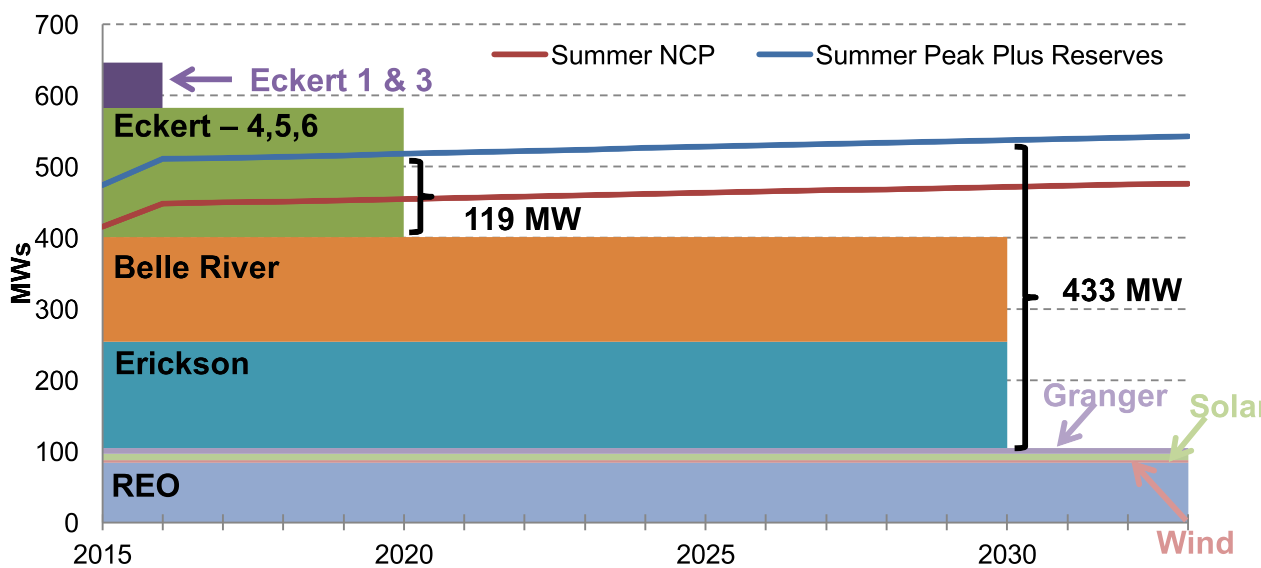
The IRP is a decision support tool and map for meeting the BWL's goals of providing clean, low-cost electric service reliably to its customers while addressing the market risks and uncertainties inherent in the delivery of utility services. Critical elements of the IRP include establishing a load forecast, identifying a resource need, comparing multiple resource portfolios of supply-side and demand-side resources that meet this need and recommending a plan that details the type and schedule of new resource additions.

Utilities have been developing integrated resource plans since the 1980's as a way to evaluate and plan for meeting their future energy and capacity needs. The IRP process allows utilities to compare a broad set of both supply-side and demand-side resources, evaluate different risks and uncertainties, and prioritize goals or objectives for the planning process. Through the IRP, a utility must first evaluate how much energy it will need to supply in the future. Forecasting energy demand relies on complex econometric models, expectations about regional weather/climate patterns, and historical-use data to determine how much energy customers will need in the future. Once the utility has determined its future need, the next step is to evaluate whether their existing electric-generation resources will be available to meet expected demand. If existing resources are insufficient to meet expected energy and capacity needs, then the utility must determine how to fill the gap.

Because the BWL is planning to retire Eckert Power Station in 2020, it will no longer have enough generating resources to meet expected energy demands or its capacity requirement. BWL's current generation resources and its expected capacity-deficiency forecast are shown in Exhibit 1. When Eckert is removed from service, the BWL will be approximately 120 MW short of its generating capacity.

EXHIBIT 1. BWL's Existing Electric Generation Resources and Deficiency Forecast, 2015–2035 (MWs)

Generating Resource	Capacity (MWs)
Eckert Station	179.0
Erickson Station	149.3
REO Town	84.4
Belle River	147.0
Beebe Wind Project	2.8
groSolar*	9.0
Granger Landfill Gas	8.3
Total	**579.8 MWs**



Source: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/9/2016)

Based on the projection that new resources will be needed in order to meet customers' energy needs, BWL has begun to develop an IRP for meeting this future need. Investments in electric-generating resources are not only expensive, they also have implications for years into the future. The high investment stakes make it important that utility planners make the right choices for meeting future energy needs and consider the full range of both supply and demand options.

In order to compare how different resource options will perform over time, utility planners rely on computer modeling software. These computer models are complex systems using mathematical approximations to calculate the economic, environmental, and operational characteristics of the proposed resource portfolios. These models simulate the addition of new resources to the BWL's existing assets. A resource portfolio is then selected that best meets the many, sometimes contradictory, selection criteria. The value of these criteria can be varied to show the impact of those changes to the modeled system. An example of such a change would be adjusting a clean-energy target or moving an implementation date.

These various portfolios are then evaluated for their sensitivity to different future assumptions, such as changes in the cost of fuel or to the load forecast. This simulates how robust each portfolio will be in addressing forecast uncertainties. By comparing the relative performance of the portfolios, an informed resource plan recommendation can be made that best meets the planner's goals. However, modeling software only provides the data and information to help make the decision—it does not make the decision. Making the right choices to meet future energy needs requires that utility planners identify the goals and objectives they are trying to achieve. The BWL identified some initial goals for the IRP process based on stakeholder input:

- Maintain affordability for customers.
- Ensure reliability of electric generation and distribution.
- Utilize energy-efficiency measures to reduce demand.
- Protect the environment.
- Maintain local control.
- Help BWL's existing work force transition to any new resource alternatives.

In order to refine and shape the final IRP goals and objectives, BWL sought the input of a CAC.

IRP CITIZENS ADVISORY COMMITTEE

As a municipal utility, BWL's customers are also its owners, making input from the community imperative to the planning process. In order to help evaluate future energy options and inform the decision making, BWL formed the Citizens Advisory Committee. BWL asked nine members of the Greater Lansing community—representing businesses, residents, and other key stakeholder organizations—to serve on its CAC. The Committee's purpose was to:

- Review and evaluate BWL staff's assumptions, forecasts, analyses, and portfolio models.
- Provide an opportunity for interested members of the community to offer opinions, information, and recommendations.
- Develop a vision and guiding principles for evaluating IRP portfolio options.
- Make recommendations for future resources to the BWL board.

Members were invited based on their expertise on energy, environment, business, and labor issues, and each represents different communities within the BWL service territory. Biographies for the nine CAC members are summarized below.

Committee Bios

Mary H. Brady-Enerson, Co-Chair

- Ms. Brady-Enerson is a resident of the City of Lansing and a longtime staff member of the Lansing-based Clean Water Action organization with a background in electric utilities, public health, and air and water issues.

James Butler

- Mr. Butler is the director of the Urban Revitalization Division of the Michigan State Housing Development Authority. He previously served as interim president and director of the Michigan Broadband Development Authority and has 30 years of experience at IBM.

Glenn Freeman III

- Mr. Freeman was appointed AFL-CIO Community Services Labor Liaison in 1999. His work at Capital Area United Way includes serving on numerous boards and committees, encouraging labor representation on local nonprofit boards and committees, and stimulating labor participation in community programs. He also assists with the annual fall fundraising campaign and helps union members, their families, and citizens in times of need, including building handicapped ramps for the elderly and disabled. Additionally, Mr. Freeman oversees the local Emergency Food and Shelter Program—which distributes federal dollars to local resources for emergencies and disasters—as well as the Combined Federal Campaign. His lifetime of service ranges from Boy Scouts to food drives, medical access advocacy to housing issues, and fundraising. He held positions at Ford Motors and General Motors and has worked in construction and the pharmaceutical industry. Mr. Freeman is an Eaton County Commissioner and serves as the vice chair of the Ways and Means Committee of Eaton County. He is also president of the Greater Lansing Labor Council. Mr. Freeman currently serves on the Capital Area Community Services board, the board of the Greater Lansing Food Bank, and is a member of the Capital Area Michigan Works Workforce Development board and Administration board.

Rory Neuner

- Ms. Neuner is the project director of MI Air MI Health, a statewide coalition of health professionals and health organizations committed to ensuring healthy air for Michigan communities. Formed in 2012, MI Air MI Health advocates for policies at the local, state, and federal levels that improve outdoor air quality, curb the harmful health impacts of climate change, and protect the health of children and families across Michigan. In Greater Lansing, Rory has led MI Air MI Health's work with the Mid-Michigan Asthma Coalition to gather data, raise awareness, and build partnerships between health professionals and policymakers to improve air quality and access to care. Rory holds a bachelor of arts from Yale University and a master of public policy from the University of Chicago Harris School.

Jeffrey R. Pillon

- Mr. Pillon is the Director of Energy Assurance for the National Association of State Energy Officials (NASEO). Since 2009, he has provided states with technical support, training, and exercises for energy emergency planning and response and efforts to enhance the security and resiliency of critical energy infrastructure. Mr. Pillon also has a Special Term Appointment to Argonne National Laboratory’s Risk and Infrastructure Science Center.

Mr. Pillon worked for the State of Michigan from 1973 to 2009 where he as Manager of Energy Data and Security for the Michigan Public Service Commission (MPSC). He was responsible for strategic and integrated resources planning, energy forecasting, and monitoring energy supply and demand. While at the MPSC, he also served as the Departmental Emergency Management Coordinator, chaired the Michigan Critical Infrastructure Protection Committee, and was a member of the Michigan Homeland Security Preparedness Committee; Michigan Homeland Security Advisory Council; and the State's Pandemic Influenza Planning Committee For twelve years was a member of the Electric Power Research Institute's Energy Efficiency/Grid Modernization Public Advisory Group. He was the past chair of the NASEO Energy Data and Security Committee and the Staff Subcommittee on Critical Infrastructure for the National Association of Regulatory Utility Commissioners.

Derrell Slaughter

- Mr. Slaughter is a college senior studying public policy at Michigan State University and a student assistant at the Michigan Public Service Commission. He has managed campaigns for various candidates around the state of Michigan, taken on an internship with the U.S. Department of Energy, and served on the boards of organizations such as the Lansing Area American Civil Liberties Union..

Steven A. Transeth, Co-Chair

- Mr. Transeth is the principal partner of the Lansing law firm Transeth & Associates PLLC, which specializes in providing legal and consulting services in energy and utility law. He is a former member of the Michigan Public Service Commission and has 30 years of experience dealing with energy and utility issues. He is the current director of energy policy for the Michigan Jobs and Energy Coalition, senior policy advisor for Michigan Energy First, and special advisor to the Senate Energy Committee for the 2016 energy policy legislation. He serves on various national committees dealing with energy resources, transmission, and regulatory ethics. He is a frequent lecturer and has written numerous articles on energy and utility issues.

  For over twenty years, Mr. Transeth served as legal counsel to the Michigan Legislature specializing in the areas of energy, technology, public utilities, and local government. Prior to his time with the Legislature, Mr. Transeth was with the Ingham County Prosecuting Attorney's office for six years and in private practice for four years.

  Mr. Transeth holds a bachelor's and master's degree from Michigan State University and a law degree from Thomas M. Cooley Law School.

Daniel G. Voss

- Mr. Voss has 29 years of experience in the energy and facility engineering fields. For the past 19 years, he has been involved with energy procurement, developing energy-related projects, and serving as a specialist on energy regulatory issues. He has implemented several large-scale renewable projects, including landfill gas projects in Fort Wayne, Indiana and Lake Orion, Michigan, as well as numerous solar photovoltaic projects throughout the United States. Mr. Voss has also served on energy-related legislative workgroups in Michigan, such as developing PA 169 of 2014, and also served as the Chair of the cogeneration subgroup working with the MPSC staff on the 21st Century Energy Plan. Mr. Voss holds a bachelor of science in mechanical engineering from the University of Michigan and is a registered Professional Engineer in the State of Michigan.

Yvonne A. Young-McConnell

- Ms. Young-McConnell is a long standing member of Union Missionary Baptist Church where she holds the positions of associate minister and Christian Education Director for the Education Pillar. She is in the pursuit of her master of divinity degree, after which, she will pursue a doctorate in theology. As president of the Lansing NAACP and executive officer of the Michigan State Conference NAACP, her duties include management of the Lansing Branch as well as pursuing and resolving issues concerning discrimination, social injustices, and civil rights. For more than 12 years, she has served as a fire commissioner for the City of Lansing, was the first appointed African-American female fire commissioner in the history of the City of Lansing, and acts as the commission's chairperson. Ms. Young-McConnell serves on the City of Lansing Ad Hoc Committee on Diversity, the Michigan Environmental Council (as back up to NAACP State Conference of Michigan), and the Board of Water and Light's Citizens Advisory Committee.

Committee Process

The Committee met eight times between October 2015 and April 2016. In addition, a website—LansingEnergyTomorrow.com—was created to provide information on the process and allow people to submit comments for the CAC's consideration.

During the first six meetings, CAC members were provided an overview of BWL operations, industry trends, projections for future energy and supply needs, and modeling inputs and assumptions that BWL used to evaluate alternative resource portfolios over the next 20-year resource scenarios. Presentations to the Committee were provided by BWL staff as well as other experts and regional stakeholders. At each meeting, members of the public were invited to speak to the CAC as well. Full presentations and summaries of each meeting are available on the scheduling page of the Lansing Energy Tomorrow website. The goal of these meetings was to provide all Committee members a common understanding of issues and information relevant to the project before beginning exploration and development of recommendations.

The focus of the final two meetings was reviewing the results of BWL's portfolio modeling, developing a vision and guiding principles for considering resource portfolios, and preparing the Committee's recommendations for BWL's Board of Commissioners. Exhibit 2 summarizes the CAC meeting schedule.

The Committee's process for adopting a consensus report and making recommendations to the board are included in Appendix A of this report.

STAKEHOLDER SCOPING MEETINGS

In late summer of 2015, the BWL conducted informal meetings with several stakeholder groups. Staff from the BWL met with representatives of the business and environmental communities, as well as leaders of local neighborhood associations. These groups were asked what they would like the BWL to consider while conducting the IRP. The consensus of these meetings was that the BWL should consider:

- Affordability
- Reliability
- Environmental impacts
- Renewable energy
- Local control
- Workforce transition

The input from the stakeholder meetings was incorporated into the development of a BWL customer survey and presented to the CAC for their consideration.

