Evaluation of Long-Term Power Supply Alternatives

MEMPHIS LIGHT GAS & WATER (MLGW)

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1. Executive Summary

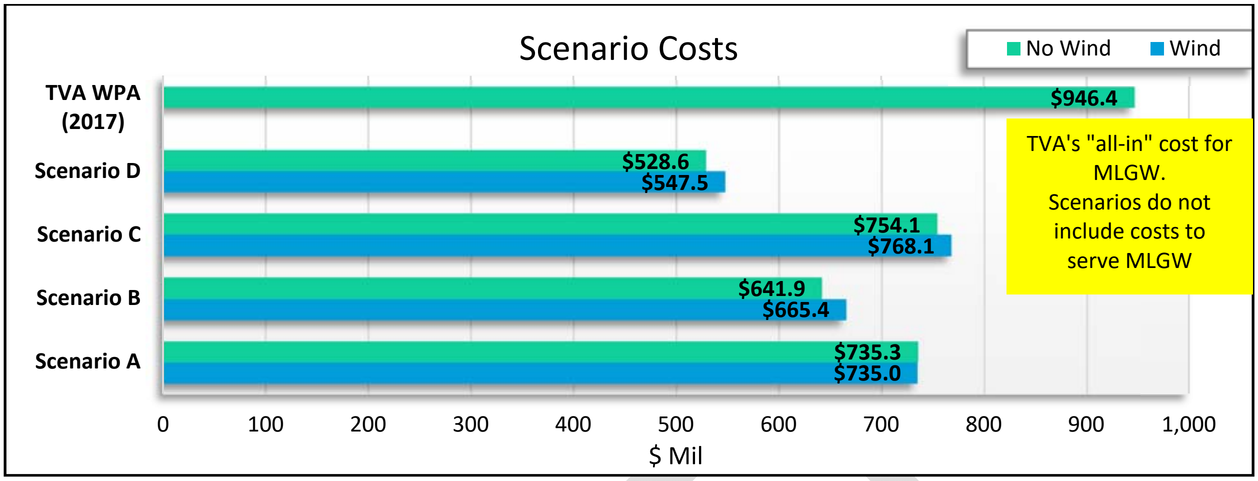
Memphis Light, Gas and Water Division ("MLGW") finds itself at a crossroads regarding potential changes in its historical supply relationship with TVA, availability of new generation options, and the potential for participation in Regional Transmission Organization (RTO) markets. In this Evaluation of Long-Term Power Supply Alternatives ("Study"), GDS Associates, Inc. ("GDS") has developed various power supply alternatives for MLGW by replacing its current TVA full-requirements power supply with a combination of the Nuclear Development - Bellefonte Proposed Power Purchase Agreement ("Bellefonte PPA"), market purchases from the MidContinent Independent System Operator ("MISO") Regional Transmission Organization ("RTO"), and generation self-build options. The alternative power supply arrangements were studied in various combinations in order to insure MLGW's load is served reliably. In addition, GDS performed a qualitative review of both the viability of the Bellefonte project as well as a review of the obligations associated with participation in the MISO RTO.

In this Study, GDS conducted a nodal pricing analysis of four power supply scenarios using PROMOD IV production cost software and the latest MISO database for the Calendar Year of 2022. PROMOD produces a fully integrated, security constrained economic dispatch adhering to generation and transmission limitations simultaneously. The scenarios include two whereby MLGW is its own NERC Balancing Authority (BA) and thus responsible for dispatching generation to meet load in accordance with NERC Reliability Standards and "keeping the lights on". The other two scenarios included MLGW in MISO's BA as an RTO Market Participant. In addition, MLGW requested GDS produce a "sensitivity case" by including renewable wind generation serving approximately 15% of MLGW's load. The PROMOD analysis includes power plant fuel costs, plant variable operations and maintenance costs, and transmission service costs. **None of the scenarios included capacity costs or the costs associated with capital expansion required to construct new generation or transmission infrastructure**. The four scenarios are as follows:

- Scenario A: MLGW as its own BA w/ Bellefonte and market purchases from MISO
- Scenario B: MLGW as its own BA w/ Bellefonte and new resources
- Scenario C: MLGW in MISO RTO w/ Bellefonte
- Scenario D: MLGW in MISO RTO w/o Bellefonte

The results of the Study may be summarized in Figure 1:

Figure 1: Scenario Costs



Bellefonte PPA costs are calculated to be well above market energy prices under modeled gas prices for the study year of 2022. In addition, there is a reliability and economic risk associated with placing so much of MLGW's energy needs with a single generator. The lowest marginal cost alternative is Scenario D which is MLGW completely integrated into the MISO RTO and purchasing all energy at spot prices. However, while purchasing energy strictly from the market provides opportunities for low-cost power, it provides no protection from scarcity energy pricing. Scenario B indicates savings over two other scenarios by using a combination of the Bellefonte PPA and MLGW-constructed generating resources. These savings are driven primarily by reduced transmission service purchases and may provide the most reliable service to MLGW customers.

The analysis of the viability of, and the risk associated with, the Bellefonte Project indicates a lack of a detailed engineering analysis of the existing plant systems and equipment. Assumptions regarding the use of Maximum Guaranteed Price (MGP) contracts with penalties assessed to the contractors for schedule delays is unrealistic. These MGP contracts are virtually non-existent in Southern Company's currently on-going construction of Vogtle Units 3 and 4. Scheduling assumptions also pose an issue including, for example, progressing from fuel load to commercial operation in three months. GDS recommends MLGW continue to evaluate the economics, transmission service, and other factors relevant to the proposed Bellefonte PPA in the course of developing a future power supply plan.

For comparison purposes, a TVA Business-as-Usual ("BAU") calculation is presented in this Study. GDS has utilized information provided by MLGW (billing summaries) and publicly available information (TVA SEC 10_K filings) to produce an estimated cost to serve MLGW's load. Utilizing PROMOD to produces an average production cost for TVA of $18.50 per MWh for 2022. This is not a realistic alternative for MLGW since PROMOD does not not account for capacity costs, river management fees and other components associated with TVA's wholesale rates.

It is GDS' recommendation that MLGW proceed with developing a complete Integrated Resource Plan ("IRP") which would enumerate the cost of owning and operating various resource portfolios over a 20-year study period and, by comparison on a net present value basis, identify the most cost-effective resource portfolio to meet MLGW's total capacity and energy requirements. The IRP would include a long-range financial forecast which evaluates the financial impacts of the various generation and transmission resource alternatives capex (e.g., impacts on cash flows, financial metrics, and retail rates) as well as possible demand response and energy-efficiency measures. The core issue that the IRP process will address is whether MLGW should continue to purchase all of its capacity and energy through a wholesale power agreement with TVA.

2. Introduction

The MLGW System

MLGW currently receives energy, capacity and associated services through Wholesale Power Agreement (WPA) with TVA. The all-in cost for this service is priced at $71/MWh. Delivery of energy to serve the MLGW peak demand requirement of 3,200 MW is provided by TVA resources and is delivered to MLGW through 500/161kV interconnections located around the MLGW service territory. MLGW has no transmission interconnections with any other entity, although the city is located electrically close in proximity to the MISO RTO.

MLGW is in a unique position due to its electrical proximity to the MISO RTO and Entergy Mississippi and the option to terminate the distributor relationship with TVA through executing their five-year "notice out" provision in the WPA, which could allow MLGW to be free to pursue other options for power supply in the future. Nuclear Development, LLC (ND) has offered a power purchase agreement from the Bellefonte Nuclear Plant in Alabama at an all-in thirty-year price of $39/MWh to partially replace energy currently provided through the TVA WPA.

GDS has evaluated four scenarios to consider the effect of MLGW terminating the TVA WPA and replacing its power supply needs through a combination of the Bellefonte PPA, market purchases from the MISO RTO and generation self-build options. The cost benefit analysis shown below focuses solely on the cost of energy to meet MLGW energy demand requirements and does not consider any of the additional costs that may be required to make those theoretical arrangements feasible, such as the capital costs of self-build or the infrastructure costs needed for MLGW to be a full participant in the MISO RTO.

3. Considerations Regarding Viability of Continuing TVA Distributor Relationship

The evaluation of the feasibility of the Bellefonte PPA and other alternatives hinges on the valuation of the TVA distributor relationship and how the products provided by TVA could be procured from an alternate source. For this analysis, GDS examined the feasibility of MLGW joining the MISO RTO for access to the wholesale energy market, market-based ancillary services, transmission cost recovery, and regional planning. The power supply alternatives considered in this assessment assume that MLGW will no longer rely on TVA for any energy, capacity or network transmission services. Consideration of the Bellefonte PPA occurs in the context of MLGW being able to maximize the value of the asset through third party sales of excess energy into the MISO market and the ability of MLGW to rely upon the MISO market for energy and capacity in the event of a Bellefonte outage, as TVA will no longer be required to provide backup service for generation if MLGW terminates the TVA distributor relationship. This study is not intended to provide the full economic evaluation required to assess the TVA WPA against a full MLGW withdrawal but only identifies those areas where MLGW participation in MISO differs from the TVA relationship.

TVA Business as Usual Case

Currently, the TVA WPA provides all of MLGW's capacity, energy and ancillary services needs on a delivered basis. TVA's billing structure under the WPA includes "bundled" rates for various customer classes (residential, commercial, industrial) as well as credits and charges associated with various TVA incentive programs and other cost structures. MLGW receives a transmission facility credit associated with its ownership of 161kV and 115kV transmission facilities. GDS reviewed TVA's 2017 and 2018 billings to MLGW under the existing WPA. The data indicates an annual average billing demand of 2,376 MW and an annual energy consumption of 14,339,976 MWh. Information provided in TVA's public filings indicate a marginal cost to serve its wholesale load of approximately $66 per MWh.[1]

4. Cost-Benefit Analysis

Description of Potential MLGW Power Supply Scenarios

If MLGW makes the determination to terminate the distributor relationship with TVA beginning 2022, the fundamental system operations structure of MLGW must change to accommodate the transmission arrangements needed to participate in power supply options such as the proposed Bellefonte PPA and to accommodate participation in an external market like MISO.

[1] TVA 2017 SEC Form 10-K

Before turning to the detailed economic analysis conducted as part of the cost benefit analysis, it is important to clarify and distinguish between the way MLGW could manage their energy load requirements as a stand-alone Balancing Authority and how this would be altered in an RTO market environment. This section provides a comparison between the two approaches and seeks to highlight key characteristics of RTO energy markets.

MLGW as their own Balancing Authority

The first change MLGW must pursue is to form an independent Balancing Authority (BA) separate and distinct from TVA. This means that TVA will not be required to provide any services to MLGW for loss of generation or reserve needs, or any ancillary services. MLGW becomes responsible for the viability and reliability of power supply and transmission service to serve MLGW load without the backstop of TVA that exists under the current WPA. To do so, MLGW would dispatch their resources, or make purchases, to meet these demands and would own and maintain certain transmission facilities. Once the needs of the native load are met, MLGW can make off-system sales with any excess generation. The costs to produce or procure energy to serve MLGW native load requirements are recovered from the customers receiving electric service from MLGW. These costs can be offset by energy margins made by making off-system sales to other parties.