BWL CUSTOMER SURVEY

In the fall of 2015, BWL commissioned EPIC-MRA to conduct a public-opinion survey to gauge what BWL residential and commercial customers believe is important for future energy planning, and what should be prioritized during the IRP process. EPIC-MRA president Bernie Porn presented the results to the CAC at the January 13, 2015, meeting. The EPIC-MRA survey polled 400 residential and 300 business customers during the periods of September 26–28 and September 29–October 6, respectively. The survey findings consistently showed that customers want BWL to focus on the following goals in developing its IRP:

- Affordability
- Reliability
- Generating energy while minimizing environmental impact
- Providing enough affordable energy to attract economic development and business

The complete results from BWL's customer survey are available on at the following link: January 13 Presentation.

EXHIBIT 2. Citizens Advisory Committee Meeting Schedule

Meeting 1 - October 1, 2015	Meeting 2 - October 21, 2015	Meeting 3 - November 12, 2015	Meeting 4 - December 9, 2015	Meeting 5 - January 13, 2016	Meeting 6 - February 3, 2016	CAC Deliberation

• Introduction and General Background
• Regional Energy Markets
• BWL's Transmission Investments
	• Forecasts
	  • Peak load and energy requirements
	  • Fuel costs
	  • Market prices for energy and capacity
	  • Capital and operating costs
	  • Load and resource requirements
		• Existing generation
		• Cost of new generation
			• Energy efficiency
			• Distributed generation
			• Demand response
				• Modeling
				• Transmission costs
				• Clean Power Plan
				• Customer survey
					• Energy efficiency assumptions
					• Demand response assumptions
					• Review modeling results
						• Committee discusses recommendations

Source: BWL. October 1, 2015. *Citizens Advisory Committee Meeting #1.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-oct-1/ (accessed 3/27/2016)

Resource Modeling Method and Inputs

As introduced earlier in this report, the main goal of BWL's IRP is to determine the right mix of energy resources to meet its future electric energy and capacity needs along with other planning goals, such as those identified in the customer survey and by the citizens advisory committee. To help make the right decision about which resources to invest in, utility planners rely on computerized resource-planning programs. These programs allow utilities to compare the performance of different resource portfolios under a variety of circumstances and sensitivities. Like weather forecasting, resource modeling is a complex process that relies on mathematical approximations of physical systems to predict how resource portfolios will respond to future events.

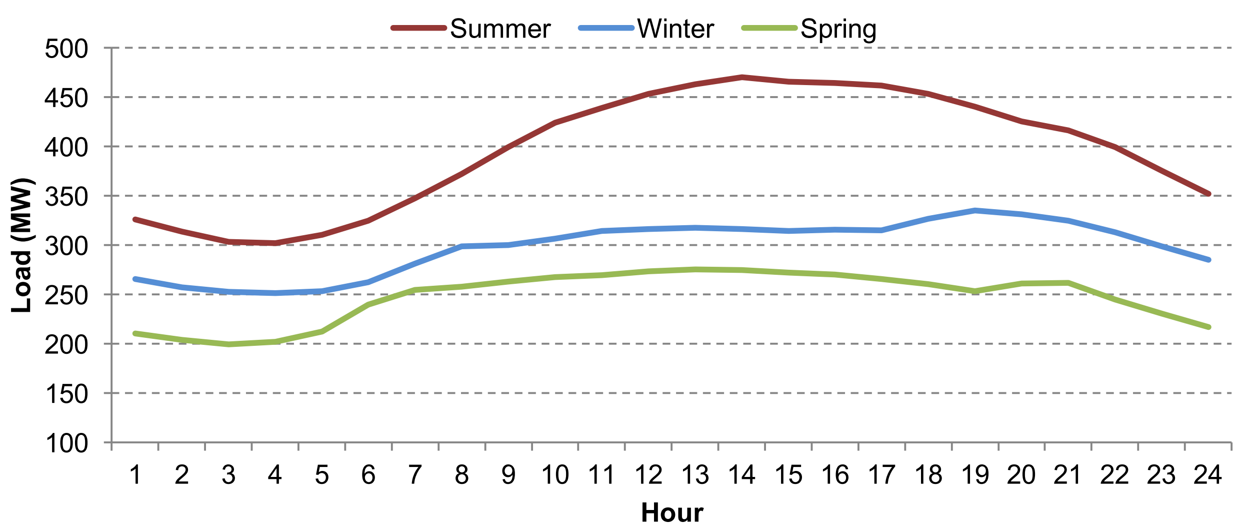
RESOURCE REQUIREMENTS

Electric generators serve multiple functions, all of which are required to maintain reliable electric service. These functions derive from the need to continuously, and instantaneously, balance the supply of electric energy with the demand. To ensure reliability, utilities' planning focuses on three critical functions—energy, capacity, and ancillary services.

Energy

Energy refers to the amount to electricity a utility must produce to meet customer demand. Because energy demand fluctuates depending on time of day and year, producers must be prepared to meet their varying energy needs every minute of every day. As shown in Exhibit 3, energy demand changes from hour to hour each day, and also varies depending on the season.

EXHIBIT 3. BWL Hourly Energy Load, by Season



Source: BWL. October 1, 2015. *Citizens Advisory Committee Meeting #1.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-oct-1/ (accessed 4/4/2016)

Capacity

In order to meet its energy needs, a utility must have sufficient generating capacity at periods of peak demand. Capacity is a measure of how much energy a utility can produce to meet the demand at any moment in time. Because energy demand can fluctuate so much, utilities are required to have enough capacity to meet their expected peak demand plus an additional cushion, or planning reserve margin.

Ancillary Services

Electric utilities also must supply ancillary services, which allow generators to maintain reliability by keeping supply and demand in balance. One ancillary service is load following. This means that as demand changes moment to moment, generators can follow those changes to keep supply and demand in balance. Generators must be available to follow this demand. Other ancillary services include spinning reserves and reactive power supply (VAR production).

Some generating sources—like coal and natural gas—can supply all three of these services. However, not all types of generation can provide all three services at all times. For example, wind generators produce energy but only when the wind is blowing. Solar photovoltaic facilities produce more in the summer during peak times; much less during the fall, winter, and spring; and never at night. The intermittent nature of wind and solar mean they are not used for ancillary services. As a result of these operating characteristics, each type of generating resource will contribute in different ways to meeting the energy, capacity, and ancillary service needs.

MODELING ASSUMPTIONS

Utility planners use models to evaluate the different operating characteristics of the various generation options, reliability compliance requirements, resource costs, and the risks associated with each resource in order to determine the best combination of options to meet the utility's future needs. A number of assumptions must be made in order to model future conditions and costs. Some examples of assumptions that go into a resource model include the price of natural gas over the next 20 years or the cost of solar panels. These assumptions are crucial to ensuring the resource model produces useful results. In developing its model assumptions, BWL enlisted the support of fuel price forecasters, professional engineers, experienced utility operators, and policy experts. BWL's base-case assumptions are shown in Exhibit 4.

EXHIBIT 4. Base-Case Assumptions

	Assumption	Value	Source
1	Modeling Software	Strategist	ABB (formerly Ventyx)
2	Study Period	2016 to 2035	BWL Staff
3	Model Region	Lansing, MI	BWL Staff
4	Weighted Cost of Capital	6.18%	BWL Staff
5	Load Growth	1.30%	BWL Staff
6	Energy Optimization Target	1.00%	BWL Staff
7	Demand Response Reduction	0% - 2016 1.1% - 2020 2.2% - 2025 2.65% - 2035	BWL Staff
8	Unit Retirements	Eckert 4, 5 and 6 - 2020 Belle River 1 and 2 - 2030 Erickson Station - 2030	BWL Staff
9	Natural Gas Price (2015 $/MMBtu)	$3.19 - 2016 $6.41 - 2035	ABB (formerly Ventyx) Michigan Burner Tip

10	Coal Price (2015 $/MMBtu)	$2.36 - 2016 $3.19 - 2035	ABB (formerly Ventyx) Michigan Delivered
11	Gas Conversion Capital Cost Thermal Power Plant Capital Cost Renewable Costs	Listed in Barr Study Listed in Barr Study $52/MWh–Wind PPA $65/MWh–Solar PPA	Barr Engineering Barr Engineering Indicative Pricing Indicative Pricing
12	Renewable Capacity Factors	37.5% - Wind 14.2% - Fixed Axis Solar 22.4% - Single Axis Solar	BeeBe Pro forma BWL experience groSolar Pro forma
13	Renewable Capacity Credit	14.7% - Wind 50% - Solar	MISO
14	Market Energy Price Forecast	$30.24 - 2016 $47.25 - 2035	ABB (formerly Ventyx) MISO-MI
15	Annual Capacity Price Forecast	$0.48 - 2016 $99.00 - 2035	ABB (formerly Ventyx) MISO-MI
16	Transmission cost	$13.25 - Short Term $6.47 - Long Term	BWL Staff
17	Network Transmission cost	$3M/year until Belle River retires $19M/year after Belle River retires	BWL Staff

Source: BWL. February 3, 2016. *Citizens Advisory Committee Meeting #6.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-feb-3/ (accessed 4/4/2016)

DESCRIPTION OF ASSUMPTIONS

The following sections provide additional explanation of BWL's base-case assumptions as mentioned in Exhibit 4.

Modeling Software

BWL is utilizing Strategist computer modeling software for the IRP process. The Strategist Resource Planning Model software has a long history of use with more than 50 utility clients ranging from very small (less than 50 MWs) to very large utilities (up to 24,000 MWs). This software enables BWL to look at a variety of different resource options and sensitivities to determine the best options for minimizing system costs. In addition to choosing the least costly resources the model also allows utility planners to individually select certain resources, such as choosing more renewable options over fossil fuels.

BWL uses several modules within the Strategist software, and each is designed to handle a specific application. The three Strategist modules used by BWL include:

- **Load Forecast Adjustment (LFA)**
  - Used for creating and modifying load forecasts
  - Uses hourly load shapes
  - Interchanges data with GAF module for production costing
- **Generation and Fuel (GAF)**
  - Simulates power system operation
  - Uses probabilistic methods to simulate resource outages

- Provides production cost and generation reliability measures

- **Proview (PRV)**
  - Dynamic Programming Algorithm generates and evaluates all appropriate resource plans
  - Evaluates the economics of resource alternatives that require capital outlay
  - Analyzes long-range strategy and its implications

Study Period

IRPs are typically a long-term planning resource; however, the length of a planning period can cover a range of time horizons, commonly 10–20 years. Typically, a utility planner will use a time horizon that looks far enough into the future to determine how well a long-lived investment—like a power plant—will perform over the course of its lifetime, but not so far into the future that the assumptions are untenable. The most common IRP horizon is 20 years (Wilson 2013). BWL has chosen to look at a 20-year planning period for its IRP covering from 2016 to 2035.

Weighted Cost of Capital

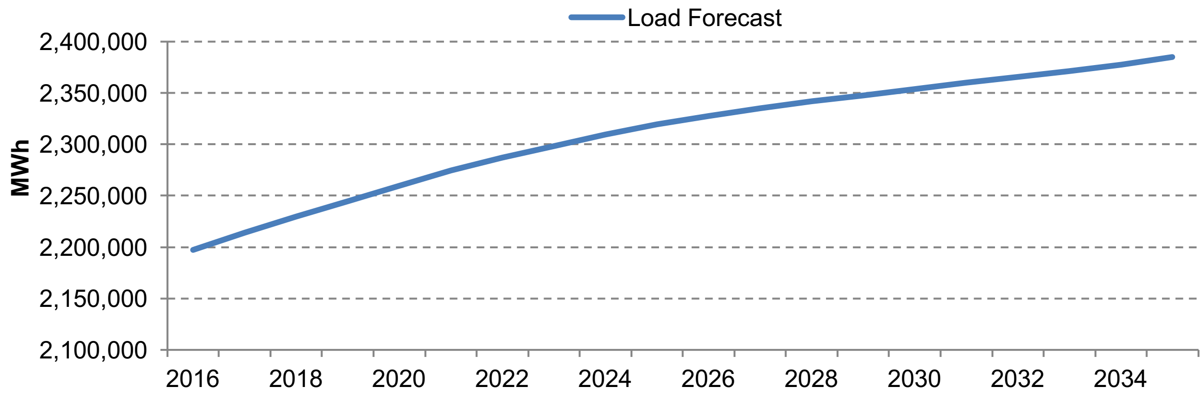
BWL has elected to use a weighted cost of capital of 6.18 percent for its planning purposes. The weighted cost of capital is defined as the "expected return on a portfolio of all a firm's securities" (NASDAQ n.d.). Explained simply—this is the rate of return that the BWL board has adopted as the target return on investment.

Load Growth

BWL's load forecast takes into account economic forecasts, expectations about weather and climate patterns, and historical data. Based on these variables BWL is forecasting that load will grow at 1.3 percent per year throughout the planning period. However, BWL has to consider other factors in determining its load growth, such as energy-efficiency and load management (e.g. demand response). Both energy efficiency and demand response impact how much energy customers consume, and therefore play a role in reducing forecasted load growth. After accounting for expected savings from energy-efficiency and demand response, BWL's load forecast estimates growth at 0.25 to 0.75 percent each year.

There are two distinct elements of load forecasting that BWL must consider in its projections. First, BWL must be able to meet its generation requirement or energy demand. This is the amount of megawatt hours (MWhs) that BWL must produce in order to supply the electricity demand of its customers. BWL's generation forecast is 2.2 million MWhs, which is projected to increase by 0.25 to 0.75 percent each year over the 20 year study period. BWL's generation requirement forecast is shown in Exhibit 5.