Since an MLGW BA would have no electrical interconnection to any transmission system other than TVA, point-to-point transmission service to the MISO RTO or the construction of transmission facilities to directly connect to the RTO are required. In each of the scenarios evaluated by GDS, the cost of transmission service to serve MLGW is included, based upon the in-effect point-to-point rates posted by TVA for long-term firm and short-term non-firm transmission. Transmission rates for MISO are based upon the drive-out point-to-point rate under the MISO Open Access Transmission Tariff (OATT). Please note that this analysis has not evaluated the cost of any transmission facilities that may require delivering Bellefonte or any other resource to the MLGW BA. A review of studies performed by ICF and provided to MLGW indicate no additional transmission is needed for Bellefonte, and GDS has not performed any incremental analysis with respect to the ICF findings.

MLGW Participation in RTO Energy Markets

It is important to contrast the formation of a MLGW BA whereby MLGW dispatches its own generation and purchases to meet its load requirements with an energy market construct where the load and generation are separated and become part of a centralized, region-wide commitment and dispatch to serve the RTO-wide load at the lowest cost. In the RTO construct, a generator receives a payment based on the Locational Marginal Price ("LMP") at the point where the generator injects power into the grid, and the load pays the LMP at an individual bus, aggregated load zone or hub.

The LMP represents the incremental cost of energy at a specific electrical bus (or collection of buses, often referred to as a "hub") at a given point in time. LMPs include the cost of the next increment of energy needed to meet system-wide demand (the "energy" component), the cost of transmission congestion impacts on a specific bus location (the "congestion" component), and the cost of electrical losses associated with a specific bus location with respect to a pre-determined reference point (the "loss" component). The use of LMP is a necessary component within the RTOs, which is represented in Table 1. The LMP provides the proper economic signal for the dispatch of resources to manage generator costs, congestion, and losses on the electrical system. Mathematically this is defined as the following in $/MWh:

Locational Marginal Price = System Energy Price + Congestion Price + Loss Price

Table 1: Components of LMP

Locational Marginal Price ($/MWh)			
Locational Marginal Price	**System Energy Price**	**Congestion Price**	**Loss Price**
• Incremental costs of energy at a specific electrical bus, or collection of busses, at a given point in time	• Represents optimal dispatch ignoring congestion and losses • Same price for every bus in the RTO	• Represents the price of congestion for binding transmission constraints • Will be $0/MWh if system is unconstrained, but will vary by location if system is constrained	• Represents the price of marginal losses • Will vary by location based on a pre-defined reference point

The primary responsibility of the RTO is the continuous monitoring and control of the reliable operation of the transmission grid in their service territory. Reliability is maintained by managing electricity supply and demand balance through the direct and indirect control of generating assets owned by power producers and by adjusting import and export transactions. Power producers are paid for their operation through competitively traded power markets managed by the RTOs and, to the extent they qualify, tariffs for ancillary services. RTOs are also responsible for monitoring the wholesale market to assure that the market is operating competitively and that no market manipulation occurs.

The RTO energy markets operate much like any commodity market, with buyers and sellers establishing a price by matching supply and demand. Generating resources in the RTOs that are not involved in bilateral transactions are required to submit energy offers into the day-ahead energy market. The RTOs use the energy price offers to perform a day-ahead, least-cost security constrained unit commitment and hourly Security Constrained Economic Dispatch ("SCED") analysis of their respective systems, from which projected loads and energy exports for the following day are modeled to be served at the lowest possible bid cost of generation (plus imports), while maintaining adequate transmission system reliability and operating reserves.

From the day-ahead dispatch, the LMP is calculated for each node on the electric grid, from which prices are further computed by the RTOs for aggregations of nodes such as load zones, hubs, and interfaces. Transmission congestion can cause prices to diverge between nodes (and therefore also between zones, hubs, and interfaces) based on the cost impact of dispatching generating units out of merit order to relieve congestion. Generators are paid the nodal LMP price and load pays the zonal price (a load-weighted average of nodal LMPs within a defined load zone). Generating resources, load, imports, and exports that participate in the day-ahead market are also required to participate in the real-time energy (also referred to as the real-time balancing) market the following day. The real-time energy market reflects prices that develop when actual market operations vary from day-ahead expectations. Real-time LMPs are set based on the real-time SCED. Generators (and imports) are paid and load (and exports) are charged in the real-time market based on their deviations from the day-ahead schedule.

Since MLGW has no direct ties to MISO, MLGW will need to be "pseudo-tied" into MISO through a 3,404 MW PTP transmission reservation across the TVA system to connect MLGW and MISO. The purpose of the pseudo-tie is to allow the MLGW generation and load to be dispatched as part of the entire MISO network. This will provide maximum value to MLGW as a MISO Market Participant. The cost of the PTP reservation for the pseudo-tie is reflected in each of the economic scenarios evaluated by GDS.

Summary: Meeting Energy Needs

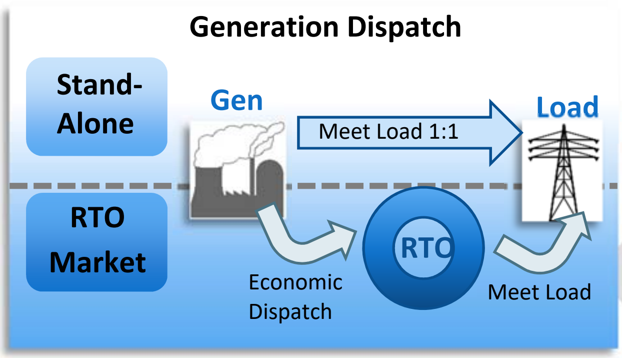
Table 2: Summary of Meeting Energy Needs

Summary: **Meeting Energy Needs**
• Both the BA approach and the RTO market offer a different means to the same end of delivering electricity to the MLGW native load. Figure 2 illustrates the key characteristics of each approach. However, given these differences, there are several important questions for MLGW to consider in the evaluation of whether MLGW's best interest continues to be served by the BA approach or whether joining an RTO may prove more beneficial. These questions include: 1. Will it be more cost effective for load to procure from the RTO or directly from the MLGW resources?

2. Are there greater opportunities to maximize generation revenue in the RTO markets?
3. How will the dispatch of any MLGW resources change?

- It is these types of questions that the energy market analysis performed by GDS looks to answer and which is outlined in the next section.

Figure 2: Member and RTO Energy Construct



Stand-Alone: Resources dispatched to meet native load demand. Once met, opportunities for off-system sales may exist.

RTO Market: Region-wide economic dispatch of resources to serve RTO wide load at the lowest cost. MLGW's load and resources would form part of the RTO.

Detailed Energy Market Analysis

To assess the economics of moving between a BA energy construct and an RTO market, GDS modeled the overall MLGW energy cost in each scenario using industry standard production cost modeling.

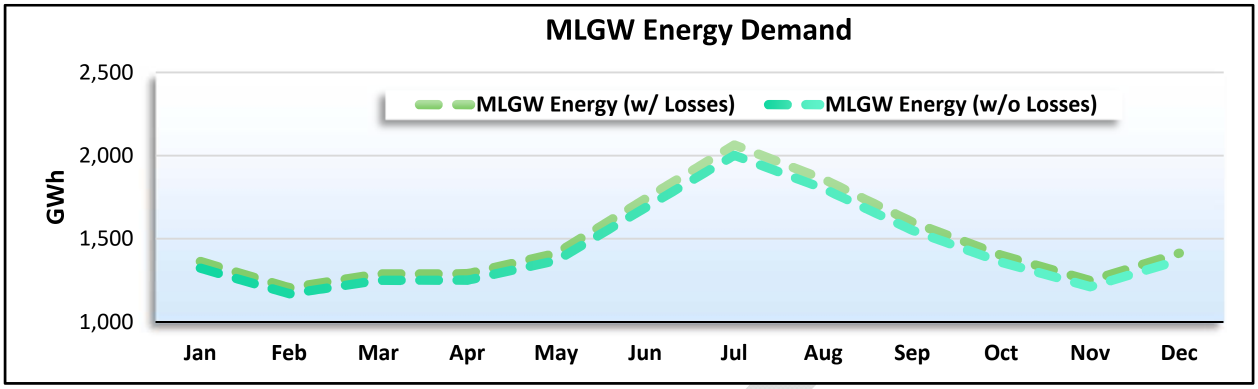
This section examines the following:

1. Overview of MLGW load forecast and its available resources
2. Production cost modeling methodology
3. Detailed results and discussion

MLGW Energy Overview

In the BA construct, the design is to serve native load first. The energy demand is monitored throughout the day and the generation dispatch is adjusted to meet this requirement, plus any operating reserves. For this analysis, MLGW provided their projections of energy demand, with and without losses, for the study period. This forecast is shown in Figure 3: MLGW Energy Demand below.

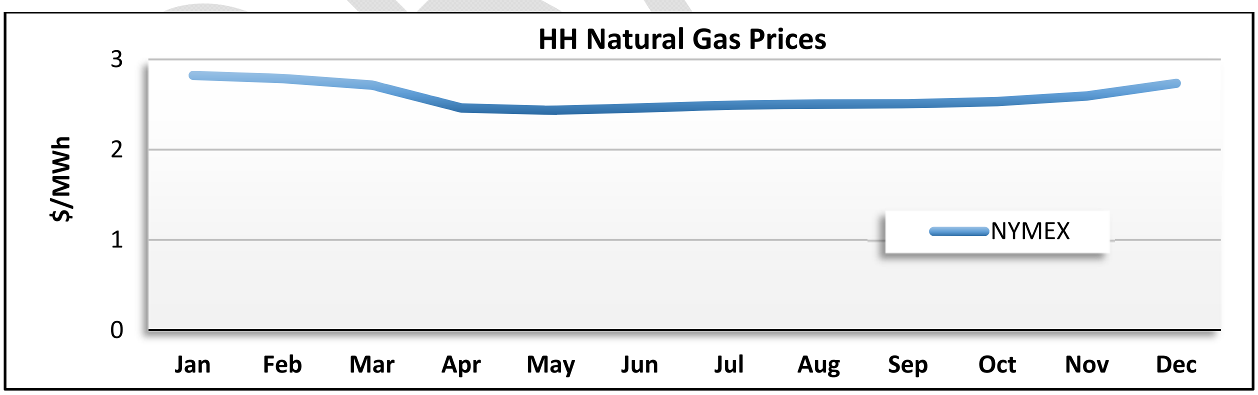
Figure 3: MLGW Energy Demand



Since MLGW is responsible for meeting all its load requirements in the BA construct, MLGW will utilize any owned and purchased resources to meet their projected load plus any transmission losses. The handling of losses within the production cost modeling will be discussed in further detail under the Methodology section below. To meet this energy demand, MLGW has a mix of thermal resources, power purchase agreements, and imports.

As part of this analysis, GDS provided gas prices used by MLGW's generating units and used a Henry Hub natural gas price index strip from 9/25/2018 that would ultimately affect the dispatch of all thermal generating units throughout the modeled footprint. This price strip is shown in Figure 4: 2022 Henry Hub Natural Gas Forecast and will be referred to often during the presentation of the results.

Figure 4: 2022 Henry Hub Natural Gas Forecast



Methodology

To best replicate the SCED used by the RTO, GDS utilized the PROMOD IV^{R} (PMIV) production cost modeling software. PMIV is proprietary modeling software which incorporates extensive details of generating unit operating characteristics, transmission grid topology and characteristics, and market system operations to support economic-based decisions affecting the electric industry including transmission planning. The simulations encompass RTO energy markets and transmission grids throughout the eastern United States, including SPP, PJM, MISO, New York ISO, and the U.S. Southeast. PMIV is an integrated electric generation and transmission market simulation tool. PMIV performs hourly chronological commitment and dispatch of generating resources that minimizes system operating costs while simultaneously adhering to a variety of constraints, including operating limits of generation sources, transmission element limits, fuel and environmental costs, operating reserve requirements, and customer demand and supply/demand balance. PMIV can be used to forecast hourly energy prices at a nodal granularity (LMPs), unit generation output, fuel consumption, emissions output, transmission flows, and congestion costs based on the input market conditions specified by the user. PMIV is a tool commonly used by RTOs, including PJM, MISO and SPP, to perform cost-benefit analyses for new transmission facilities.

Earlier in this section we had a brief mention of losses. When RTOs are performing their planning functions, they receive a load forecast from each LSE that does not include losses. Since these losses are not included in the load forecasts, then in the actual dispatch the generation would have to generate more than the forecast to account for these losses. This additional generation would lead to extra cost, but not extra revenue. To account for this lost revenue, the loss component of LMP is included in the total LMP to provide additional compensation to generation for over producing to account for losses. Losses on the actual AC system are estimated when power flow is converted to heat in the transmission system. This heat is produced by current ("I") flowing through resistance ("R") and is represented by I^2R.

PMIV has two methods of handling losses. In the first method, and since PROMOD uses a DC solution, the losses can be approximated by using the power flow ("P") through transmission equipment versus I. However, the risk in using the model to develop the losses is that there can be instances where the losses on a transmission line can get out of line with the rest of the simulation causing erroneous results in generation and LMPs. This is due to the non-linear nature of the loss calculation and trying to use a DC solution to resolve an AC problem. The model will work through an iterative process of dispatching to load, calculating losses, re dispatching to the new load plus losses, and so on, until an iteration limit is reached or convergence on the line losses within a tolerance. The second method applies the losses into the load, and the resources dispatch to this load plus losses. During this dispatch, penalty factors are computed for each generator as a function of the change in losses versus the change in generation output of a specific generator. If a generator causes more losses, then a penalty is applied to a generator to make it look more expensive in the dispatch. This works in reverse as well. In this method, generators produce to meet load plus losses, generators are assigned penalty factors based on their loss contributions, and a loss component of LMP is derived.

GDS recommends the use of the second method for a few reasons; 1) including the losses in the load forecast will allow for a consistent commitment and dispatch between the stand alone and RTO scenarios, 2) removes the risk of producing erroneous results, 3) improves simulation time, and 4) this second method was implemented by the developers of PMIV for MISO and is used by MISO, SPP, and PJM for their production costs modeling. In the RTO construct, MLGW will only be required to pay for the substation load that is being served from the market. Therefore, when performing the load cost calculations for the RTO scenarios, the hourly load without losses is multiplied by the hourly MLGW load-weighted LMP to arrive at a final load cost.

In the stand-alone scenarios, each member is modeled as its own "pool"; meaning that it will commit its own resources to meet native load, import energy, and then look for opportunities to make off-system sales. The costs to serve member load are based on the production cost of the thermal and non-thermal generation, adjusted for import costs and any margins made by off-system sales.

In the RTO integration scenarios, and the MLGW generation resources become part of the MISO centralized, region-wide commitment and are dispatched to serve the RTO wide load at the lowest cost. In this construct, off-system sales occur but are not necessarily tracked for accounting purposes, with generators being paid for the energy they produce at the point of injection. On the load side, there is not a direct relationship between MLGW's generators and the load as there is in the stand-alone scenario. The load cost is determined by a load-weighted LMP including all the MLGW load busses.

Through the remaining part of the energy analysis, GDS will focus on presenting the metrics we believe are most important from an energy perspective. Currently, MLGW would be concerned with providing safe, reliable, low-cost energy to its customers. This means operating the lowest cost resources to serve the load at the lowest cost. In the RTO construct, the goal would be to maximize profit on MLGW's resources, but to also compare the cost of serving its native load. To show this, GDS will produce the proper metrics to help with the overall net benefit analysis. These metrics include the following:

- Load Costs – The cost to serve MLGW native load
- Supply Costs – The costs of operation of thermal and non-thermal resources
- Energy Margin – The profit made by MLGW's generating units in the centralized dispatch of an RTO market
- Off-System Sales – Sales made outside of the MLGW BA under the stand-alone scenario
- Operations – Changes in operations

In the RTO's, MLGW generation and load are integrated into the RTO. In this construct, MLGW resources are offered into the integrated market on a day-ahead basis, and the RTO sets the dispatch schedules for each of the resources for the following day. From any generator's perspective, the goal is to maximize profits by being locationally, mechanically, and economically positioned on the transmission grid to operate at the lowest possible cost. This increases the likelihood that MLGW's generators will be dispatched economically as much as possible throughout the year.

5. Bellefonte: Viability Qualitative and Risk Analysis

The economic analysis performed by GDS assumes that the Bellefonte Project is feasible and can be used as a resource to meet MLGW energy demand requirements. However, there is a reliability and economic risk associated with placing so much of MLGW's energy needs with a single generator. If MLGW operates as its own BA, it must meet certain generation reserve requirements associated with the potential of an outage of the Bellefonte Project. This can be accomplished through reserve sharing arrangements with other BA's that may add additional costs as well as increased NERC reliability obligations. In addition to the power supply feasibility of Bellefonte, GDS has also conducted a high-level viability qualitative and risk assessment to identify any concerns regarding the Project, without regard to the economic impact of including it in the MLGW power supply plan.

The proposed Bellefonte project has many uncertainties including the proposed cost, schedule, contracting philosophy and overall viability.

Positives

Nuclear Development ("ND") proposes to replace most of the major plant equipment including the Steam Generators, Turbine / Generator, Feedwater Heaters, Moisture Separators and Condenser. ND's plan has a large contingency and appears to be comprehensive and covers the significant aspects of the project.

Negatives/Concerns

The detailed engineering review and analysis of the plant systems and equipment has not been completed due to unknown costs and work hours. In addition, the availability of equipment needed for replacement is unknown. Many of the original equipment vendors are no longer in existence or no longer providing safety related qualified equipment. Note that reverse engineering and/or commercial grade dedication is expensive and time consuming. The availability/quality of support for safety analyses, update of the Final Safety Analysis Report and support of licensing activities is uncertain as the original plant design engineer, Babcock & Wilcox, is no longer in the nuclear power plant engineering business. Furthermore, Framatome's capability to provide the technical support for a reactor design never constructed in the United States is questionable.

ND assumes that the major subcontractors will be willing to agree to Maximum Guaranteed Price contracts with significant Liquidated Damages for schedule delay. Following the Westinghouse bankruptcy, Georgia Power recently negotiated nearly 100 subcontracts for completion of the Vogtle 3 & 4 project and very few if any of these subcontractors were willing to agree to a MGP contract or significant LDs for schedule delay. These assumptions by ND are unrealistic and the schedule seems optimistic and based on "best case" performance. One example is progressing from fuel load to commercial operation in 3 months. A duration of six months would be optimistic but the ability to attract, hire and train operators including construction of a training center and development of a certified plant reference simulator in the time allowed is unrealistic. Westinghouse took nearly twice as long to fully develop a plant reference simulator for the AP 1000 plants.

SNC Lavalin has no relevant experience constructing and licensing nuclear power plants in the United States. Building plants in China, South Korea and Romania is very different than working in the US under strict NRC oversight and regulations.

Recommendation

It is GDS' recommendation to continue to evaluate the economics, power supply, transmission and other relevant issues associated with the proposed Bellefonte PPA.

Scenario A: MLGW Stand-alone BA with Bellefonte PPA and MISO Purchases

In the first scenario (Scenario A), MLGW has procured 1,350 MW of energy and capacity from a single unit at the Bellefonte Nuclear Plant (the "Unit") at $39/MWh. Since the Unit is located on the TVA system, MLGW will need to procure Point to Point ("PtP") transmission service from the Unit to MLGW to deliver this energy and capacity. In addition, MLGW will need to procure 3,404 MW (MLGW's peak) of firm PtP transmission service from MISO through TVA to reliably serve MLGW's load due to the full loss of the Unit.

As a sensitivity, GDS analyzed the economic effects of procuring 700 MW of high capacity factor wind (approximately 15% of MLGW's energy requirements) from MISO on Scenario A. In such cases, the wind is assumed to have a power purchase agreement ("PPA") price of $15/MWh. MLGW would need to procure firm PtP transmission service through MISO to TVA, and firm PtP transmission service through TVA to deliver this energy and capacity to the MLGW BA.

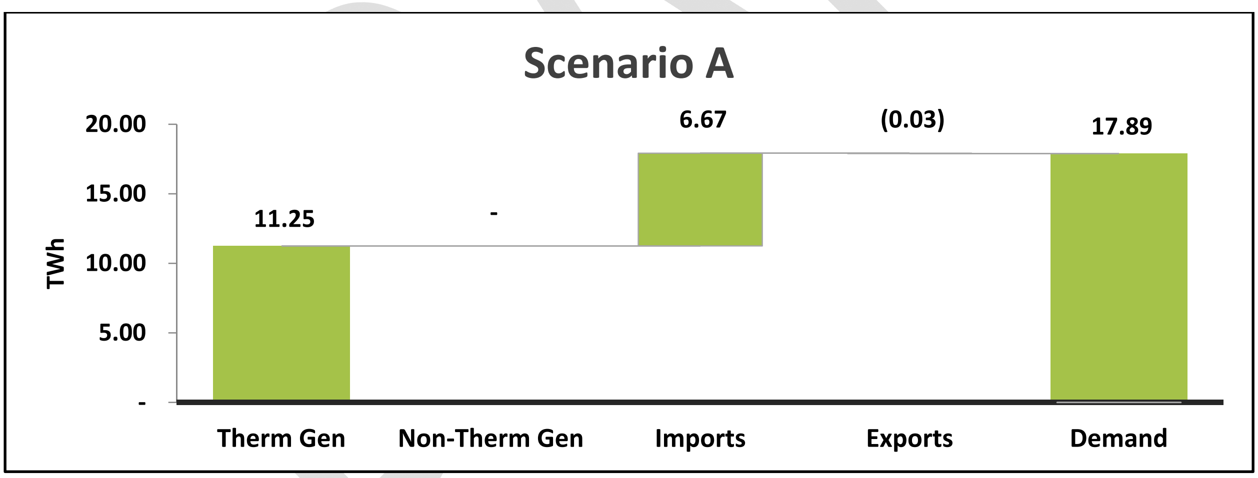
Scenario A assumes the following framework:

- MLGW is an independent Balancing Authority

- Power Supply Resources Base Case
  - 1,350 MW Bellefonte PPA delivered to MLGW through 1,350 MW PTP transmission service from TVA to MLGW
  - MISO Market Purchases for balance of MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW
- Power Supply Resources Renewables Sensitivity
  - 1,350 MW Bellefonte PPA delivered to MLGW through 1,350 MW PTP transmission service from TVA to MLGW
  - Renewable Resource of 700 MW of Wind Generation from MISO delivered to MLGW through 700 MW PTP transmission reservation from MISO to MLGW
  - MISO Market Purchases for balance of MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW