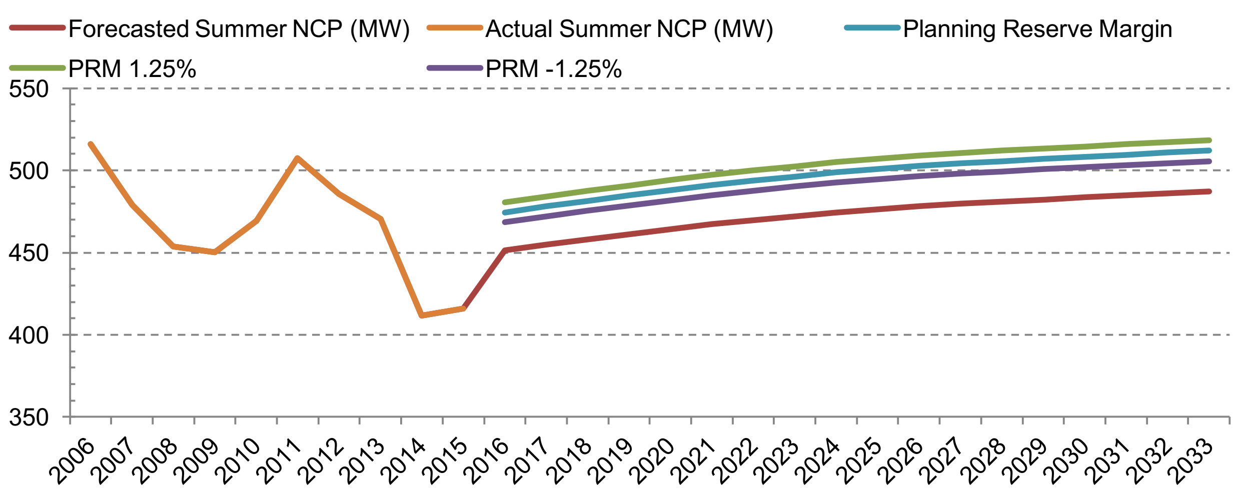
EXHIBIT 5. Load Forecast—Generation Requirements, MWhs



Source: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/4/2016)

The second element of load that BWL forecasts is its peak energy need or capacity. While energy requirement measures how many MWhs a utility must generate in order to meet consumption at any given time, capacity measures the energy a utility can produce in order to meet its expected peak energy needs. Capacity helps ensure that there is always enough power available to meet customer demand throughout the year. In addition to meeting their peak energy needs, utilities are also required to supply an additional reserve margin of capacity. This planning reserve margin is dictated by the regional electric transmission operator—the Midcontinent Independent System Operator (MISO). BWL's peak load is driven primarily by economic activity and weather patterns. To account for variability in weather BWL uses a weather normalized peak demand for its long term projections. BWL projects that its peak demand will grow by 0.25 to 0.75 percent per year, rising to a peak energy demand of 498 MWs by 2035. BWL's peak energy demand forecast is shown in Exhibit 6.

EXHIBIT 6. Load Forecast—Summer Non-coincident Peak Demand and Planning Reserve Requirement, MWs



Source: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/4/2016)

Energy Efficiency Target

One way for a utility to help bridge the gap between its energy supply and demand is by reducing the amount of energy its customers consume. BWL's target is to reduce energy use by 1 percent through energy-efficiency (EE) programs that help customers reduce their energy consumption and eliminate energy waste by installing new, more efficient technologies or by shifting their consumption habits. For BWL, EE programs have been in place for years and continue to save customers money. In response to Public Act 295 of 2008, the BWL launched Hometown Energy Savers® (HES) program in April 2009 which offers a variety of energy-efficiency programs for all BWL electric customers. These residential programs include efficiency upgrades for income-qualified customers, appliance recycling, multifamily services, and educational programs. HES also provides financial incentives for both residential and business customers who install high-efficiency lighting, appliances, and heating and cooling equipment. Since 2009, BWL has managed to meet its 1 percent energy-efficiency targets each year, as shown in Exhibit 7.

EXHIBIT 7. Hometown Energy Savers® Outcomes, 2008–2014

Program Year	Total Savings Required MWH	Actual Savings Achieved	Percentage of Goal	Program Budget ($)	Actual Spending ($)	Percent of Budget
2008–09	6,831	6,971	102%	$1,223,335	$1,223,335	100%
2010	11,306	11,524	102%	$1,663,361	$1,590,178	96%
2011	16,236	17,587	108%	$2,739,644	$2,643,804	97%
2012	21,581	23,147	107%	$3,544,711	$3,260,845	92%
2013	22,230	26,757	120%	$3,743,194	$3,612,207	97%
2014	22,460	23,094	103%	$4,053,316	$3,537,494	87%

Source: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/4/2016)

Despite past successes, there is concern regarding diminishing returns from investing in EE. The majority of BWL's past efficiency savings have come through improved lighting technologies, such as compact fluorescents and LEDs. However, due to more efficient lighting standards, the type of savings BWL has experienced in the past will likely be more difficult to achieve going forward as older, less efficient lighting sources are phased out. This means that BWL will need to rely on other, more expensive, sources for new EE savings. According to a study undertaken by the Michigan Public Service Commission and published in 2013, there are still opportunities to invest in EE across the state of Michigan, although the cost of achieving these savings may be higher. A summary of this report is available in Appendix B (GDS Associates 2013). BWL has assumed that it will be able to achieve 1 percent savings from EE each year for the next 20 years, and has used this assumption in each of its portfolios except two, which assume a more aggressive energy-efficiency program.

Demand Response Reduction

Demand response (DR) programs can help utilities avoid making significant new infrastructure investments by shifting the time when customers consume energy or reducing the amount of energy consumed during peak periods. Since utilities are required to supply enough capacity to meet their peak energy demand, reducing the amount of energy consumed at peak times can help a utility avoid building or procuring additional capacity. DR has been around for decades. One example is air-conditioner cycling programs, which allow utilities to rotationally control power to a customer's air conditioner during periods of high demand to reduce the utility's peak demand when traditional generation resources are short. This allows utilities to capture this peak shaving capability as part of their resource portfolio.

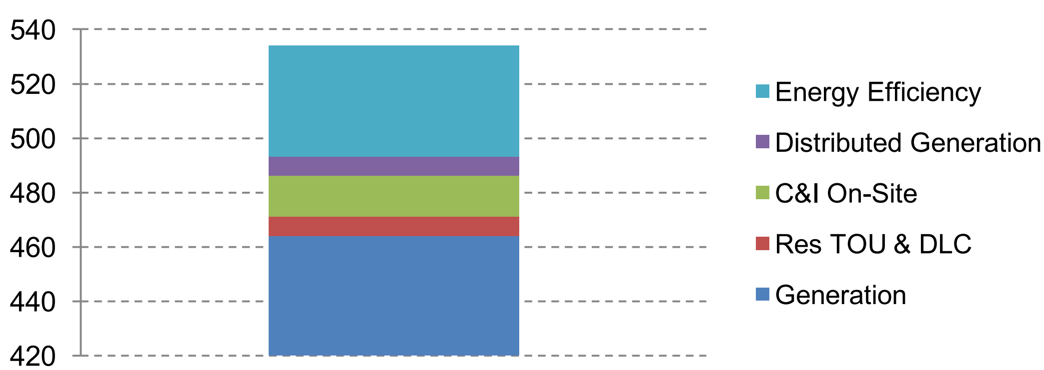
Alongside cycling power during peak periods, the deployment of advanced metering infrastructure (AMI) has created new opportunities for utilities to implement DR programs. BWL is expecting to have AMI installed for all of its electric customers by 2022 and plans to begin offering DR programs for residential customers, once infrastructure is in place. BWL plans to offer two programs for these customers, including:

- **Direct load control (DLC) programs: DLC programs** allow utilities to control the electricity delivered to a water heater or air conditioner. This allows utilities to directly control energy consumption by interrupting demand, which can alleviate the need to run additional power plants.
- **Time-of-use (TOU) rates: TOU rates** charge customers different prices for energy consumed at different times of day. Energy costs typically vary throughout the day as the demand for electricity changes, but customers traditionally have paid an average rate wherein each kilowatt hour costs the same amount. Time-of-use rates send a price signal to customers intended to encourage them to consume less at high-cost (on-peak) periods and more when costs go down (off-peak periods). By modifying consumption patterns, the system can become more efficient and reduce overall costs. TOU rates are being adopted by many electric utilities, including Consumers Energy, DTE Energy, and all of Ontario.

In addition to offering DR programs for its residential customers, BWL will also offer DR programs for both commercial and industrial customers. These program options include allowing customers to self-generate the power they need at certain times instead of relying on BWL, or undertake voluntary load curtailment, which would allow the utility to curb customers' energy consumption.

The BWL uses a weather-normalized, peak-demand forecast in its planning process. For example, the weather-normalized, peak-demand forecast in 2025 is 464 MW, though actual peak demand has been above this value six times in the last ten years. The BWL plans to undertake demand response programs to manage the demand above the weather-normalized forecast. With the planned deployment of AMI, TOU rates, on-site distributed generation, direct load control, and energy efficiency-programs, the BWL expects to reduce its unadjusted peak demand by approximately 80 MW. The impact of these programs can be seen in Exhibit 8.

EXHIBIT 8. Peak Load Breakdown—2025 (MWs)



Source: BWL. March 14, 2016. *Citizens Advisory Committee Deliberation Meeting.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-feb-3/ (accessed 4/4/2016)

Unit Retirements

The main impetus for BWL's IRP is that when Eckert Station shuts down its remaining three units in 2020, BWL will not have enough capacity to meet its requirements based on projected electricity demand. In addition to the Eckert Station retirement, BWL expects that both Erickson Station and the Belle River Power Plant could retire during the current planning horizon; however, decisions regarding the retirement of either of these plants have not yet been made. For most of the portfolios modeled in this IRP, BWL is using an expected retirement date of 2030 for both plants (see Exhibit 9). However, one risk discussed by the Committee was the early retirement of the Belle River coal-fired plant. The Committee requested the BWL include a portfolio in which Belle River was retired in 2025.

EXHIBIT 9. Expected Power Plant Retirement Dates

Generating Resource	Installed Capacity (MWs)	Expected Retirement Date
Eckert Station (6 units)	190.2	Units 1 & 3: 2016 Units 4-6: 2020
Erickson Station	154.8	2030^
Belle River Power Plant	150.0*	2030^

* Plant is owned by DTE Energy, BWL has an ownership stake through the Michigan Public Power Agency for 150 MWs.
^ No retirement date has been announced. BWL utilized a 2030 retirement date for the purposes of its modeling.

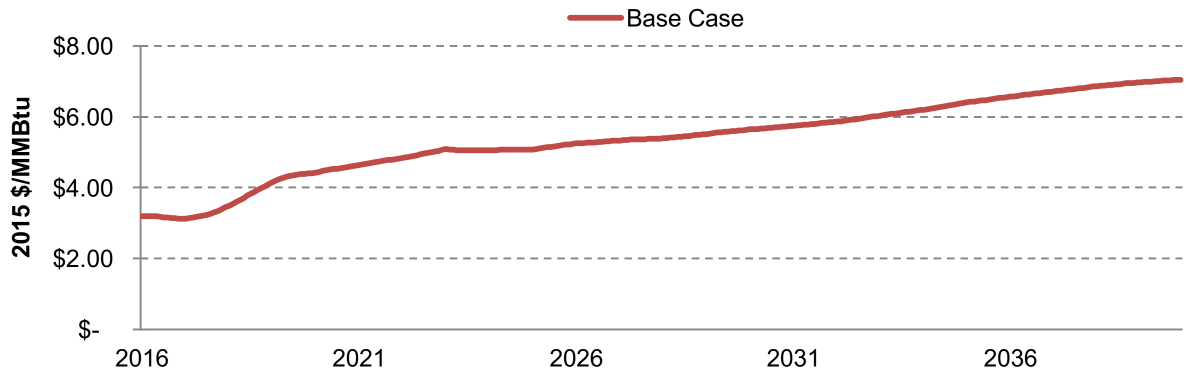
Source: BWL. November 11, 2015. *Citizens Advisory Committee Meeting #3.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-nov-12/ (accessed 4/9/2016)

Natural Gas Price Forecasts

Natural gas is increasingly relied upon in the electric power sector because it can respond quickly to changes in demand, serve as a baseload energy source, reduces air emissions, and has been relatively inexpensive in recent years. Recent changes in natural gas markets, including new natural gas exploration technologies that have dramatically increased production from previously untapped sources, have contributed to these low prices. New natural gas production in Ohio, Pennsylvania, West Virginia, and New York has begun to change how natural gas moves across the country, and increasing demand for natural gas in the electric power sector is contributing to growing demand for natural gas transport infrastructure.

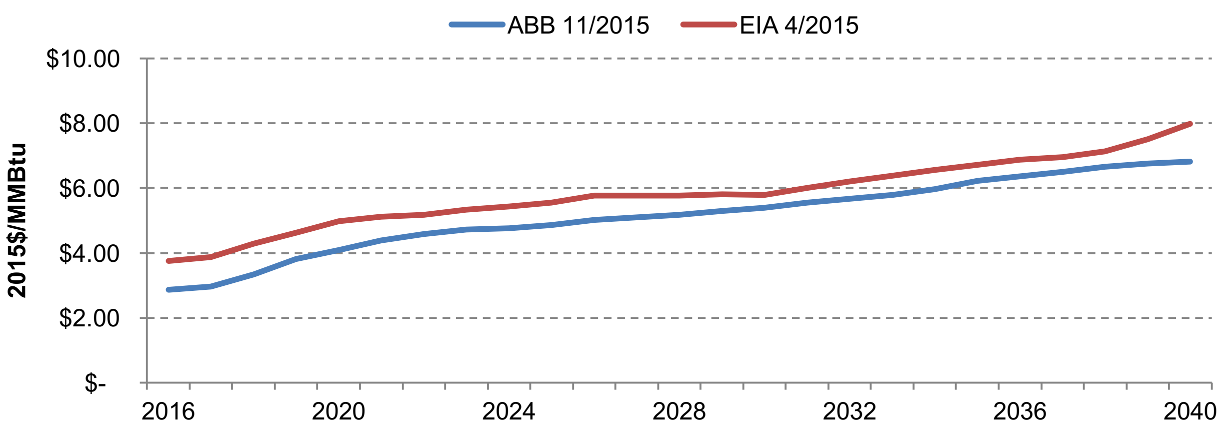
Natural gas prices have historically been volatile, ranging from more than $13 per billion cubic feet per day (Bcf/D) in 2008 to under $3 per Bcf/D as recently as August 2015 (Sapp 2015). However, new industry projections forecast that natural gas prices will remain relatively stable over the coming years. Using the forecasts, the BWL expects natural gas prices to start at $3.19 per million British Thermal Units (MMBtu) in 2016 and rise to $6.41 per MMBtu by 2035, as shown in Exhibit 10. The prices are standardized using 2015 dollars and are based on natural gas price forecasts from ABB Energy Market Intelligence Services (ABB), an international engineering and consulting company specializing in market forecasting. Exhibit 11 shows how ABB's natural gas price projection compares to projections from the U.S. Energy Information Administration (EIA) in April 2015.