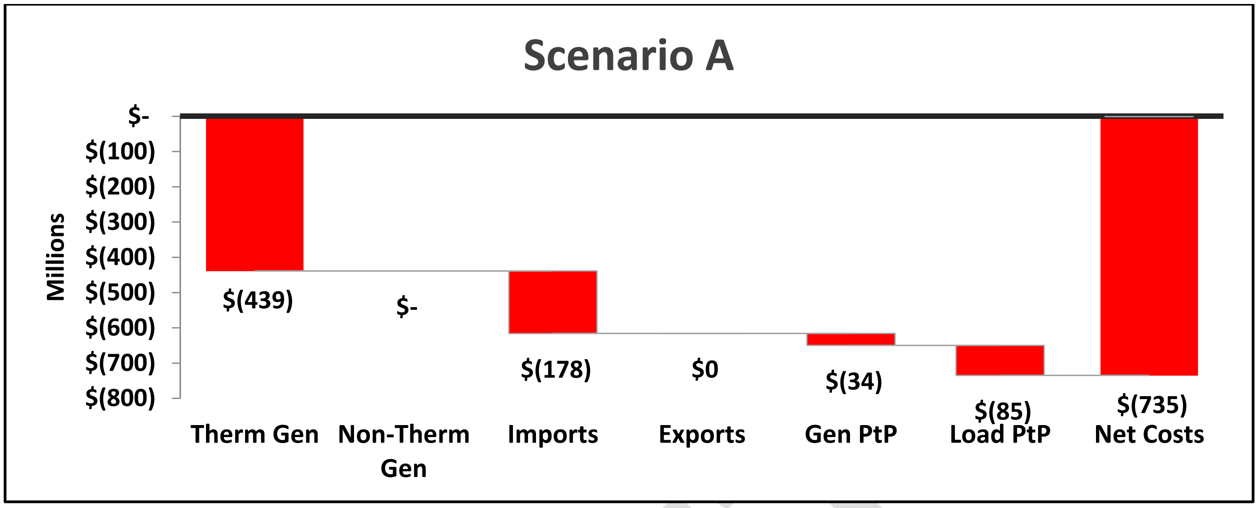
In Scenario A (Figure 5) MLGW uses the output from the Bellefonte Unit and imports to satisfy the load requirements of 17.89 TWh. MLGW can use the firm PtP from MISO through TVA to procure these imports and can make small amounts of sales from the Bellefonte Unit when the MLGW load falls below the output of the Unit.

Figure 5: Scenario A Energy Balance



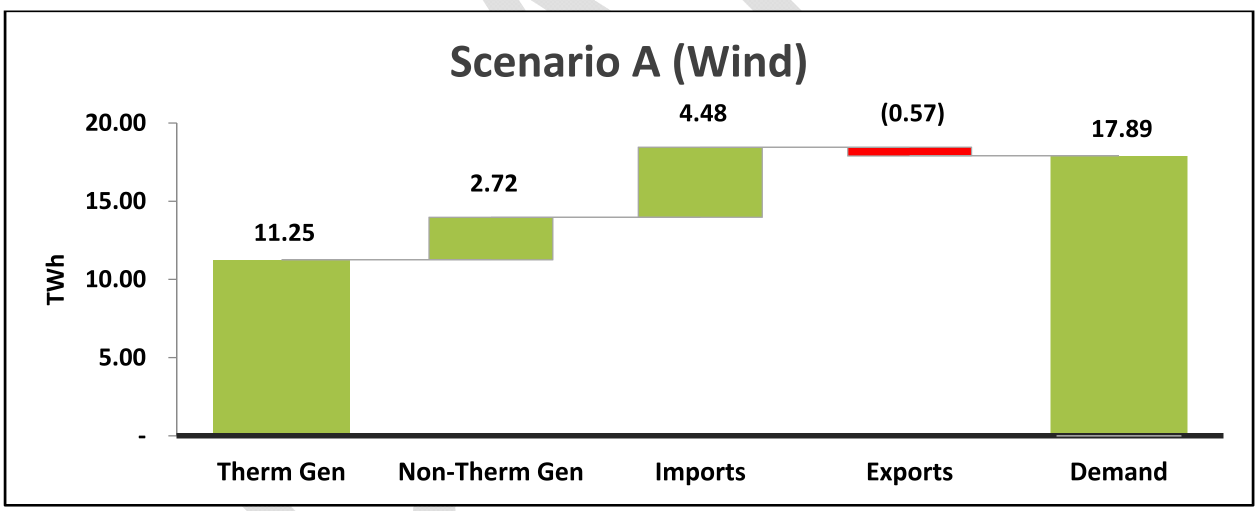
The ultimate cost of serving this almost 18 TWh of demand is approximately $735MM (see Figure 6), with most of that cost coming from the PPA with the Unit at Bellefonte. This scenario provides a partial hedge by covering approximately 63% of MLGW's energy requirements with the Unit.

Figure 6: Scenario A Energy Costs



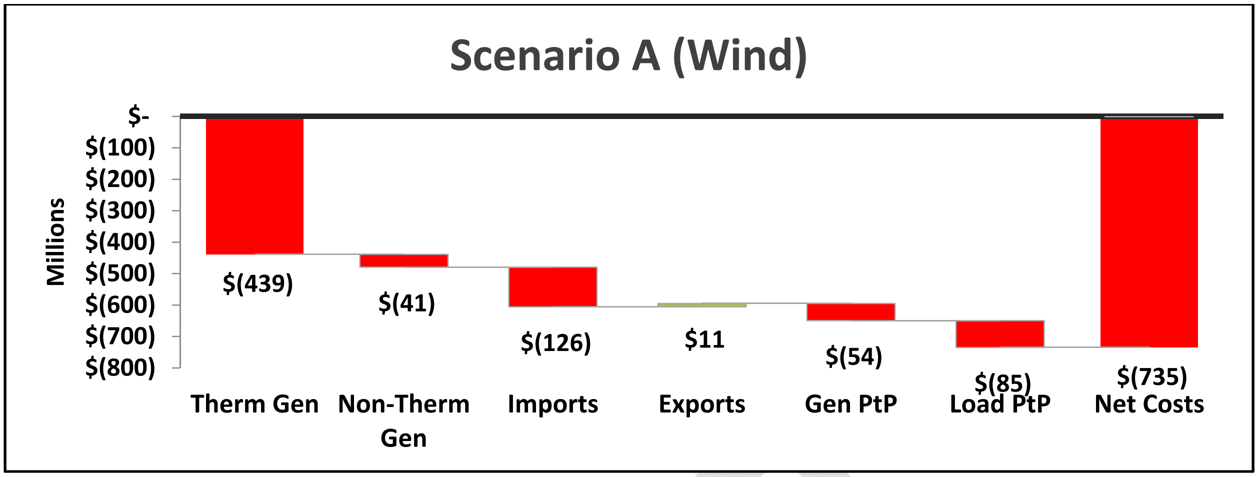
With a renewable wind PPA, sourced from the Upper Midwest of MISO, serving approximately 15% of MLGW's load requirements, the amount of energy needed from imports is reduced (see Figure 7).

Figure 7: Scenario A (Wind) Energy Balance



The firm PtP transmission costs associated to move the wind across the MISO system are an additional cost and included in the Gen PtP item below (Figure 8). MLGW does not need to procure additional PtP service through TVA since delivery of this wind can be included in the transmission service used to maintain reliability during peak loads. Notice that in this scenario the reduction in import costs is offset by the increased costs of procuring the wind and moving it through the MISO system, realizing almost identical net costs with and without the renewable wind PPA.

Figure 8: Scenario A (Wind) Energy Costs



Scenario B: MLGW Stand-alone BA with Bellefonte PPA and Self-Build

In Scenario B, MLGW will still procure energy and capacity from the Bellefonte Unit but will also build two (2) new combined cycle generating units and six (6) new simple cycle combustion turbine units totaling 2,604 MW. In this scenario, MLGW will still need to procure firm PtP from the Bellefonte Unit to MLGW but will not need to procure firm PtP transmission service from MISO through TVA to serve its entire load since MLGW will have enough of its own internal generating resources to satisfy MLGW's peak. However, MLGW will utilize hourly non-firm transmission transactions priced at the hourly rates to allow purchases and sales of energy with MISO when economic.

As a sensitivity, MLGW analyzed the economic effects of procuring 700 MW of high capacity factor wind (approximately 15% of MLGW's energy requirements) from MISO on Scenario B. In such cases, the wind is assumed to have a power purchase agreement ("PPA") price of $15/MWh. MLGW would need to procure firm PtP transmission service through MISO to TVA, and firm PtP transmission service through TVA to deliver this energy and capacity to the MLGW BA.

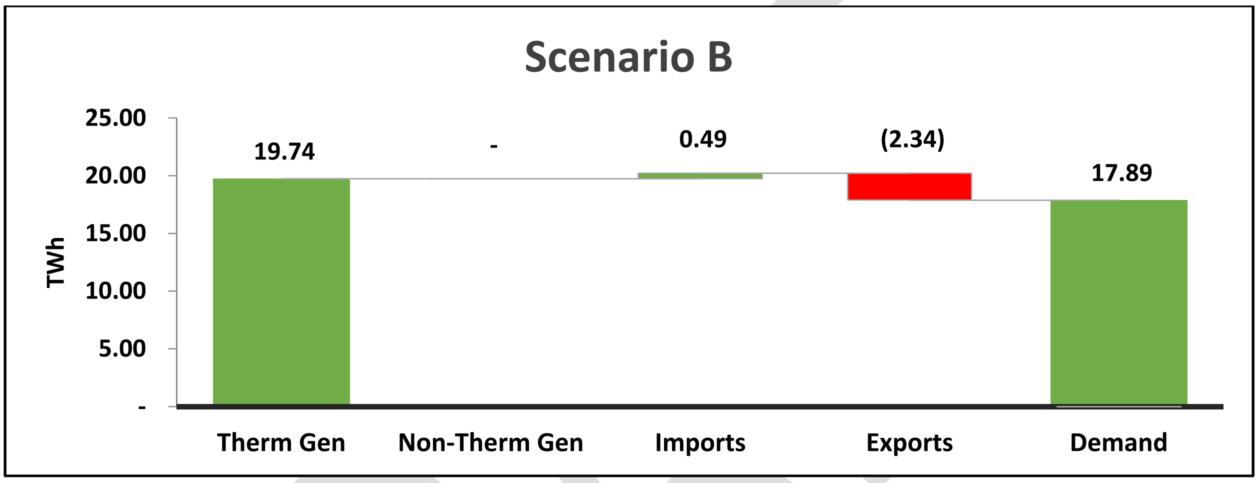
Scenario B assumes the following framework:

- MLGW is an independent Balancing Authority
- Power Supply Resources Base Case
    - 1,350 MW Bellefonte PPA delivered to MLGW through 1,350 MW PTP transmission service from TVA to MLGW
    - MLGW Self-build resources to meet balance of MLGW load Requirements
- Power Supply Resources Renewables Sensitivity
    - 1,350 MW Bellefonte PPA delivered to MLGW through 1,350 MW PTP transmission service from TVA to MLGW

- Renewable Resource of 700 MW of Wind Generation from MISO delivered to MLGW through 700 MW PTP transmission reservation from MISO to MLGW
- MLGW Self-build resources to meet balance of MLGW load Requirements

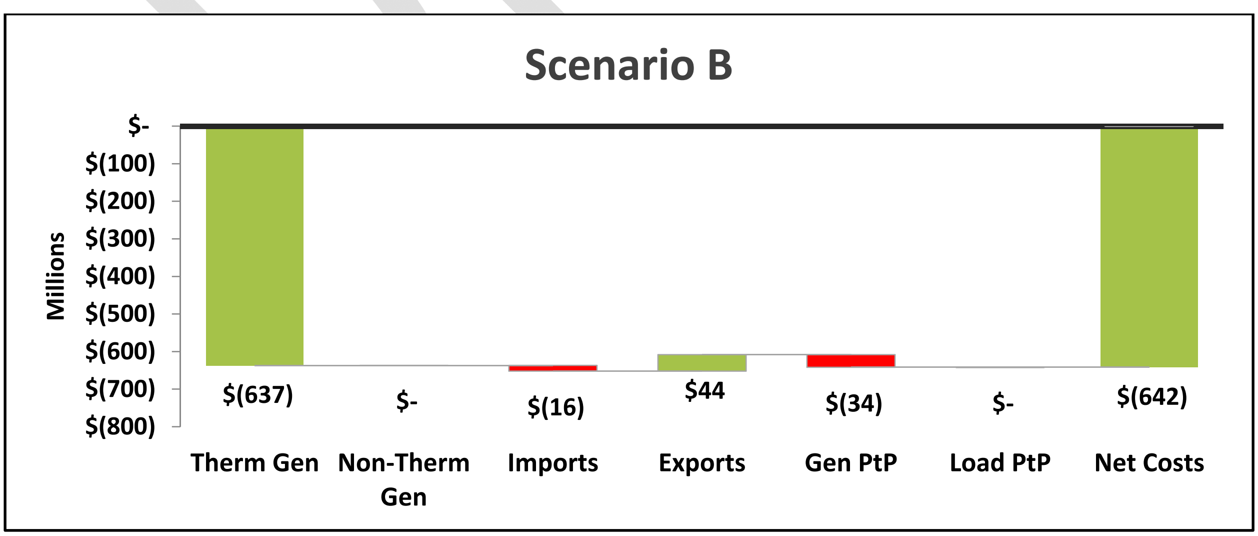
In Scenario B, MLGW uses the output from the Bellefonte Unit and the newly constructed generation to satisfy the load requirements, but also to make off-system sales as evidenced by the over 2 TWh of exports (Figure 9).

Figure 9: Scenario B Energy Balance



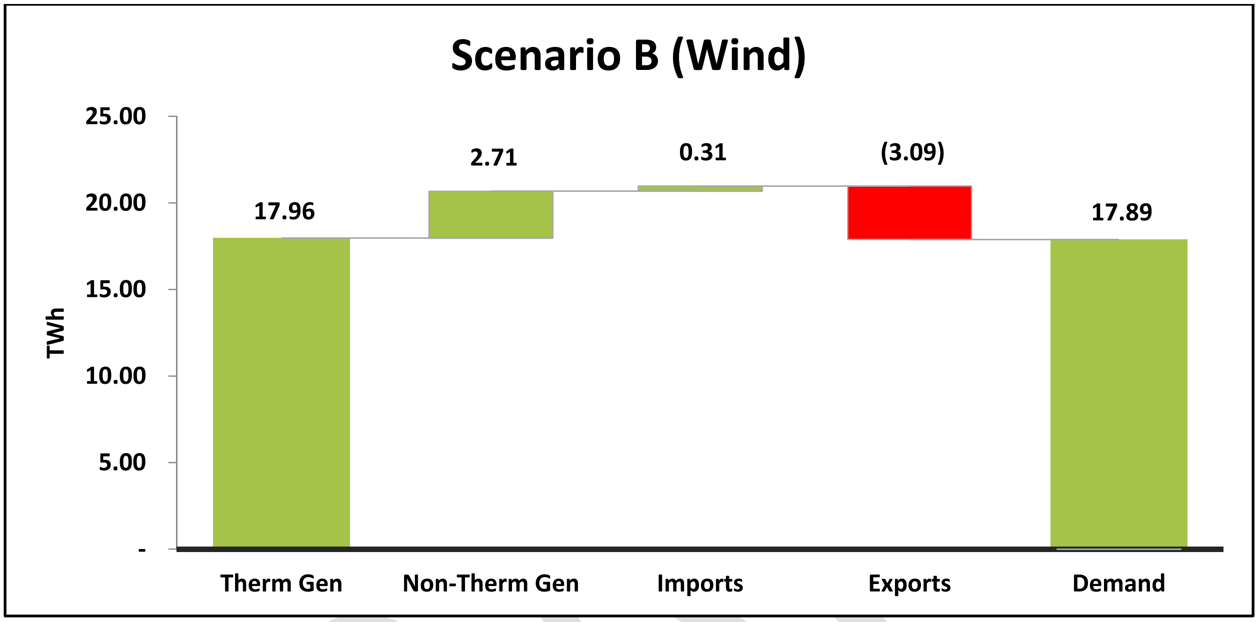
While the cost to serve MLGW's customers under Scenario B (Figure 10) is approximately $93MM less than Scenario A, there would be additional capital expenditures required to build the new generating facilities. Depending on the technology type and size of these generating projects, this cost could exceed the cost of Scenario A.

Figure 10: Scenario B Energy Cost



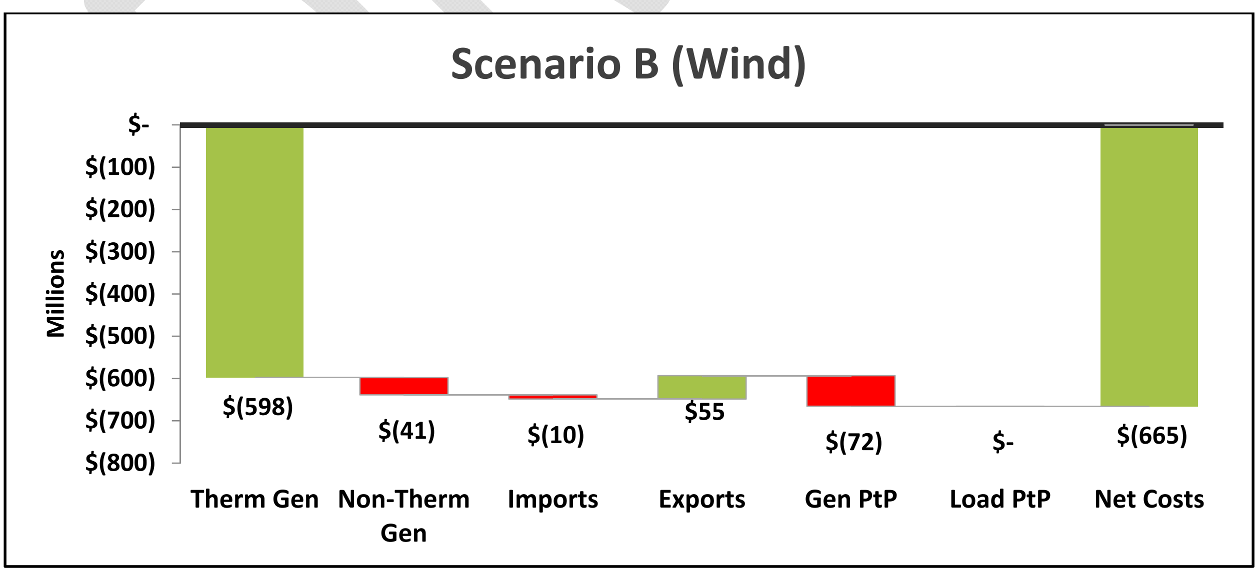
Utilizing the renewable wind PPA to serve a portion of the load, the new thermal generation can make additional off-system sales as evidenced by the increase in exports when compared to Scenario B without the wind (Figure 11).

Figure 11: Scenario B (Wind) Energy Balance



On an energy basis, there is a $15MM savings by procuring the renewable wind PPA in Scenario B. However, the additional transmission service needed to move the wind across the TVA system to MLGW increases the cost of Scenario B with the wind by approximately $23MM (Figure 12).

Figure 12: Scenario B (Wind) Energy Costs



Scenario C: MLGW pseudo-tie to MISO with Bellefonte PPA and MISO Purchases

In Scenario C, MLGW would Pseudo-Tie their load into the MISO market and would become part of the centralized commitment and dispatch within MISO. MLGW would offer the 1,350 MW of the Bellefonte Unit into the MISO market and would receive market-based revenue from that resource to offset the cost of the PPA. PtP transmission service would need to be procured to move the Bellefonte Unit through the TVA system to MISO, and MLGW would need to procure firm PtP service through TVA to Pseudo-Tie its load into the MISO market.

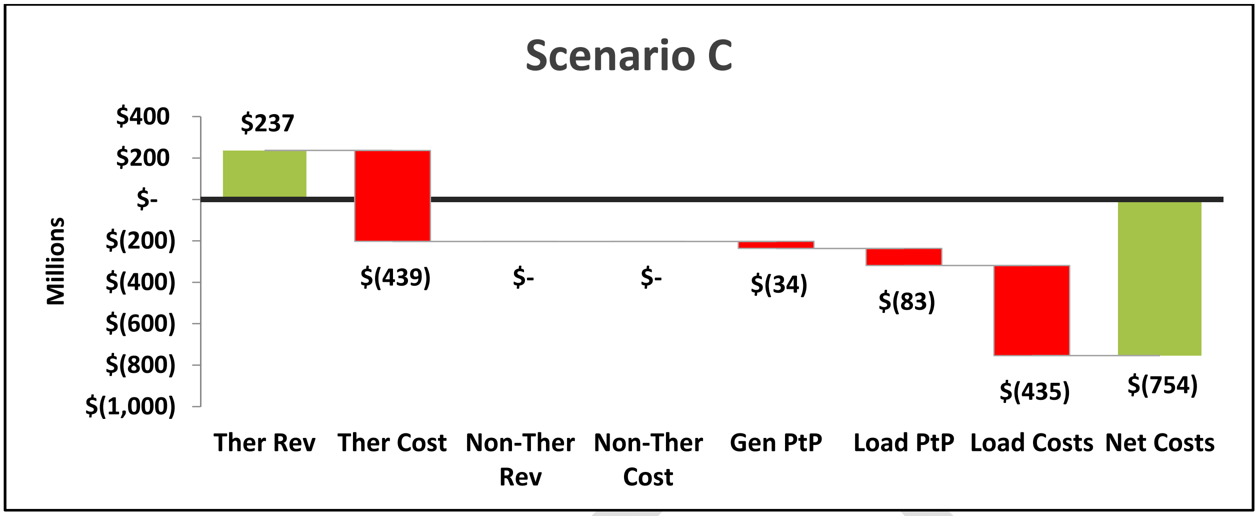
As a sensitivity, MLGW analyzed the economic effects of procuring 700 MW of high capacity factor wind (approximately 15% of MLGW's energy requirements) from MISO on Scenario C. In such cases, the wind is assumed to have a power purchase agreement ("PPA") price of $15/MWh. MLGW would need to procure firm PtP transmission service through MISO to TVA, and firm PtP transmission service through TVA to deliver this energy and capacity to the MLGW BA.