EXHIBIT 10. Michigan Burner Tip Natural Gas Price Base Forecast, 2015–2035



Source: ABB Electricity and Fuel Price Outlook-Power Reference Case, Midwest, Fall 2015, cited in: BWL. February 3, 2016. *Citizens Advisory Committee Meeting #6.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-feb-3/ (accessed 4/4/2016)

EXHIBIT 11. Henry Hub Natural Gas Price Forecasts Comparison, ABB Fall 2015 Power Reference Case and U.S. EIA 2015 Annual Energy Outlook

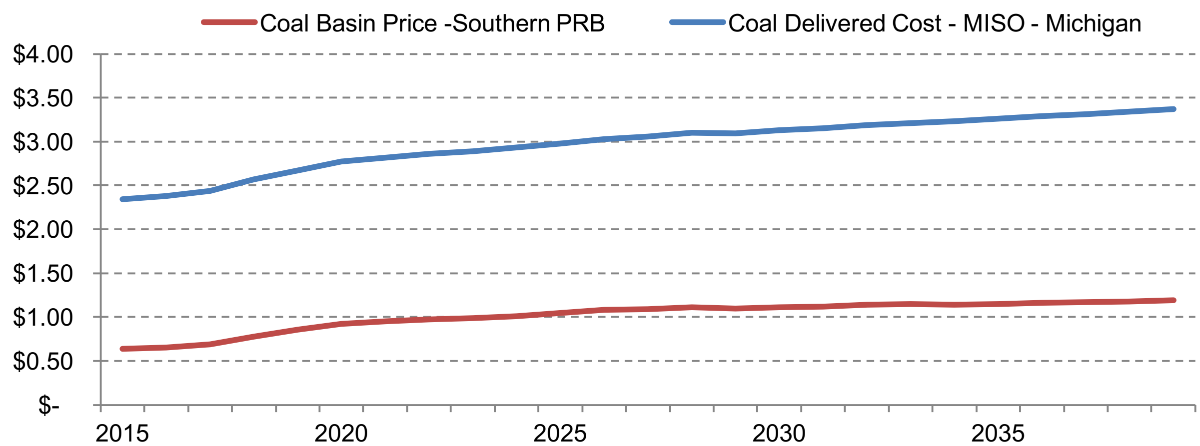


Source: BWL. March 14, 2016. Citizen Advisory Committee Deliberation Meeting. (accessed 4/4/2016)

Coal Price Forecasts

Nationwide, coal's share of the electric power sector is declining. This is due in part to competition from low-cost natural gas, increased deployment of renewables, and environmental regulations that are making coal a more costly source of electricity. In Michigan and the Midwest, coal still makes up a large portion of electric supplies. Even after Eckert Power Station retires in 2020, coal will still supply nearly 50 percent of BWL's generating capacity. As BWL will continue to rely on coal for at least a portion of its energy needs, the price of coal will be an important factor in determining how BWL is going to meet future demand. BWL's forecast—provided by ABB—projects that the price for coal delivered to Michigan will increase from $2.36 per MMBtu in 2016 to $3.19 per MMBtu by 2035, as shown in Exhibit 12. These projections are standardized using 2015 dollars.

EXHIBIT 12. Coal Price Forecast 2015 $/MMBtu



Source: ABB Electricity and Fuel Price Outlook-Power Reference Case, Midwest, Spring 2015, cited in: BWL. October 21, 2015. *Citizens Advisory Committee Meeting #2.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-oct-21/ (accessed 4/4/2016)

Gas Conversion Capital Cost, Thermal Capital Cost, and Renewable Cost

One of the most substantial costs associated with planning new electric infrastructure investment is the price of constructing a new generating resource, referred to as the "capital cost." BWL partnered with Barr Engineering Company (Barr) to get a cost overview of a variety of different energy resources. Barr presented the capital costs for 17 different supply-side resource options. Barr's analysis provided a breakdown of cost and various characteristics for the following technologies: biomass, simple-cycle natural gas, combined-cycle natural gas, photovoltaic solar, wind turbines, microturbines, battery storage, and hydrogen fuel cells. The size and capital cost of these resources is provided in Exhibit 13, and a complete overview of Barr's analysis is available at the following link: November 12 Meeting Presentation.

After the extension of the Production Tax Credit (PTC) and the Investment Tax Credit (ITC), BWL updated the renewable energy cost inputs by assuming wind and solar energy would be acquired through a power purchase agreement rather than capital expenditures. The model was updated to reflect indicative pricing for wind and solar energy through the end of the tax credits.

Additionally, based on new information obtained after Barr's presentation, BWL determined that it needed to include a reduced capital cost for photovoltaic solar in its base assumptions. BWL's updated forecast projects a capital cost of $1,606 per kW in 2016 and $1,144 per kW in 2035. These updated capital cost projections were used to forecast power purchase agreement prices during the years covered by the tax credit extensions.

EXHIBIT 13. Electric Energy Resource Options

Resource	Online lead time (Months)	Summer Capacity (MWs)/ Monthly Production (kWhs)	Winter Capacity (MWs)/ Monthly Production (kWhs)	Overnight Construction Cost (2015 $/ kW)	Overnight Construction Cost in Millions (2015 $)
Efficiency Improvement—Erickson	24	153 MW (Net)	153 MW (Net)	640	96
Natural Gas Conversion—Eckert 4-6	18	Base + 4 MW Base = 195 MW(net)	Base + 4 MW Base = 95 MW (net)	50	12
Natural Gas Conversion—Erickson	12	Base + 3 MW Base = 153 MW (net)	Base + 3 MW Base =153 MW (net)	75	12.375
Bio Mass Cofiring—Erickson	12	15.3	15.3	1,000	15.3
150 MW—Bio Mass	36	150	150	3,800	570
12 MW—Simple-Cycle Gas Turbine (GT)	15	10	12	1,400	16.8
50 MW—GT	15	43	50	1,100	55
100 MW—GT	18	85	100	1,050	105
150 MW—Combined-Cycle Gas Turbine (CCGT)	30	128	150	1,500	225
300 MW—CCGT	30	255	300	1,300	390
400 MW CCGT	36	340	400	1,200	480
10 MW—Photovoltaic Solar	24	10; 1,300,000	10; 550,000	3,000	30
20 MW—Wind Turbine	36	20; 2,619,900	20; 6,184,155	1,980	39.6
11.2 MW—Microturbine	15	11.2	11.2	2,500	28
1 MW—Utility Scale Battery Storage	21	1	1	3,300	3.3
1 MW—Hydrogen Fuel Cell Production	18	1	1	7,108	7.108
1 MW— H2 Fuel Cell Storage	18	1	1	2000–6000	4

Source: Analysis prepared for BWL by Barr Engineering Company cited by: BWL. November 12, 2015. *Citizens Advisory Committee Meeting #3.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-nov-12/ (accessed 4/4/2016)

Renewable Capacity Factors

A capacity factor is "the ratio of the total energy generated by a generating unit for a specified period to the maximum possible energy it could have generated if operated at the maximum capacity rating for the same specified period, expressed as a percent" (PJM 2014). Certain types of resources—such as wind or solar—are intermittent and do not constantly produce at their full capacity (e.g., on days without wind or on cloudy days or at night). Based on past experience and expectations about future renewable energy projects, BWL expects that new renewable energy sources will exhibit the following capacity factors:

- Wind: 37.5 percent (Beebe pro forma)
- Solar (fixed axis): 14.2 percent (BWL Staff—past experience)
- Solar (single axis): 22.4 percent (groSolar pro forma)

Renewable Generating Capacity Credit

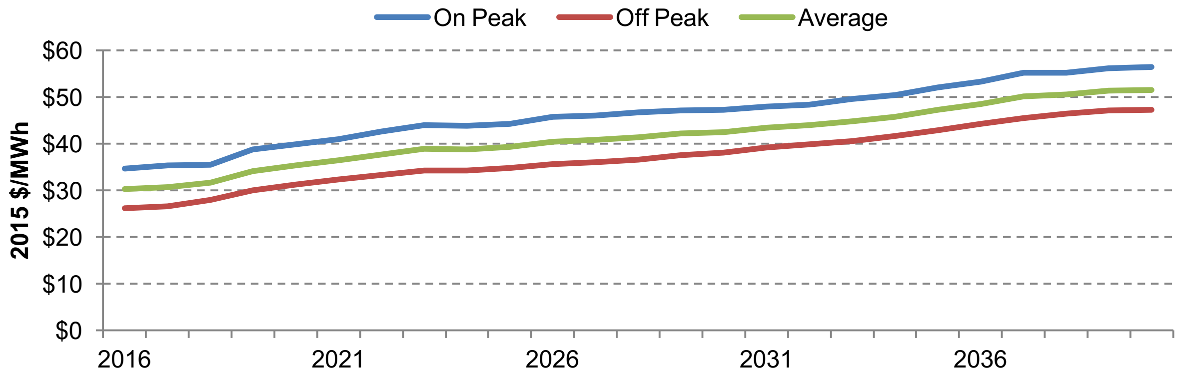
Generating resources supply both energy and capacity. A resource's capacity factor rates how much energy it can be expected to produce. Similarly, resources are assigned capacity credits, which rate how much of the resource's nameplate capacity can be counted towards a utility's mandated resource requirement. Since different types of electric generators have different operating characteristics, they are assigned specific capacity credits. MISO—the regional entity which sets BWL's capacity requirement—has determined wind resources will receive capacity credits for 14.7 percent of their nameplate capacity and solar will get 50 percent of its nameplate capacity.

Energy Price Forecast

Energy prices are another important assumption to consider when evaluating different resource options. BWL—along with nearly every Michigan utility—participates in the regional electricity market operated by MISO. This regional market determines electricity prices across 15 states through coordinated auctions, which allows MISO to draw on a diverse set of generating resources. Prior to MISO's existence, BWL managed its own generation in order to match its load. However, since the creation of MISO's energy market in 2005, BWL provides electricity resources when called on by MISO and can also buy electricity from the MISO market if needed. Being part of this regional energy market has helped improve reliability and create savings for BWL customers by drawing on a large, diverse set of resources to meet energy needs.

Despite the available resources, pricing for energy is slowly rising. BWL projects that energy prices in Michigan will be $30.24 per MWh in 2016 and rise to $47.25 per MWh in 2035. These projections were provided by ABB and are shown in Exhibit 14.

EXHIBIT 14. MISO Annual Market Clearing Price Forecast, Michigan



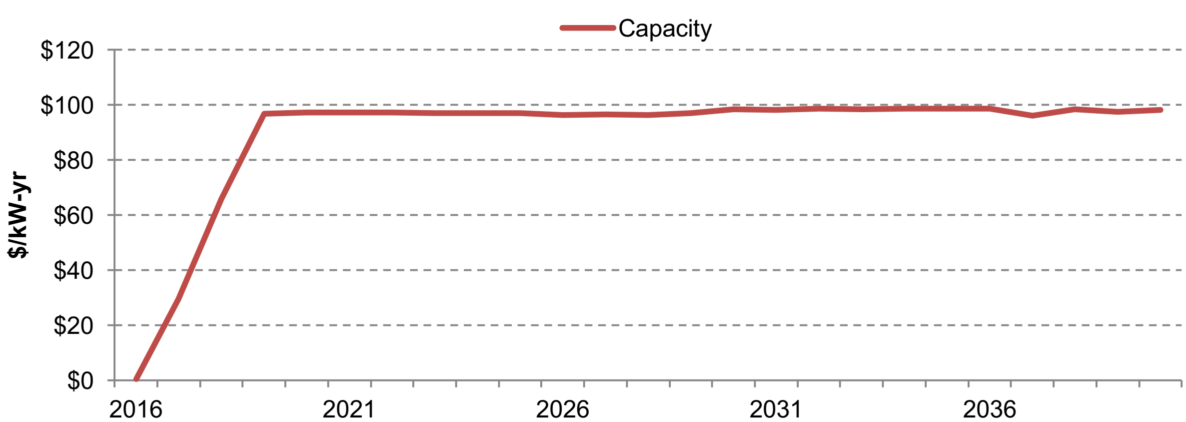
Source: ABB Electricity and Fuel Price Outlook-Power Reference Case, Midwest, Fall 2015, cited in: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/4/2016)

Annual Capacity Price Forecast

In addition to setting regional energy prices, MISO also operates a capacity auction that establishes a price for the capacity that utilities are required to maintain. BWL—like every other utility within the MISO network—must meet a specific capacity requirement, including a planning reserve margin. Utilities can own enough generating resources to meet their capacity requirement, procure capacity from the regional market, or pay a penalty in lieu of maintaining capacity. If a utility has more capacity than necessary to meet their requirements, they can sell the excess through annual capacity auctions.

Just as Eckert station is set to retire, there are many other generators within MISO's footprint that are likely to close over the next several years as age, economics, and environmental regulations alter the electric power sector. For example, this spring, Consumers Energy closed seven operating coal-fired units totaling 958 MW of capacity. Due to these potential plant retirements, the market price for capacity is expected to rise dramatically in the next five years. BWL's forecast—provided by ABB—projects that the price for capacity will rise from $0.48 per kilowatt year (kW-yr) in 2016 to $99.00 per kW-yr in 2035. The expected capacity price forecast is shown below in Exhibit 15.

EXHIBIT 15. MISO Capacity Market Value Forecast, Michigan



Source: ABB Electricity and Fuel Price Outlook-Power Reference Case, Midwest, Fall 2015, cited in: BWL. December 9, 2015. *Citizens Advisory Committee Meeting #4.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-dec-9/ (accessed 4/4/2016)

Transmission Costs

Just as its operations determine energy and capacity prices, MISO is responsible for providing electric transmission service throughout most of Michigan and nearby states. Transmission is the high-voltage transport of electricity from a generator to local utilities' distribution systems. MISO offers two different types of transmission services: point to point (PtP) and network integration transmission services (NITS). PtP transmission allows utilities to reserve service from a generating source to the ultimate consumer. NITS gives utilities full access to the entire MISO system, allowing utilities to contract power from anywhere within the MISO footprint.