Scenario C assumes the following framework:

- MLGW is an independent Balancing Authority pseudo-tied to MISO
- Power Supply Resources Base Case
    - 1,350 MW Bellefonte PPA delivered to MISO through 1,350 MW PTP transmission service from TVA to MISO
    - MISO Market Purchases for balance of MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW
- Power Supply Resources Renewables Sensitivity
    - 1,350 MW Bellefonte PPA delivered to MISO through 1,350 MW PTP transmission service from TVA to MLGW
    - Renewable Resource of 700 MW of Wind Generation from MISO delivered to MLGW. MLGW will pay the congestion charges associated with the delivery of this wind.
    - MISO Market Purchases for balance of MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW

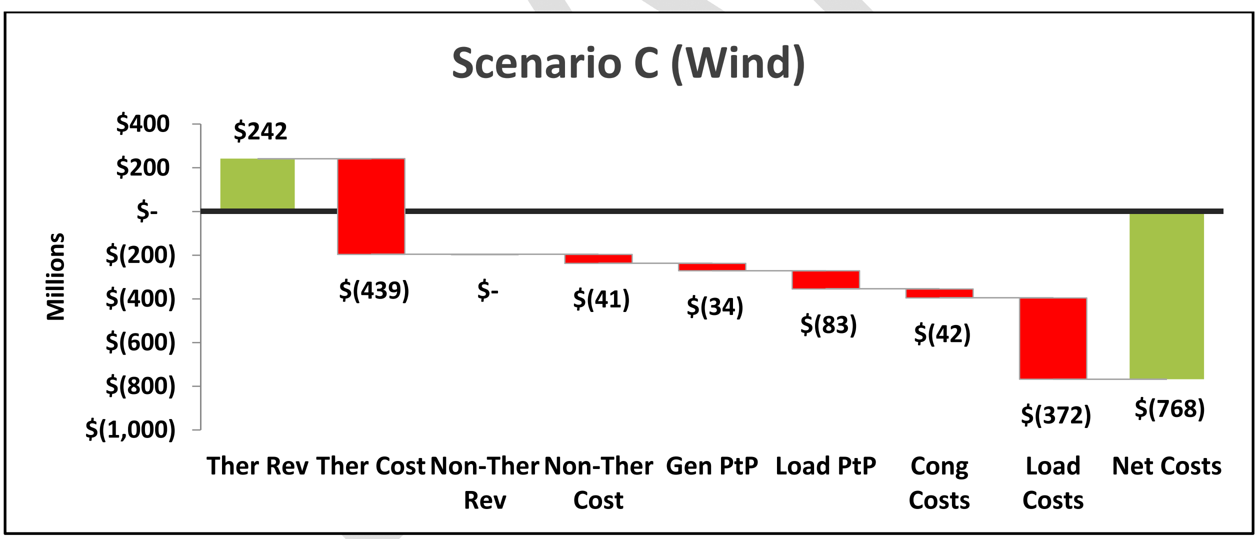
In Scenario C, the Unit received $237MM in revenue to offset the cost of the PPA (Figure 13). The load costs represent the product of the hourly, load-weighted MLGW LMP and the hourly MLGW load without losses.

Figure 13: Scenario C Energy Metrics



The increase cost in wind energy, and the congestion incurred across the MISO system, overcomes the reduction in load costs, leading to an overall increase in cost of $14MM when compared to Scenario C without the wind (Figure 14).

Figure 14: Scenario C (Wind) Energy Metrics



Scenario D: MLGW pseudo-tie to MISO with MISO Purchases Only

In Scenario D, MLGW would Pseudo-Tie their load into the MISO market and would become part of the centralized commitment and dispatch within MISO. MLGW would not own or operate any generating facilities in this Scenario.

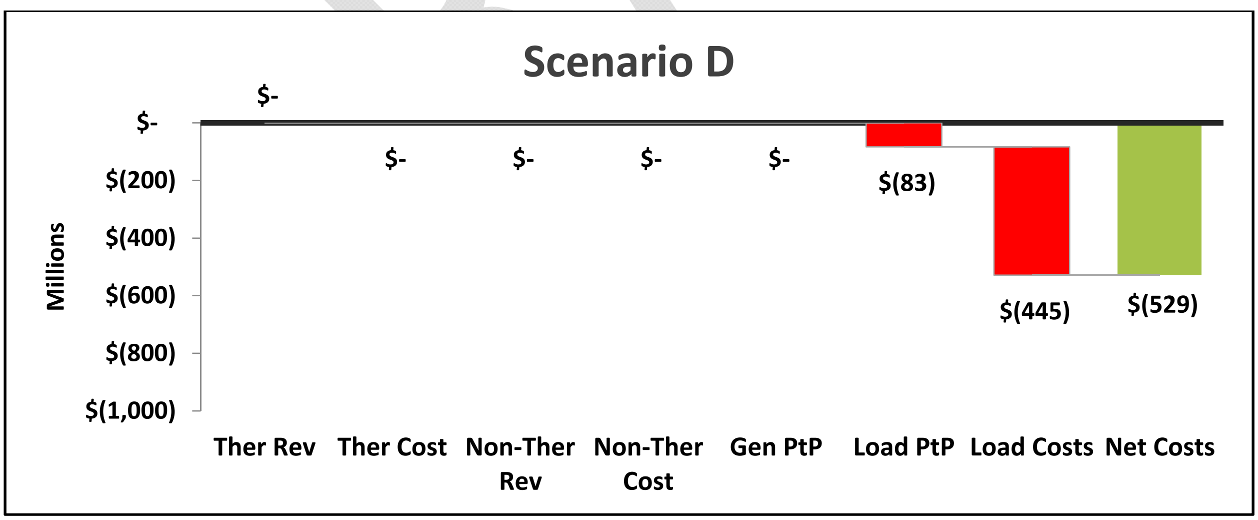
As a sensitivity, MLGW analyzed the economic effects of procuring 700 MW of high capacity factor wind (approximately 15% of MLGW's energy requirements) from MISO on Scenario D. In such cases, the wind is assumed to have a power purchase agreement ("PPA") price of $15/MWh. MLGW would need to procure firm PtP transmission service through MISO to TVA, and firm PtP transmission service through TVA to deliver this energy and capacity to the MLGW BA.

Scenario D assumes the following framework:

- MLGW is an independent Balancing Authority pseudo-tied to MISO
- Power Supply Resources Base Case
  - MISO Market Purchases for all MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW
- Power Supply Resources Renewables Sensitivity
  - Renewable Resource of 700 MW of Wind Generation from MISO delivered to MLGW. MLGW will pay the congestion charges associated with the delivery of this wind.
  - MISO Market Purchases for balance of MLGW Load Requirements delivered through 3,404 MW PTP transmission Reservation from MISO to MLGW

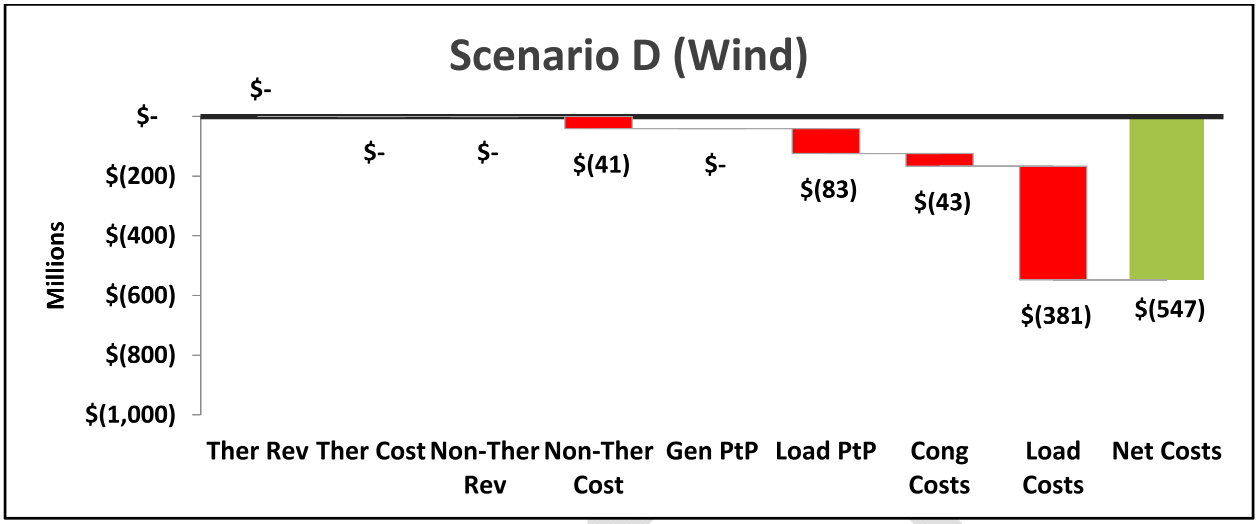
MLGW is completely Pseudo-Tied into the MISO market and must procure firm PtP transmission service. In this scenario, MLGW enjoys a situation of low-cost energy and high reserve margins in the MISO market but by not owning any generation, is unhedged against any market scarcity pricing that might manifest itself (Figure 15).

Figure 15: Scenario D Energy Metrics



As seen earlier the congestion from the wind increases the costs above Scenario D without the wind (Figure 16).

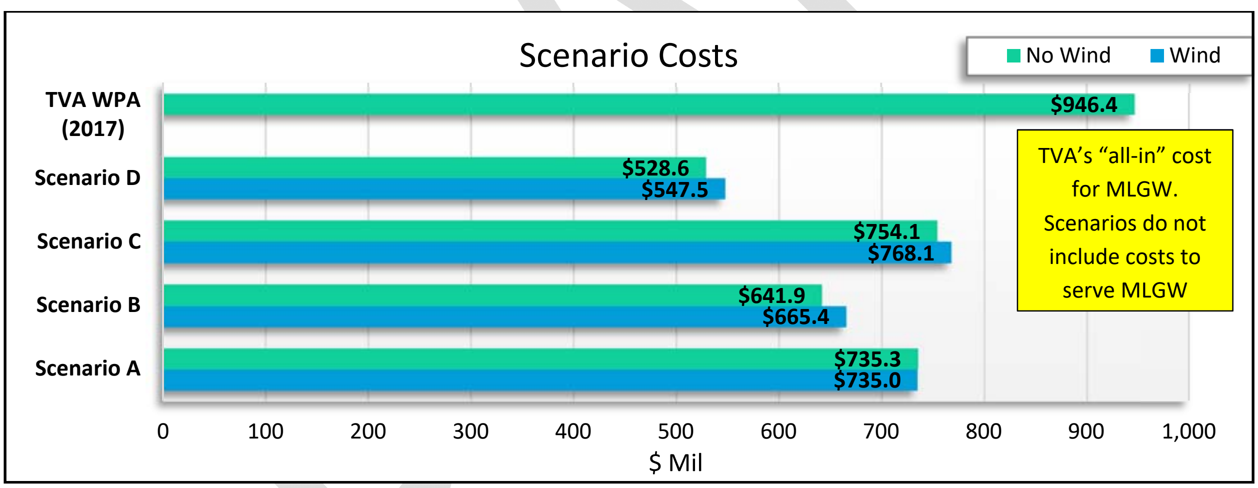
Figure 16: Scenario D (Wind) Energy Metrics



Summary of Results

Figure 17: Summary of Scenario Costs below summarizes the costs of each scenario.

Figure 17: Summary of Scenario Costs



6. Participation in the MISO RTO vs. TVA Relationship

Transmission

MLGW's transmission infrastructure and contractual arrangements are critical in delivering energy safely, reliability and efficiently to its members. The MLGW Transmission System is designed for MLGW's member specific requirements to transport electricity generated by its procured resources to MLGW transmission substations and distribution network to provide electricity to customers' homes or businesses. The TVA Transmission System underlies MLGW's continued success and is necessary to meet MLGW load requirements whether resources are procured from the adjacent MISO RTO market or through owned generation and power purchases.

RTO membership raises important considerations regarding how MISO or another RTO would have on MLGW's transmission infrastructure and the services currently provided by TVA that would no longer be required were the power supply arrangement with TVA to be terminated. Figure 18 highlights the major impacts on the transmission asset control, planning and costs.

Figure 18: Transmission Characteristics Comparison

	Transmission Characteristics			
Current:	MLGW has control	MLGW planning criteria	Local reliability planning	Retail rates support transmission costs
RTO:	RTO has functional control	RTO planning criteria	Local and regional reliability / economic planning	Recovery of transmission costs through RTO & native load payment for transmission

The Transmission section is organized to address the primary issues and will examine the following:

1. **Transmission Planning**: Discussion of the MISO planning processes and how MLGW could effectively participate in the process.
2. **Asset Control**: Assess the criteria for determining which transmission facilities qualify under the MISO Tariffs and can be placed under the functional control of the RTOs and the operational control of assets under the RTO' functional control.

3. **Transmission Revenue Requirements**: Examination of the annual transmission revenue requirement needed to support the ownership and maintenance of MLGW's facilities and which can be recovered through RTO transmission rates.

Transmission Planning

Transmission Planning affects many aspects of MLGW's business if it were to join an RTO market. Membership in an RTO would likely entail MLGW to place some of its transmission facilities under the functional control of the RTO and compliance with the RTO's planning criteria. GDS discusses the depth of the RTO influence on MLGW's transmission planning function and describes the planning processes in SPP, MISO and PJM. In addition, also discussed is MLGW's involvement in the RTO planning process for transmission projects allocated to MLGW or other entities in an RTO.

The section will examine the following topics:

1. A brief description of how MLGW currently plans its Transmission System.
2. A discussion of how RTOs in general undertake transmission planning including specific details regarding the transmission planning process in MISO.
3. The prior discussion also highlights how MLGW could effectively participate in the RTO process if it were a member.

Transmission Planning in a NON-RTO Construct

The MLGW Transmission System functions as the means to facilitate delivery of MLGW generation resources to MLGW load and is jointly planned in conjunction with TVA transmission planners. As load grows and as new generation resources are added to the Transmission System, flows through and within the MLGW system change. This change results in potential violations of NERC Transmission Planning (TPL) criteria. MLGW and TVA jointly share the responsibility to ensure that the MLGW Transmission System can withstand a set of pre-defined contingency conditions without significant loss of load or damage to equipment resulting from facility overloading or voltage excursions.

Transmission Planning in an RTO Construct

One of the recognized benefits of being part of an RTO is the ability of the RTO to engage in "top-down" planning, by taking a wide area perspective and developing transmission projects that benefit multiple members through achieving economies of scale. For example, two adjacent utilities may both propose a line to address a reliability issue that is caused by loop flow from the adjacent system, but the RTO can identify a single higher voltage regional project to effectively meet the needs of both entities.

RTO transmission planning also considers "economic" transmission projects which may not necessarily provide reliability benefits as defined by the NERC TPL standards, but may result in reduced congestion costs or lower system production costs. With each of the RTO options being considered by MLGW, economic planning is an important part of the transmission planning process. Usually, these types of projects are of greater scale than local reliability projects and tend to provide benefits to a large group of entities that may cover multiple states.

Finally, placing facilities under the functional control of an RTO and participating in the RTO planning process has certain economic benefits with respect to the allowed rate of return on the transmission rate base. In addition to an equitable rate of return on rate base, the FERC has permitted a 50-basis point adder for companies whose transmission assets are in the RTO. This creates the economic incentive join an RTO and participate in the development of transmission projects to expand the Transmission System, resulting in an increase the Annual Transmission Revenue Requirement (ATRR).

The benefits of RTO participation in the RTO transmission planning process and economic benefits as a Transmission Owner must be weighed against the additional control exerted by the RTO over local planning and asset control. For an RTO Transmission Owner to realize the economic benefit, its qualifying Transmission System assets must be placed under the functional control of the RTO. "Functional control" means that the RTO has the ability to either automatically operate or direct the Transmission Owner to operate their facilities in accordance with RTO directives. Such activities include, but are not limited to outage coordination, and opening and closing breakers and switches on RTO-defined assets. Typically, the extent of the RTO reach does not extend into approval of as-built drawings, design and construction criteria, inventory control and rating of facilities. The matter of asset control is discussed further in next section.

In accordance with the RTO transmission planning procedures, the RTO directs construction of new projects as approved by the RTO Board of Directors. MLGW has the Right of First Refusal (ROFR) to build projects between their substations. The only projects that are available for competitive solicitation are determined by the respective RTO under their Transmission Planning guidelines, which are usually found in Attachment K of the OATT. These projects are usually of higher voltage (300 kV and up) and provide significant economic or reliability benefits and have been developed under the FERC Order No. 1000 guidelines. GDS recommends that MLGW pursue "Qualified Transmission Developer" status in whichever, if any, RTO the company decides to join, so that MLGW can also compete for those Order 1000 competitive projects.

Transmission Planning in MISO

The MISO transmission planning model is heavily weighted toward the Transmission Owners through the use of the "bottom-up/top-down" planning construct. The "bottom-up" process relies on the Transmission Owners developing their own solutions to the local reliability needs in their footprint. Distribution facilities are not part of the MISO planning process and are planned by the local distribution companies. Local planning projects are usually rolled up into the MISO Transmission Expansion Plan (MTEP) without much challenge from others. The MISO Transmission Expansion Plan has two Appendices: A and B. Appendix A projects are those approved by the Board in the current MTEP cycle for construction. Appendix B projects are those that are retained for further analysis but are not immediately needed. Only "bottom-up" projects can be placed in Appendix B.

MISO's "top-down" approach takes a regional perspective to assess transmission need drivers, such as multi-company reliability issues, congestion relief, and state/federal policy drivers (e.g., Renewable Portfolio Standard or the Clean Power Plan). The MISO process tends to be driven more by the individual Transmission Owners than the ITP employed by SPP process, which is SPP stakeholder driven. As such, the MISO "top-down" process produces multi-jurisdiction projects with high voltage and economic thresholds. Under FERC Order No. 1000, EHV projects will be competitively bid (see Duff-Coleman 345 KV). If MLGW want to own and maintain these types of projects, it should pursue "Qualified Transmission Developer" status under the MISO Transmission Developer Qualification and Selection (TSQS).

The MISO Transmission Expansion Plan (MTEP)

MTEP is the annual process which has a cycle of 18 months that evaluates the needs for all of MISO footprint. The MTEP is guided by six Planning Principles outlined in Figure 19.

Figure 19: MTEP Guiding Principles

- **Guiding Principle 1**: Make the benefits of an economically efficient electricity market available to customers by identifying transmission projects which provide access to electricity at the lowest total electric system cost.
- **Guiding Principle 2**: Develop a transmission plan that meets all applicable NERC and Transmission Owner planning criteria and safeguards local and regional reliability through identification of transmission projects to meet those needs.
- **Guiding Principle 3**: Support state and federal energy policy requirements by planning for access to a changing resource mix.
- **Guiding Principle 4**: Provide an appropriate cost allocation mechanism that ensures that costs of transmission projects are allocated in a manner roughly commensurate with the projected benefits of those projects.

In December of each year, the MISO Board of Directors determines whether to accept the results of the MTEP and grant approval of the listed projects to be built. Once the MTEP has been approved, the Transmission Owners can then move forward with the engineering and construction of their MTEP projects based on their Right of First Refusal. Projects which are chosen to be competitively bid are then held out for the TDQS process.

Transmission facility cost allocation in MISO is driven by a functional classification as opposed to the voltage bright line in SPP. The six categories of MISO transmission projects are:

Baseline Reliability (BRP)

These projects are driven by the identification of criteria violations under the NERC TPL Standards and the BRP is the proposed mitigation plan. This project type would include the majority of transmission planning performed by MLGW today.

Transmission Delivery Service Projects (TDSP)

These facilities are those driven by requests for transmission service to adjacent areas for Point-to-Point (PTP) or Network Integration Transmission Service (NITS). MLGW may currently be developing these projects to facilitate Third Party Sales.

Generation Interconnection Projects (GIP)

Upgrades needed to interconnect new generation assets to the MLGW system. This set of projects are governed by FERC Order 2004, 2004-A, and 2004-B requirements. In MISO, the local Transmission Owner works with MISO to evaluate the interconnection and determine needed facilities to accommodate the new resource.

Market Efficiency Projects (MEP)

The MEP is designed to provide economic benefits measured by Adjusted Production Costs divided by the project cost. A project must be at least $5MM, have at least 50% of the project cost for facilities with a minimum voltage of 345 KV, and be able to achieve at least a 1.25 benefit-to-cost (B/C) ratio. It has been GDS' experience that very few MEP are successfully identified and developed on an annual basis due to the high voltage and B/C ratio requirements.

Multi-Value Projects (MVP)

The MVP portfolios are similar to the MEP except that these projects have a much wider area of benefits on both a reliability and economic savings basis. The MVP portfolio involves many MISO members and affects multiple state jurisdictions. The allocation of MVPs is based on the benefits that each Transmission Pricing Zone receives.

Other Projects

Other Projects is the default for anything that does not fall into one of the five buckets.

Impact of Cost Allocation on Planning Process

Unlike the current MLGW planning environment, MISO planning process participation requires understanding the impact of a new facility from both a power flow perspective and from a cost/benefit perspective.

Table 3 shows the high-level cost allocation methodology for each of the project types described.

Table 3: MISO Project Types and Cost Allocation

Allocation Category	Driver(s)	Allocation to Beneficiaries
Participant Funded ("Other")	Transmission Owner identified project that does not qualify for other cost allocation mechanisms	Paid by requestor (Local Pricing Zone)
Transmission Delivery Service Project	Transmission Service Request	Generally paid for by Transmission Customer; Transmission Owner can elect to roll-in into local pricing zone rates
Generation Interconnection Project	Interconnection Request	Primarily paid for by requestor; 345 kV and above 10% postage stamp to load
Baseline Reliability Project	NERC Reliability Criteria	Paid by local pricing zone
Market Efficiency Project	Reduce Market Congestion when benefits are 1.25 times in excess of cost	345 kV and above: 80% distributed to local resource zones (LRZs) commensurate with expected benefit, 20% postage stamp to load
Multi-Value Project	Address energy policy laws and/or provide widespread benefits across footprint	100% Postage stamp to load

Participation within the Planning Process

As with any RTO planning process, being an effective participant in the MTEP process requires a greater commitment than just model development and solution testing. It also requires active participation in the multiple stakeholder forums that touch the Transmission Planning paradigm. The critical committees related to MTEP and transmission planning/cost allocation include:

a. System Planning Committee - Oversight of the MISO Transmission System and MTEP planning processes
b. Planning Advisory Committee - Focused on policy and procedures
c. Regional Expansion Criteria and Benefits Task Force - Develop solutions to issues related to the criteria and cost allocation methodology
d. Planning Subcommittee - Provides recommendations for execution of planning responsibilities
e. Loss of Load Expectation Working Group - Performs analysis of the Planning Reserve Margin requirements for each Load Serving Entity
f. Interconnection Process Task Force - Develop generator interconnection queue procedures

Should MLGW choose to integrate into MISO, MLGW should plan to commit resources to take an active role in the RTO stakeholder working groups and committees to achieve its strategic objectives as it relates to (i) encourage cost allocation policies that positively impact MLGW and the member systems, (ii) identify projects that result in improving competitive position with neighboring companies, and (iii) be in a position to develop projects that increase revenue and benefits to MLGW.

Impact of MISO Process on MLGW

The MISO process has some factors that would benefit MLGW, including:

- Ability to maintain some control using Transmission Owner criteria.
- Right of First Refusal – The majority of projects can be developed by MLGW with very little third-party influence.

Transmission Planning Summary

Table 4: Summary of Transmission Planning

Summary: **Transmission Planning**
• Today MLGW primarily plans for own reliability needs. An RTO seeks to achieve economies of scale by taking a wide area perspective focusing on both reliability and economic based projects. • Each RTO develops an annual transmission plan as approved by the RTO for the development of the projects across the footprint.