BWL's transmission system is not typical of most utilities that operate within MISO since BWL controls its own system. This is due in part to the fact that most of BWL's generation is located within its own service territory, so it does not rely heavily on transmission services from the bulk electric grid. The utility does, however, rely on transmission under its contract with the Belle River Power Plant, located in southeast Michigan. BWL's contract predates the creation of MISO and thus qualifies as a Grandfathered Transmission Agreement (GFA), which essentially allows BWL to avoid some of the transmission and other market charges that MISO imposes. This means that despite relying on transmission across the MISO grid, the Belle River Power Plant is treated as though it is located within BWL's service territory. Without this GFA, BWL would have to pay for transmission and other market costs through the MISO market to receive energy from Belle River for BWL customers.

In the future, if BWL opts to contract new additional capacity outside of its transmission network, it would be required to purchase transmission services through MISO, resulting in additional costs for customers. In order to import this new capacity resource, the BWL would need to become a network transmission customer. Although BWL would be able to receive some revenue from its transmission system under this arrangement, the utility would have to pay to reserve transmission services for the entire load, and in addition to these increased costs, any future transmission planning would be governed by MISO. BWL research indicates that network transmission costs are some of the fastest-growing utility expenses and expects that in the event it needs to rely on MISO for transmission following the retirement of the Eckert Power Station, the utility would face an extra $3 million in costs annually and up to $19 million when Belle River retires or its GFA is terminated. Short-term hourly transmission services currently cost $13.25 per MWh during on-peak hourly service and $6.47 per MWh for long-term service.

SENSITIVITIES ON ASSUMPTIONS

Preparing model assumptions is the first step in developing scenarios for an IRP; however, it is also important to include a variety of sensitivities and alternative scenarios in modeling efforts because there are several factors that can change over the course of 20 years. By modeling how a resource portfolio performs under a variety of conditions, utilities can see how well an approach deals with certain risks, such as changing fuel prices. BWL has opted to consider several sensitivities in addition to its base case-assumptions. These sensitivities include:

- The price of natural gas is higher than projected in the base case.
- The demand for electricity grows slower than projected in the base case.
- The demand for electricity grows faster than projected in the base case.
- The cost for the installation of gas infrastructure supply to a new natural gas plant is increased.

Modeling Results

METHODOLOGY

In order to evaluate the total cost, rate impacts, performance, and risks of future generation options, BWL created three initial screening portfolios and seven final revised portfolios. Each portfolio consisted of a different set of options. For example, one included expanding renewable energy options to meet a clean-energy goal, another consisted of expanded energy efficiency, and a third relied on purchasing energy from the regional market. The reference portfolio, was based strictly on total cost, without consideration to the options that were selected. For each portfolio, BWL provided an evaluation of the total incremental cost and rate impacts for customers as well as each portfolio's expected emissions rate. Each scenario was also reviewed under various sensitivities to determine the impact that changing assumptions would have on the cost of the portfolio. The goal of this methodology is to determine the least costly resource portfolio and the tradeoff between cost and risk of the various resource options.

INITIAL OPTIONS SCREENING

Using the methods and inputs described in the previous section, BWL performed initial screening of resource alternatives in order to determine what some of the most acceptable options might be and whether there were any options that should be excluded from further analysis due to technical feasibility, excessive cost, or high risk. In conducting its first screening, BWL considered issues that had been raised by the CAC during their meetings, including:

- Should BWL build generation or buy electricity on the market?
- What level of market reliance is best?
- What fuel mix/diversity is desired?
- To achieve environmental goals, which combination of renewables and energy efficiency works?
- What are the emission targets under the Clean Power Plan?
- Should a lot of time be used evaluating technologies that may or may not be available in 10 years?
- How can the scenario/sensitivity analysis be used to help demonstrate some of the risks associated with a changing environment?

BWL decided to exclude the following alternatives from its modeling considerations due to significant technical involvement, cost, and high risk:

- **Converting the Eckert Station to natural gas:** BWL excluded this scenario because there is insufficient natural gas infrastructure downtown, Eckert is already over 50 years old, the plant is in the 100-year floodplain, and the units are inefficient by today's standards, which would result in higher fuel costs.
- **Co-firing or converting the Erickson Station to biomass:** This alternative was eliminated because the region lacks the fuel processing infrastructure for biomass, and there is no local "wood basket" (significant source of wood) in southern Michigan. These factors would make it very challenging to feed the biomass facility, and the expense and environmental trade-offs for trucking the biomass from the Upper Peninsula or other sources would be substantial. There is also some uncertainty surrounding how biomass will ultimately be treated by the EPA under the Clean Power Plan.
- **Use of hydrogen fuel cells:** This alternative was excluded because hydrogen fuel cell infrastructure has not advanced or been built out enough in the region to support this option at a level that meets BWL energy-delivery needs. Also, both the capital and operation/maintenance costs for hydrogen fuel cells are dramatically higher than battery storage.

INITIAL PORTFOLIOS

After determining which options to exclude through its initial screening, BWL developed three initial screening portfolios each of which included 1 percent savings from energy efficiency every year for the next 20 years,

Reference Portfolio

In this portfolio, resources are selected to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions, as described in the previous model inputs and methods section.

New resources selected by the model in this portfolio include:

- Natural gas—500 MW

Clean-Energy Goal Portfolio

This modeled portfolio assumes a clean-energy goal of 30 percent by 2025 and 40 percent by 2030. BWL's clean-energy goal combines renewable energy and energy efficiency. Energy efficiency is kept at the base assumption of 1 percent annually throughout the study period, with renewable energy resources added incrementally to meet the modeled clean-energy goal. Remaining resources are selected based on economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Wind—180 MW
- Natural Gas—450 MW

Market-Based Portfolio

The model assumes that BWL would meet its energy and capacity needs through interactions with and purchases through the regional market rather than building additional resources.

Results

BWL presented the results of these initial models to the CAC and explained that modeling sensitivities is important because the economics and emission rates of the portfolios can change significantly with changes in assumptions. In addition, each of the options could have similar economic impacts but dramatically different risk profiles, including:

- Environmental risk
- Economic risk
- Reliability risk

Exhibit 16 summarizes the relative cost index for these three initial screening portfolios modeled by BWL under both the base-case assumptions and a high-gas scenario (full summaries of the initial model results are available on the Lansing Energy Tomorrow website). The cost of each portfolio is presented as the 20 year net present value which includes incremental capacity, operations and maintenance, and fuel costs. Presenting these costs in an index eases comparison of costs across portfolios   The CAC quickly decided to exclude the *Market-Based Portfolio* from further analysis because of the significant cost (more than double the expected cost for other portfolios) and risk of being overly reliant on nonlocal sources of generation.

EXHIBIT 16. Relative Cost Index for Initial Screening Portfolios, February 3, 2016

Portfolio	Base Case	High Gas
Reference	100.0	107.5
Clean-Energy Goal	112.4	117.5
Market-Based	238.4	246.3

Source: BWL. February 3, 2016. *Citizens Advisory Committee Meeting #6.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-feb-3/ (accessed 4/4/2016)
An index of 100 represents approximately $1.6 billion dollars on a 20 year present value basis

REVISED PORTFOLIOS

Following the presentation of BWL's initial screening portfolio modeling results, CAC members were given the opportunity to request additional portfolios to be modeled. Based on the Committee's discussion of the initial screening portfolios, BWL was asked to model two additional portfolios. One based on an early retirement date for the Belle River Power Plant, and the second that included a more aggressive target for energy efficiency.

Prior to conducting the revised portfolio modeling, BWL updated a few of their base-case assumptions to account for new information on the capital cost of solar power. BWL reduced the expected capital cost of solar to $1,606 per kW in 2016 and $1,144 per kW by 2035. In addition to new expectations about the price of solar, BWL also added a scenario which included a potential 85 MW wind energy project assumed to be eligible for the PTC. PTC eligibility lowers the cost of renewable energy by allowing investors to pass on the tax savings in the form of lower purchase power cost. The wind PTC is scheduled to begin phase-out in 2019. This wind project was created as a separate portfolio for the CAC to consider.

BWL presented the Committee with the following five resource portfolios (full summaries of the additional portfolios modeled can be viewed at the Lansing Energy Tomorrow website):

Reference Portfolio

In this portfolio, resources are selected by economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—30 MW
- Natural gas—450 MW

Clean-Energy Goal Portfolio

This model assumes a clean-energy goal of 30 percent by 2025 and 40 percent by 2030. BWL's clean-energy goal combines renewable energy and energy efficiency**.** Energy efficiency is kept at the base assumption of 1 percent annually throughout the study period, with renewable energy resources added incrementally to meet the modeled clean-energy goal. Remaining resources are selected based on economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—310 MW
- Wind—20 MW

- Natural gas—300 MW

Belle River Early Retirement Portfolio

This portfolio assumes that the Belle River Power Plant will retire in 2025 instead of 2030 as projected in the base case. The remaining resources are selected by economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—30 MW
- Natural gas—450 MW

85MW Wind Project Portfolio

This model assumes the addition of an 85 MW wind project in 2018. Remaining resources are selected based on economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—100 MW
- Wind—85 MW
- Natural gas—400 MW

Expanded Energy Efficiency Portfolio

This model assumes that BWL pursues a more aggressive energy-efficiency target than the 1 percent annual target used in the base-case assumptions. In this portfolio, additional energy efficiency eliminates any future growth in energy demand. The remaining resources are selected by economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Natural gas—450 MW

EXHIBIT 17. Relative Cost Index for Modeling Results, March 14, 2016

Portfolio	Base Case	High Gas	Low Load Growth	High Load Growth	Increased Gas Line Cost
Reference	100	108.4	98.5	101.8	101.3
Clean-Energy Goal	104.5	110.1*	103.1	106.7	105.9
85MW Wind Project	100.4	106.1*	98.9	102.7	101.7
Expanded Energy Efficiency	102	109.9			103.3
Belle River Early Retirement	101	110.8	99.5	102.9	102.3

Compliant with the Clean Power Plan
Does not comply with the Clean Power Plan by 2030
*Potentially compliant with the Clean Power Plan

Source: BWL Modeling Results

After reviewing the revised portfolio modeling results, Committee members noted that the cost difference between the *Reference Portfolio* and the *85MW Wind Project Portfolio* was negligible. The Committee considered this especially important given how these two portfolios compare in terms of their ability to comply with the Clean Power Plan. In 2029, the *85MW Wind Project Portfolio* is projected to have a carbon dioxide (CO2) emission rate of 1,210 lb./MWh, compared to 1,525 lb./ MWh for the *Reference Portfolio*. Members of Committee expressed that, for essentially the same cost, it would make sense to choose a portfolio that also helps BWL comply with costly regulation. Based on this discussion, the Committee suggested that the BWL run additional portfolios that include the 85 MW wind project.

ADDITIONAL 85MW WIND PROJECT PORTFOLIOS

BWL's final round of modeling gave the CAC two new portfolios in addition to the five already presented. These portfolios are:

Clean-Energy Goal with 85MW Wind Project Portfolio

This model assumes the addition of an 85 MW wind project in 2018 and a clean-energy goal of 30 percent by 2025 and 40 percent by 2030. BWL's clean-energy goal combines renewable energy and energy efficiency. Energy efficiency is kept at the base assumption of 1 percent annually throughout the study period, with renewable energy resources added incrementally to meet the modeled clean-energy goal. Remaining resources are selected based on economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—140 MW
- Wind—85 MW
- Natural gas—400 MW

Clean-Energy Goal with 85MW Wind Project & Expanded Energy Efficiency Portfolio

This model assumes the addition of an 85 MW wind project in 2018 and a clean-energy goal of 30 percent by 2025 and 40 percent by 2030. BWL's clean-energy goal combines renewable energy and energy efficiency. This model assumes that BWL pursues a more aggressive energy-efficiency target than the 1 percent annual target used in the base-case assumptions. In this portfolio, additional energy efficiency eliminates any future growth in energy demand. Remaining resources are selected based on economics to produce the lowest-cost option to meet energy and capacity needs according to the base-case assumptions.

New resources selected by the model in this portfolio include:

- Solar—60 MW
- Wind—85 MW
- Natural gas—450 MW

COMPARING MODELING RESULTS

Exhibits 189 through 21 compare the results of the final seven portfolios in terms of their cost, carbon-dioxide emissions, and clean-energy technology deployment under the base case. Full summaries of the final five portfolios modeled can be viewed at the Lansing Energy Tomorrow website.

EXHIBIT 18. Relative Cost Index for Modeling Results, March 21, 2016

Portfolio	Base Case	High Gas	Low Load Growth	High Load Growth	Increased Gas Line Cost
Reference	100	108.4	98.5	101.8	101.3
Clean-Energy Goal	104.5	110.1*	103.1	106.7	105.9
85MW Wind Project	100.4	106.1*	98.9	102.7	101.7
Clean-Energy Goal with 85MW Wind Project	100.8	106.2*	99.3	102.9	102.1
Expanded Energy Efficiency	102	109.9			103.3
Clean-Energy Goal with 85MW Wind Project & Expanded Energy Efficiency	101.8*	107.2			103.1*
Belle River Early Retirement	101	110.8	99.5	102.9	102.3

Compliant with the Clean Power Plan
Does not comply with the Clean Power Plan by 2030
*Potentially compliant with the Clean Power Plan

Source: BWL Modeling Results

EXHIBIT 19. Annual Utility Cost per MWh, Base Case

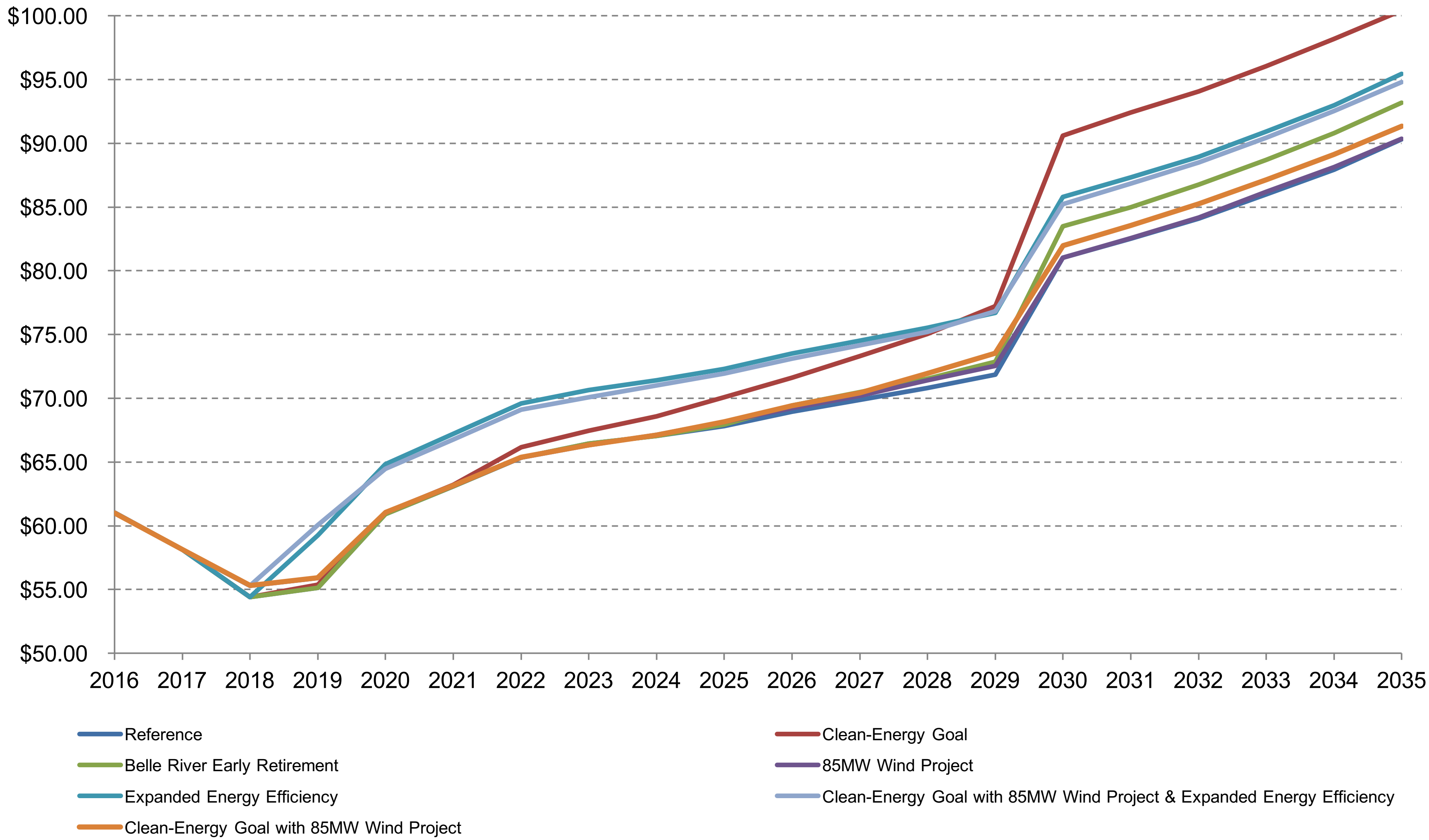


EXHIBIT 20. Comparison of Carbon Dioxide Emissions Rate, Base Case

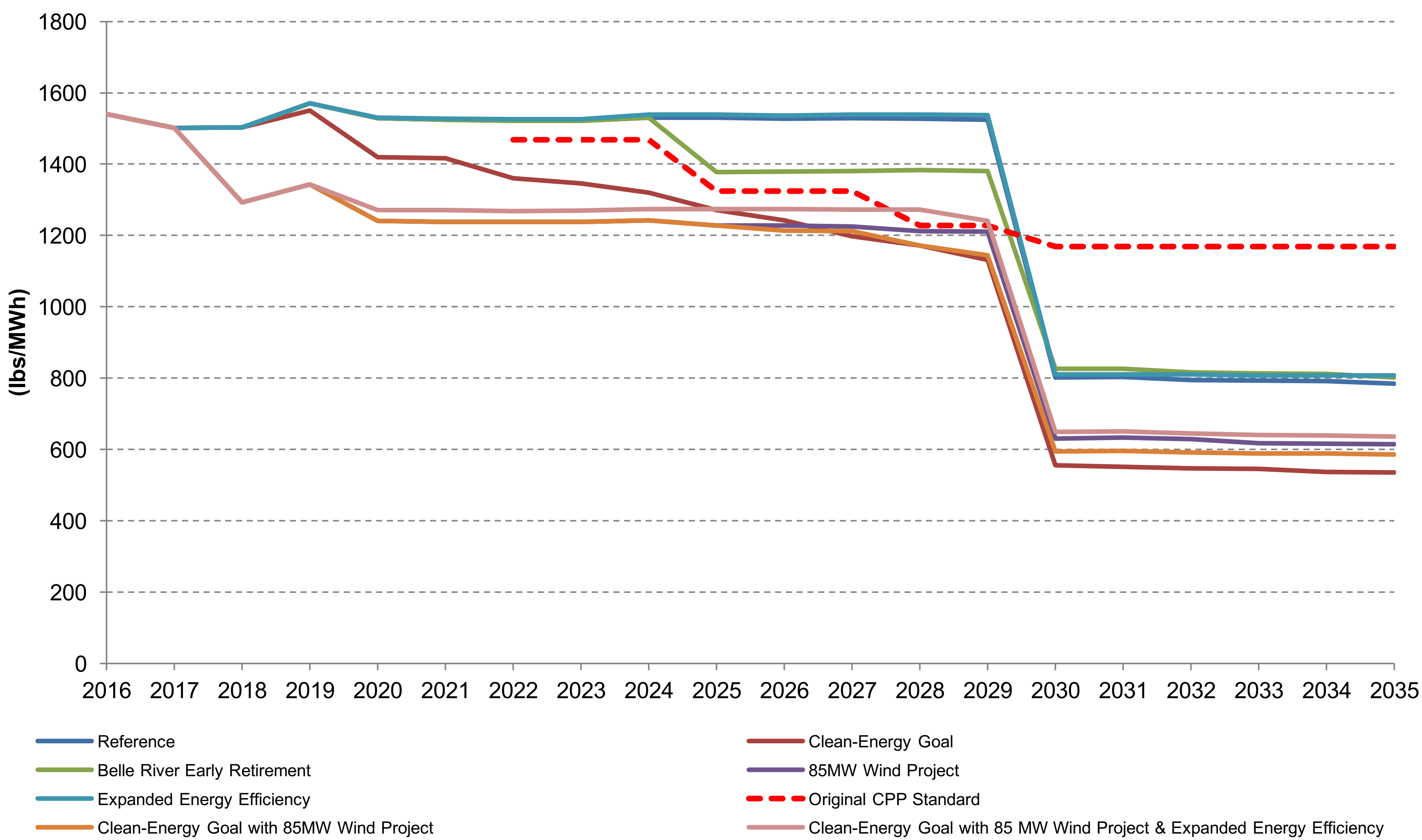
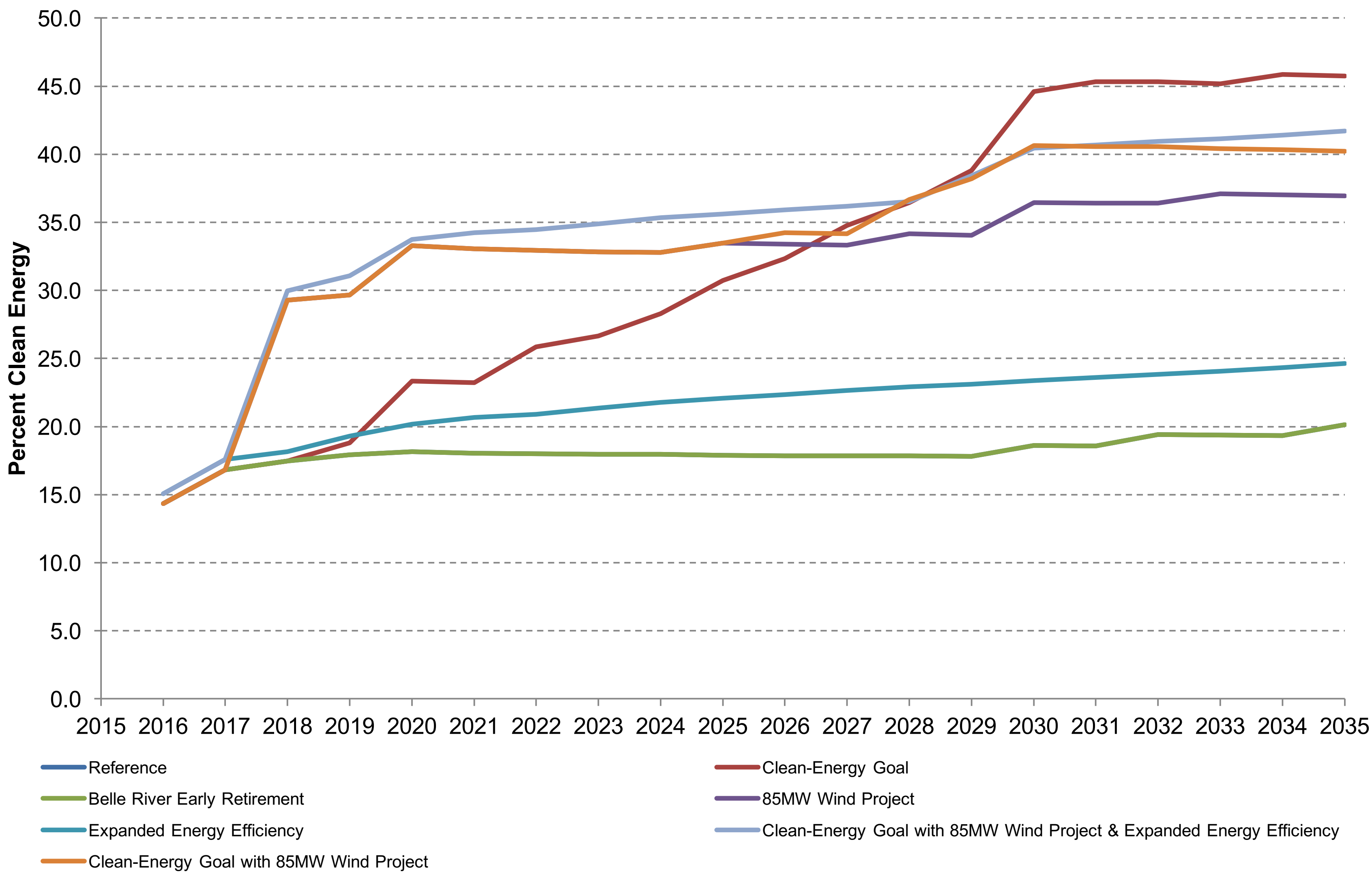


EXHIBIT 21. Clean Energy Comparison, Base Case



Committee Recommendations

After data and other information had been compiled and presented, and the results of BWL's portfolio modeling had been presented, the CAC began to discuss and develop their IRP recommendations. The group first reexamined the results of the BWL customer survey in order to ensure that the priorities and feedback provided by customers would be adequately considered and integrated into the recommendations.

The survey results were used by the Committee to identify factors shaping their recommendations, including the principles that they would use to guide their consideration of potential IRP portfolios and potential unknowns or risks that could affect resource portfolio decisions during the IRP timeframe.

The CAC then used its guiding principles and knowledge of identified risks to evaluate the modeled portfolios and make recommendations to BWL.

FACTORS INFLUENCING COMMITTEE RECOMMENDATIONS

Guiding Principles

Guiding principles are used to help establish the fundamental norms or values that guide an organization or process regardless of changes in strategies. They describe a group's beliefs and philosophies pertaining to a topic and guide what the organization does, why it does this, and how it is done. Their principles were also reflected in the residential and commercial customer survey conducted by EPIC-MRA. The CAC developed eight guiding principles for evaluating and making recommendations on BWL's integrated resource energy planning:

1. ***Provide affordable, reliable, secure, and sustainable electricity to customers.***

   BWL currently provides some of the most affordable electricity in the state, and any selected portfolio must continue to ensure that the BWL offers its customers affordable electricity that is reliable, secure, and sustainable.

2. ***Continue BWL's leadership in the deployment of clean-energy technologies, such as renewable energy, energy efficiency, and distributed-energy resources.***

   BWL's future energy portfolio should build on their current leadership in deploying renewable energy, energy efficiency, and distributed-energy generation. Customer survey results clearly indicate that BWL's customers see an economic and social value in deploying clean-energy technologies as a significant part of their energy portfolio.

3. ***Promote further improvement in a healthy environment for customers and the Greater Lansing region.***

   Any portfolio selected should help reduce the use of fossil fuels in BWL's energy production in order to provide better air quality and related health benefits for the Greater Lansing region. The Committee also noted the relationship between affordable energy and health benefits, particularly given the poverty rate in the Lansing area.

4. ***Generate and maintain local employment.***

   BWL is a local, municipally-owned utility and its future energy portfolio should continue to support local jobs, including training and transition to new types of employment, to the extent practicable.

5. ***Promote economic development in the Greater Lansing region.***

   BWL's future energy portfolio should continue to support development and growth of new and existing local businesses.

6. ***Be adaptable and mitigate future risks related to resource/fuel availability, technological advances, and cost.***

   BWL's future energy portfolio should be diverse enough to accommodate advances in technology, buffer against resource-availability issues, and minimize market exposure to changing fuel, construction costs, and other uncertainties.

7. ***Emphasize the importance of local control and continue to seek input from the community when making major decisions.***

   Customers clearly value their role as stakeholders in a locally-owned municipal utility, and as BWL makes decisions regarding future energy portfolios, they should continue to engage the community in major decisions regarding energy infrastructure in the region.

8. ***Prioritize energy self-sufficiency by reducing BWL's reliance on outside energy markets.***

   Given the potential implications on cost and availability of resources, future energy portfolios should limit reliance on outside energy markets and ensure that BWL has sufficient resources to fulfill the majority of its customers' energy needs.

After identifying this initial list, CAC members prioritized the three most critical principles to use in making recommendations to BWL. The CAC members agreed that the highest-priority guiding principles for selecting a recommended IRP scenario are the following:

- Provide affordable, reliable, secure, and sustainable electricity to customers.
- Continue BWL's leadership in the deployment of clean-energy technologies, such as renewable energy, energy efficiency, and distributed-energy resources.
- Promote the creation of a healthy environment for customers and the Greater Lansing region.

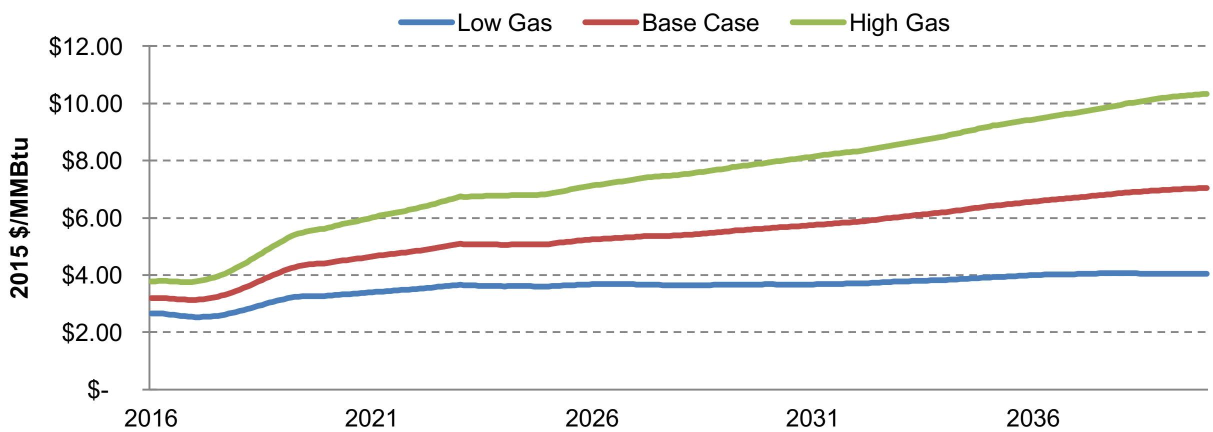
Risks and Unknowns

The CAC deliberations included substantial discussions about the risks (and opportunities) around unknown future fuel costs, technology advancements, and the implementation of the Clean Power Plan. Although the Clean Power Plan is on hold pending court action, BWL modeled all of the portfolios to assume implementation of the Plan, based on an emission rate standard. Each of the portfolios modeled includes a different date by which BWL would be compliant.

One of the largest risks identified by the Committee was the date for retiring both the Erickson and Belle River plants, particularly since BWL has no control over when Belle River will be retired. The modeled portfolios assume a 2030 closure of the Erickson and Belle River plants (except the *Belle River Early Retirement Portfolio*), but Clean Power Plan or other environmental requirements could trigger an earlier closure, and BWL would have to meet the demand for the energy provided by those plants sooner than planned.

Similarly, substantial increases in fuel costs could also change the timeline for, and quantity of, renewable energy added to BWL's energy portfolio. The model included sensitivity analyses for high fuel costs, which ranges from $3.79 per MMBtu in 2016 to $9.42 per MMBtu in 2035. If fuel costs exceed the upper range, BWL may need to shift from planned gas turbine or combined-cycle investments to more renewable energy, and thus the relative cost index will increase. Sensitivities around natural gas prices are shown in Exhibit 22.

EXHIBIT 22. Estimated Range of Fuel Costs Assumed in the Portfolio Models



Source: ABB Electricity and Fuel Price Outlook-Power Reference Case, Midwest, Fall 2015, cited in: BWL. February 3, 2016. *Citizens Advisory Committee Meeting #6.* Available at: http://lansingenergytomorrow.com/news/meeting-recap-feb-3/ (accessed 4/4/2016)

Finally, the CAC discussed the likelihood that there will be significant technology advancements during the IRP planning period that cannot be fully foreseen at this time, particularly in the area of renewable energy technologies. For example, the Committee discussed the role that battery storage might play in helping to meet reliability needs in the future and how that might affect the mix of renewable technologies versus baseload fossil fuel plants.

RECOMMENDED RESOURCE PORTFOLIO

The CAC reviewed and discussed each of the final IRP portfolios for their identified guiding principles, which portfolios helped leverage multiple BWL goals, and how well they helped mitigate risks and unknowns. As previously discussed, BWL modeled three initial screening portfolios. After reviewing the results, the CAC recommended BWL not run additional models related to the *Market-Based Portfolio* having determined this portfolio was too costly and exposed BWL customers to too much risk from market volatility, and did not provide enough environmental benefits, or local employment.

After refining the base-case assumptions and receiving recommendations on additional portfolios to consider, BWL presented a total of seven revised portfolios for consideration.

In its discussions, the CAC quickly rejected the following portfolios because they did not match their guiding principles:

- *Reference Portfolio:* The CAC noted that the cost difference between the *Reference Portfolio* and the *85MW Wind Project Portfolio* was negligible. The Committee considered this especially important given how these two portfolios compare in terms of their ability to comply with the Clean Power Plan and respond to higher natural gas prices. Members of the Committee expressed that, for essentially the same cost, it would make sense to choose a portfolio that also helps BWL comply with costly regulation. Based on this discussion, the Committee rejected portfolios that did not include the 85 MW wind project or a clean-energy goal.
- *Belle River Early Retirement Portfolio*: The CAC determined that a Belle River closure of 2025 is not a planning portfolio but a risk and a trigger for action across any of the portfolios considered. This assumption resulted in the model selecting a combined-cycle plant in 2025 to replace the capacity, energy, and ancillary services that can be provided by the unit.

The CAC then focused its discussions on the portfolios that increased clean-energy attributes—both through greater renewable energy use and increased energy efficiency. The Committee compared the costs (relative cost index), carbon-dioxide emission levels, and percent of clean energy among the remaining portfolios.

In addition, the Committee discussed the impacts of these portfolios on local jobs and economic development. It was noted that investment in combustion-gas turbines, baseload combined-cycle plants, and energy efficiency all contribute greater support to local jobs and businesses than investments in renewable energy because some of BWL's renewable energy capacity must be developed outside the Greater Lansing area (due to space constraints in this region for wind and large solar projects).

The Committee also discussed the level of energy efficiency that should be included in BWL's energy planning efforts. BWL's load forecast includes a 1 percent, annual, energy-efficiency savings goal, but Committee members requested a scenario with expanded energy efficiency programming. The resulting portfolio eliminated all growth in energy demand but resulted in higher system costs and rates. It also led to fewer renewable energy resources being constructed. The Committee also discussed the impact of higher rates that resulted from lower sales on low-income customers, especially those who rent. They noted that higher rates may adversely affect these customers the most because landlords do not typically invest in higher-cost energy-efficiency improvements, even when incentives are available.

The only resource added in the *Expanded Energy Efficiency Portfolio* was natural gas. Similarly, in the *Clean-Energy Goal with 85MW Wind Project & Expanded Energy Efficiency Portfolio*, instead of increasing the amount of clean energy produced, the model actually selects fewer renewable energy resources than in the *Clean-Energy Goal with 85MW Wind Project Portfolio*, and the portfolio is not Clean Power Plan compliant until after 2030.

Based on their discussions, the CAC ultimately identified the *Clean-Energy Goal with 85MW Wind Project Portfolio* as their recommended IRP selection because it was judged best among the portfolios to match the guiding principles, BWL's goals for the IRP, survey input from customers, and compliance with the (pending) Clean Power Plan.

Clean-Energy Goal with 85MW Wind Project Portfolio

The *Clean-Energy Goal with 85MW Wind Project Portfolio* includes an 85 MW wind project in 2018 and an additional 140 MW of solar between 2020 and 2030. These renewable energy investments will be made in conjunction with the development of 250 MW of combustion-gas turbine generation between 2020 and 2030, as well as construction of a 150 MW combined-cycle turbine in 2030. The portfolio would result in meeting energy demand with approximately one-third clean energy by 2025 and 40 percent clean energy by 2040, as well as compliance with the Clean Power Plan under each of the four sensitivity analyses.

The portfolio assumes the following plant retirement dates:

- Eckert: 2020
- Erickson: 2030
- Belle River: 2030

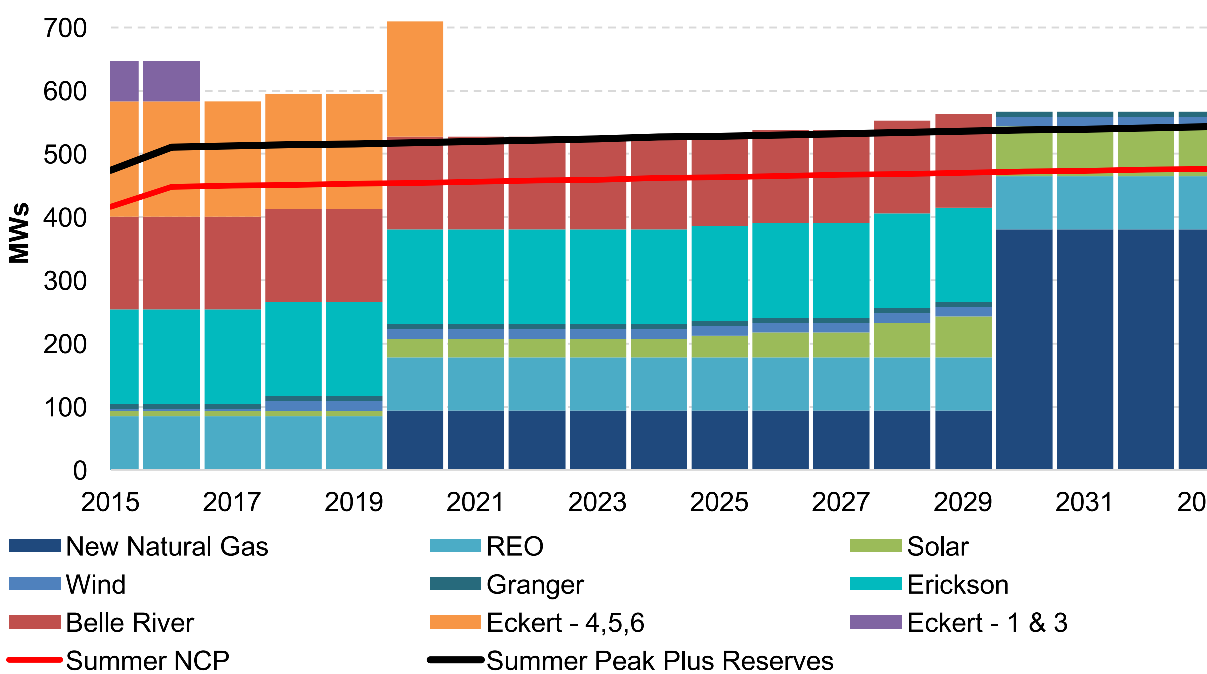
The model selected the renewable energy resource options (e.g., solar versus wind) based on the economics of costs given other potential generation sources. Exhibit 23 summarizes the model results for the *Clean-Energy Goal with 85MW Wind Project Portfolio* as well as the timeline for and type of energy resource additions the BWL will add to its generation portfolio. BWL's capacity forecast with its existing resources and resource additions under the selected portfolio are displayed in Exhibit 24,

EXHIBIT 23. Summary of Clean-Energy Goal with 85MW Wind Project Portfolio

Model Results		Supply-side Resources		Demand-side Resources	
Relative Cost Index:	100.8	**2018**	85MW Wind	**Energy Efficiency**	41 MW
PV Cost ($000):	$1,693,448	**2020**	100MW Gas Turbine 40MW Solar	**Distributed Generation**	7 MW
Clean Power Plan Compliant	Yes	**2025-2029**	70MW Solar	**C & I On-site Generation**	15 MW
		2030	150MW Gas Turbine 150MW Combined Cycle 30MW Solar	**Residential TOU & DLC Programs**	7 MW

EXHIBIT 24. BWL Capacity Forecast with Selected Portfolio Resource Additions by 2030

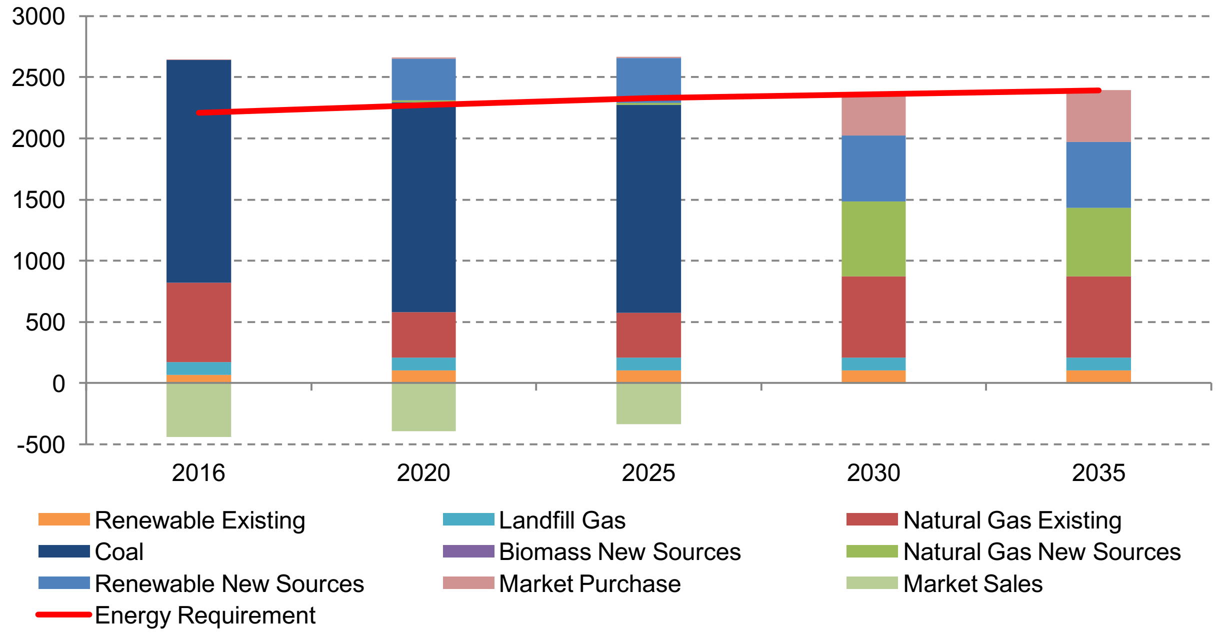
Generating Resource	Capacity (MWs)
REO Town	84.4
Beebe Wind Project	2.8
groSolar*	9
Granger Landfill Gas	8.3
New Wind	12.5
New Solar	70
New Natural Gas	380
Total	**567.0 MWs**



Source: BWL Portfolio Modeling

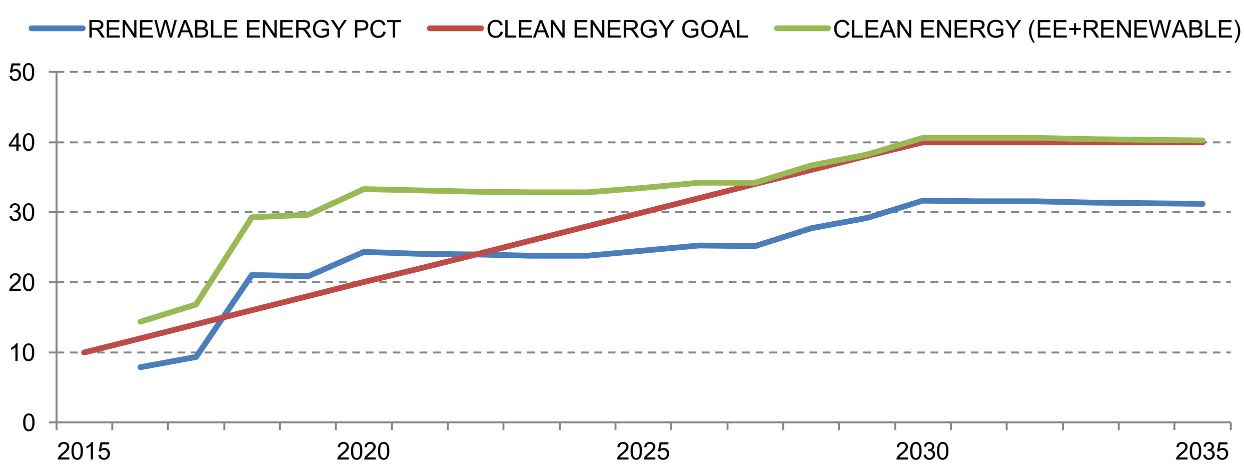
Exhibits 25 through 27 show the energy requirements, percentage of clean energy, and carbon-emissions rate respectively of the *Clean-Energy Goal with 85MW Wind Project Portfolio*. Exhibit 25 shows that by 2030 BWL will meet a portion of its energy requirement through market purchases. This should not construe that BWL will be dependent on outside sources for its energy needs, only that in some cases purchasing energy from the regional market can be economical.

EXHIBIT 25. Clean-Energy Goal with 85MW Wind Project—
Energy Requirement (GWHs)



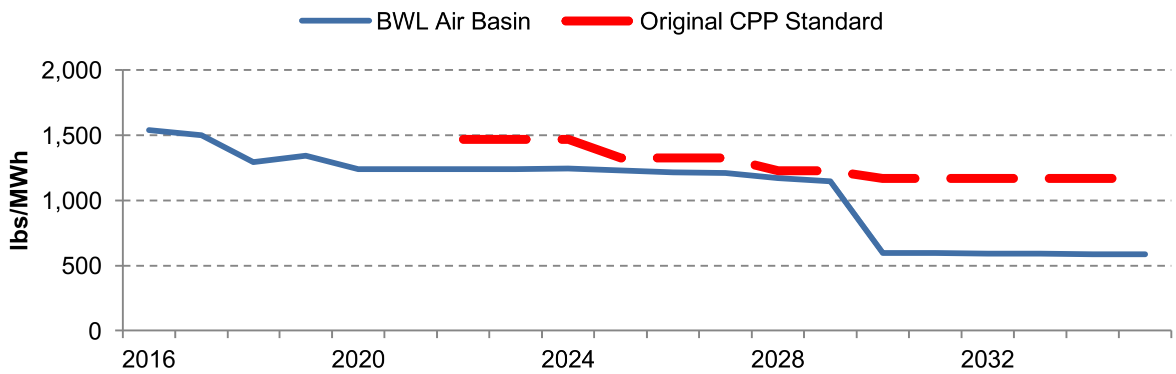
Source: BWL. Portfolio Modeling

EXHIBIT 26. Clean-Energy Goal with 85MW Wind Project - Percent Clean Energy



Source: BWL. Portfolio Modeling

EXHIBIT 27. Clean-Energy Goal with 85MW Wind Project - Carbon Emissions Rate



Source: BWL. Portfolio Modeling

OTHER RECOMMENDATIONS

Given the risks and uncertainty around future fuel prices, Clean Power Plan implementation, and related plant closure dates, as well as future technology advances, there was agreement among all Committee members that while the IRP is a 20-year plan, the modeling assumptions and recommendations regarding resource portfolio investments need to be reassessed more frequently. For example, the Committee identified an early retirement of Belle River as a risk, but over 80 percent of the plant is owned by DTE Energy which also operates the plant. Any decision regarding the retirement of Belle River rests with DTE Energy, but will have an impact on the BWL. As noted previously, an early retirement of Belle River (or BWL choosing to terminate its agreement with DTE prior to the plants closing) would cause resource decisions to change. Since key planning assumptions are more likely to change as time goes by, the first five to ten years are the most important in recommending a resource plan, and beyond this plan's first years, there is time to revisit and update. The most immediate need is the impending retirement of the Eckert station in 2020 and preparing for the Clean Power Plan. The Committee recommends BWL should do the following:

- Review and update the IRP (with input from the standing CAC) every four years or as triggered by a major resource event (e.g., the early closure of the Belle River or Erickson Plant). In several of the scenarios, the model selected the same resources in which BWL should invest during the first five years because cost estimates and predicted energy generation for those technologies are relatively well known in the short term. However, there are greater uncertainties around costs and technology the further out the model projects. As such, the IRP should be reviewed and updated (including assumptions about fuel costs and available technologies and resource portfolio scenarios) after a few years in order to provide a better foundation for IRP decisions.
- Regularly review the applicability and costs of advancing renewable energy technologies, particularly battery storage. As battery storage and lower-cost renewable energy technologies become available, integrate these resources into IRP updates.
- BWL should continue to explore opportunities to expand its energy-efficiency program based on ongoing evaluation of costs and benefits.

Acknowledgements

The CAC would like to thank the BWL and the many technical experts who provided an enormous amount of information, context, and history on BWL’s energy systems, energy markets, cost estimates, technical considerations, environmental issues, health issues, and model assumptions. This data was essential for the Committee in understanding all of the complexities regarding how to meet BWL’s future energy needs.

The Committee is also grateful for the many members of the public who attended our meetings and provided verbal and written comments. We recognize that there is significant expertise and passion in our community regarding energy production and energy use, and we appreciate the public’s willingness to help us understand all of the related IRP issues.

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Appendix A

CITIZENS ADVISORY COMMITTEE RESPONSIBILITIES AND PROCEDURES

The Lansing Board of Water and Light (BWL) has undertaken an integrated resource planning (IRP) process which will recommend how to power the region with respect to a detailed technical analysis of costs, reliability, environmental impact, and safety of resource options. The ultimate goal of the IRP process is to craft a plan the BWL will implement based on a balanced consideration of costs to customers, ensuring a reliable energy source for the region, environmental stewardship, risks, federal regulations, local-generation capacity and economic development. BWL has committed to making the IRP process inclusive and transparent by giving customers and stakeholders a voice in its development. To this end, the BWL has formed a nine-member Citizens Advisory Committee (CAC) of BWL customers, experts in energy and utility operations, and local leaders who will guide the process together. Based on the CAC's technical analysis and input received at meetings, a final report will be presented to the BWL Board of Commissioners in 2016.

RESPONSIBILITIES

- ***Review Background Research:*** During the first six meetings, CAC members will be provided an overview of BWL operations, industry trends, projections for future energy and supply needs, and modeling scenarios for the next 20 years. The goal of these meetings is to provide all committee members a common understanding of issues and information relevant to the project before beginning exploration and development of recommendations.
- ***Develop a Vision and Guiding Principles*:** Committee members will develop vision and guiding principles for their recommendations for BWL's IRP.
- ***Recommendations:*** Using background research and direction provided by the approved vision and guiding principles, the CAC will explore and define their priorities for meeting the future energy needs of BWL. These recommendations will be made to the BWL Board of Commissioners. The process of adopting a consensus report and making recommendations to the board are outlined at the end of this document.

OPERATING PROCEDURES

- Meeting materials, schedules, and summaries are available electronically, and e-mail communication with committee members will provide instructions on when materials become available and how to access them.
- Meeting summaries will be prepared and distributed to members.
- Members are encouraged to solicit input from others between meetings to assist in the discussions during the meetings.
- Members who have materials they wish to share are encouraged to provide electronic copies to the co-chairs as well as a copy to Public Sector Consultants (PSC) for distribution to all members.
- E-mail will be the primary means of communication with members.

DISCUSSION GUIDELINES

- Acknowledge one another as equals in the discussion.
- Stay open to each other's perspectives.

- Do not criticize the ideas of others, but offer your own ideas that might be different.
- Slow down so CAC members have time to think and reflect.
- Remember that this process allows everyone to think together. Expect the process to be messy at times, particularly given the controversial nature of the issues with which the members will be grappling.
- Stay focused on the responsibilities listed above.

GUIDELINES FOR FINALIZING THE COMMITTEE'S RECOMMENDATIONS

- The CAC should strive for consensus recommendations. A supermajority of those members (i.e., at least one more than a simple majority) will constitute the level of agreement necessary for a consensus recommendation to the board of commissioners.
- The board of commissioners intends to give great weight to the recommendations of the Committee members, but must assume the ultimate responsibility for any decisions on BWL's IRP.
- BWL staff members, although involved in the discussions with the CAC, have alternative means to express their opinions; therefore, only appointed committee members will participate in determining recommendations to the board of commissioners.
- The written recommendations of the CAC will be prepared by Public Sector Consultants and finalized following review and approval by members.
- In the event that an individual member determines he or she cannot support a specific consensus recommendation, he or she will have the opportunity to record the reservation.
- In the event that a consensus cannot be reached among the members on a specific recommendation (e.g., a supermajority of committee members do not concur and/or there are multiple alternatives still under discussion at the end of the process), PSC will summarize, with the help of those members advocating for a specific recommendation, the different alternatives and the potential consequences in a written report that will be shared with all members for review before being sent to the board of commissioners.
- When the final recommendations to the board of commissioners are prepared, the Committee will be asked to agree that the report accurately describes the process, that the process provided adequate opportunities for members to provide input into the final recommendations, and for individual members to record reservations on specific recommendations.
- When the advisory committee's recommendation has been finalized, the co-chairs may be asked to present the group's recommendations to the board of commissioners.

Appendix B

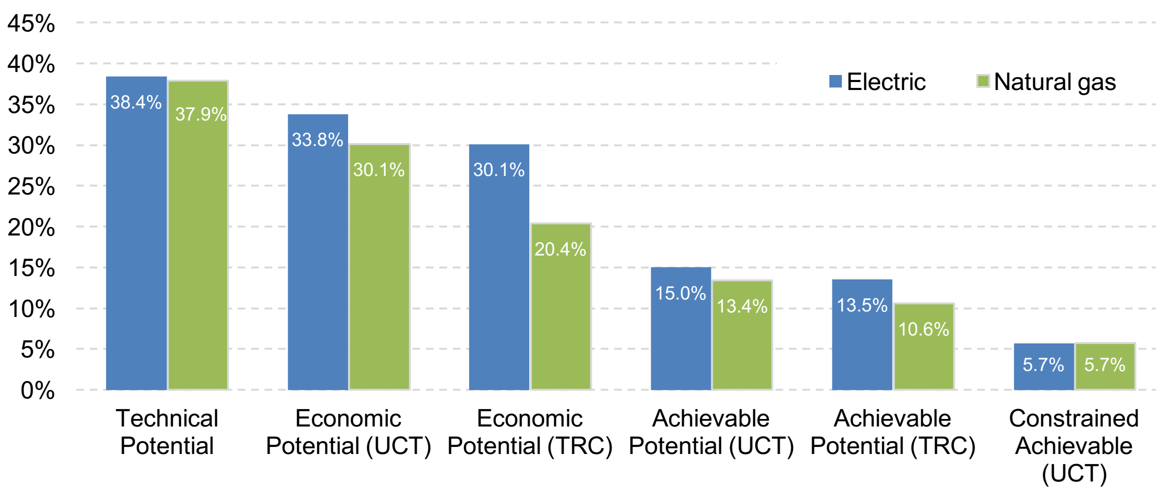
MICHIGAN'S ENERGY EFFICIENCY POTENTIAL

In 2013, GDS Associates completed a study on behalf of the Michigan Public Service Commission that evaluated the potential energy savings from efficiency measures. The study examined the economic potential of these savings using the Total Resource Cost (TRC) test and the Utility Cost Test (UCT). GDS defines these tests as follows:

- "**Total Resource Cost Test**: The TRC measures the net benefits of the energy efficiency program for a region or service area as a whole from the combined perspective of the utility and program participants. Costs included in the TRC are costs to purchase and install the energy efficiency measure and overhead costs of running the energy efficiency program. Costs include all costs for the utility and the participants. The benefits included are the avoided costs of energy and capacity plus any quantifiable non-energy benefits (such as reduced emissions of carbon dioxide)."
- "**Utility Cost Test**: The UCT measures the net benefits of the energy efficiency program for a region or service area as a whole from the utility's perspective. Costs included in the UCT are the utility's costs to design, implement and evaluate a program. The benefits included are the avoided costs of energy and capacity."

The following Exhibit "shows that cost effective electric energy efficiency resources can play a significantly expanded role in Michigan's energy resource mix over the next five and ten years. For the State of Michigan overall, the achievable potential for electricity savings based on the UCT in 2023 is 15.0% of forecast kWh sales for 2023. For the State overall, the achievable potential for natural gas savings based on the UCT in 2023 is also 13.4% of forecast MMBtu sales for 2023" (GDS Associates Inc.).

EXHIBIT B.1. Electric & Gas Energy Efficiency Potential Savings Summary



Source: GDS Associates Inc. November 5, 2013. *Michigan Electric and Natural Gas Energy Efficiency Potential Study.* Available at: http://www.dleg.state.mi.us/mpsc/electric/workgroups/mi_ee_potential_studyw_appendices.pdf (accessed 4/4/2016)