Asset Control

As discussed in the Transmission Planning section, a transmission owner may place its qualifying Transmission System assets under the functional control of the RTO. In this section, we explore the implications in terms of RTO control of MLGW transmission assets. The following issues are examined:

1. The qualification criteria used by each RTO in defining a 'Transmission Facility' eligible for RTO functional control and revenue recovery.
2. A description of what is meant by RTO functional control.
3. Areas that the RTOs' function control does not extend to.

The determination of benefits and risks in Qualification Criteria and Asset Control are driven by the balance between increased revenue to the utility versus the loss of control of the assets for which revenue recovery is desired. From a pure financial play, the RTO criteria that results in the greatest number of MLGW facilities, and therefore highest ATRR, is preferable to achieve the highest return on the investment made by MLGW. The other side of that coin is that as more facilities are included in the ATRR, more facilities are now placed under the RTO control and more independence in operation of member facilities is ceded to the RTO.

Transmission Assets Included in the RTO Tariff

MISO Criteria

MISO applies the FERC Seven Factor Test from Order 888 to make a functional determination of what is transmission as opposed to distribution. This is primarily applied to looped or networked facilities with a nominal operating voltage of 69-KV and above. Expressed review and approval of MISO is required to qualify Transmission Facilities for inclusion under the MISO Tariff. The Seven Factor Test is an exclusionary test that defines those facilities that would qualify as "distribution" and assumes that all other facilities would be classified as "transmission". The criteria for the Seven Factor Test are:

1. Local distribution facilities are normally near retail customers;
2. Local distribution facilities are primarily radial in character;
3. Power flows into local distribution systems, and rarely, if ever flows out;
4. When power enters a local distribution system, it is not consigned or transported on to some other market;
5. Power entering a local distribution system is consumed in a comparatively restricted geographic area;
6. Meters are based at the transmission/local distribution interface to measure flow into the local distribution system; and
7. Local distribution systems will be of reduced voltage.

RTO Functional Control

There are two terms in relation to transmission asset control. The first term, "jurisdictional control", refers to the entity with the authority to direct an action to occur on a transmission element. The second term, "functional control", refers to the entity that undertakes the action to operate a transmission element. For example, the opening of a circuit breaker. MISO uses the term of "functional control" to broadly incorporate both concepts.

The term "functional control" refers to the ability of the RTO, as the Reliability Coordinator, to either remotely control switching equipment or to direct the Transmission Owner to operate switching equipment in accordance with a Reliability Coordinator operating directive. In addition, the RTO as the Reliability Coordinator can approve or deny scheduled outages on the Transmission Facilities if the Reliability Coordinator decides in its sole discretion that taking the requested outage would negatively impact system reliability. It is important to note that the approval or rejection of outages is not based on market conditions, but only on reliability needs.

Areas where RTO Asset Control does not Extend

MLGW not need approval from the RTO for the following:

- Local planning criteria for local transmission facilities
- Construction specifications for transmission facilities
- Purchasing and inventory control for MLGW facilities
- Approval of engineering drawings, including "as-built" drawings

The RTO transmission planning processes dictate that modifications to MLGW Transmission Facilities be submitted to be included in the package of projects approved by the respective RTO Board. Also, the RTOs work with MLGW to develop generation interconnection studies to identify solutions and detailed project cost estimates for new generation resources that impact line or transformer loading or breaker duty due to short circuit effects.

Asset Control Summary

Table 5: Summary of Asset Control

Summary: **Asset Control**
• The extent of asset control is driven by the RTO definition of qualifying transmission facilities. • Asset control only extends to (i) automatic or manual switching of assets under RTO functional control and (ii) outage coordination for reliability purposes. This control is only exerted by the RTO in the context of their role as the Reliability Coordinator. • MLGW detailed engineering practices are not included in the definition of "asset control".

Transmission Revenue Requirements

MLGW owns various Transmission Facilities that are eligible for cost recovery under a Regional Transmission Operator (RTO) arrangement.

Other RTO Considerations

Compliance Implications

One consideration for MLGW in determining if joining MISO would be most beneficial for its members is how the RTO will affect MLGW's registration and compliance requirements with the North American Electric Reliability Corporation (NERC) and SERC Reliability Corporation (SERC). This section outlines the registration and compliance changes that MLGW could be subject to if joining MISO.

MISO

If MLGW chooses to join MISO, MLGW will be able to de-register as a Transmission Service Provider (TSP) and Planning Coordinator (PC) as both of those functions are only conducted by MISO in the RTO footprint. MISO will also become the Reliability Coordinator (RC) for MLGW. MLGW will remain the Registered Entity for the following NERC functions:

1. Balancing Authority (BA)
2. Distribution Provider (DP)
3. Generator Owner (GO)
4. Generator Operator (GOP)
5. Resource Planner (RP)
6. Transmission Owner (TO)
7. Transmission Operator (TOP)
8. Transmission Planner (TP).

Balancing Authority (BA)

The BA function will be shared with MISO. MLGW will become a Local Balancing Authority (LBA) under the overall MISO BA (MBA). In the MISO RTO both MISO and MLGW will be registered with NERC and SERC for the BA function. MLGW will need to enter into a Coordinated Functional Registration (CFR) Agreement with MISO for most the BA Standards and Requirements. The CFR covers may of the Resource Demand and Balancing (BAL), Interchange Scheduling and Coordination (INT), Interconnection Reliability Operations and Coordination (IRO), and Transmission Operations (TOP) Standards and Requirements.

Distribution Provider (DP)

If MLGW has an Under-frequency Load Shed (UFLS) Program or an Under-voltage Lod Shed (UVLS) Program those programs would need to be rolled into the overall MISO UFLS and UVLS Program. MISO, as the PC, has the responsibility for designing the UFLS and UVLS programs in their PC Area.

Generator Owner (GO) and Generator Operator (GOP)

Once MLGW moves its generation into the MISO market MLGW will be subject to the MISO policies and procedures for outages scheduling and providing unit planning and real-time information to MISO. MISO has a set of Business Practice Manuals (BPM) and Real-Time Operating Procedures (RTO) that generators in the MISO footprint must follow.

These MISO requirements are also considered part of the NERC and SERC Compliance obligation for MLGW under the Communications (COM), TOP, IRO, and Voltage and Reactive (VAR) NERC Standards.

MLGW will continue to have the responsibility for compliance with the Protection and Control (PRC), Facilities Design and Construction (FAC), and Voltage and Reactive (VAR) Standards. This includes, but is not limited to, generator Protection System Maintenance, Protection System Coordination, Disturbance Monitoring, generator Facility Ratings, and maintaining the TOP specified voltage schedule.

Transmission Operator (TOP)

In the MISO RTO, MLGW will continue to be a TOP and will continue to be required to meet all the NERC Standards and Requirements for the TOP Function. MISO may provide real-time and day-ahead operation planning assessment data to MLGW but MLGW will reaming obligated to review the study information and the MLGW System Operators will continue to develop Operating Plans for any projected System Operating Limit exceedances. Since MLGW must remaining registered as a TOP, all System Operators will continue to be required hold NERC Certification and meet the NERC Personnel and Training Standards.

From a NERC Critical Infrastructure Protection (CIP) perspective, since MLGW with continue to be a TOP in MISO, MLGW will continue to be an entity with at least Medium Impact BES Cyber Systems and therefore subject to the NERC CIP Standards, CIP-002 through CIP-011, and CIP-013 once it is approved.

Transmission Owner (TO)

Similar to generation, once MLGW moves its transmission assets into the MISO, MLGW will be subject to the MISO policies and procedures for outages scheduling and providing unit planning and real-time information to MISO. MISO has a set of Business Practice Manuals (BPM) and Real-Time Operating Procedures (RTO) that generators in the MISO footprint must follow.

These MISO requirements are also considered part of the NERC and SERC Compliance obligation for MLGW under the COM, Emergency Operations (EOP), TOP, IRO, and Voltage and Reactive (VAR) NERC Standards.

MLGW will continue to have the responsibility for compliance with the Protection and Control (PRC) and Facilities Design and Construction (FAC) Standards. This includes, but is not limited to, transmission Protection System Maintenance, Disturbance Monitoring, and transmission Facility Ratings.

Transmission Planner (TP)

MLGW will remain registered for the TP function, although MISO will perform many of the TP requirements. As a TP, MLGW will need to enter the MISO TPL CFR and the MISO MOD CFR. With these CFRs, MLGW will also have to sign an agreement with MISO that states what data and study information MLGW must provide to MISO, so MISO can perform their obligations under the CFRs.

Compliance Implications Summary

The MISO RTO provides some NERC Compliance risk management through various CFR agreements with its Members. MISO does not fully take all the NERC Compliance Responsibility for the BA or TOP function but does assume all PC and some TP responsibilities. Therefore, MLGW would remain responsible for certain requirements for the BA and TOP functions.

Administrative Expenses

As discussed in the report, RTOs are responsible for many planning, operational and regulatory activities. This of course requires manpower and supporting computer systems to successfully deliver on these mandated functions and responsibilities. Consequentially, income is required to pay for the costs incurred and therefore fees are charged to members to recover the necessary income. This section details the activities involved and associated rates for the following areas:

1. General Administrative Fees
2. FERC Annual Recovery Fees
3. Independent Monitoring Fees

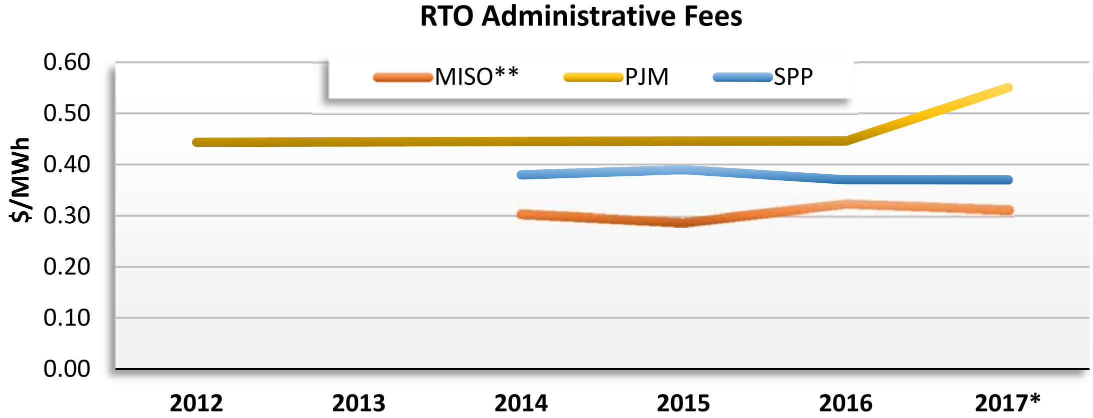
General Administrative Fees

The components of RTO and ISO administrative costs are capital costs – capital charges, debt service, interest expense and depreciation expense – and operating and maintenance costs net of miscellaneous income. Total administrative costs vary widely by ISO and RTO. MISO recovers its administrative costs through three Electric Tariff Schedules while PJM and SPP each recover their administrative costs through one schedule of their Tariffs. A review of the administrative costs of MISO, PJM and SPP identified several cost classifications that were common to all. These common cost categories are:

- Office Supplies and Expense
- Regulatory Costs
- Consulting Fees/Outside Services
- Insurance
- Depreciation Expense
- Interest Expense
- Employee Salaries and Benefits

Unlike PJM and SPP, MISO recovers the cost of Independent Market Monitoring through its general administrative fees (Figure 20).

Figure 20: RTO Administrative Fees in $/MWh (2014 to 2017)



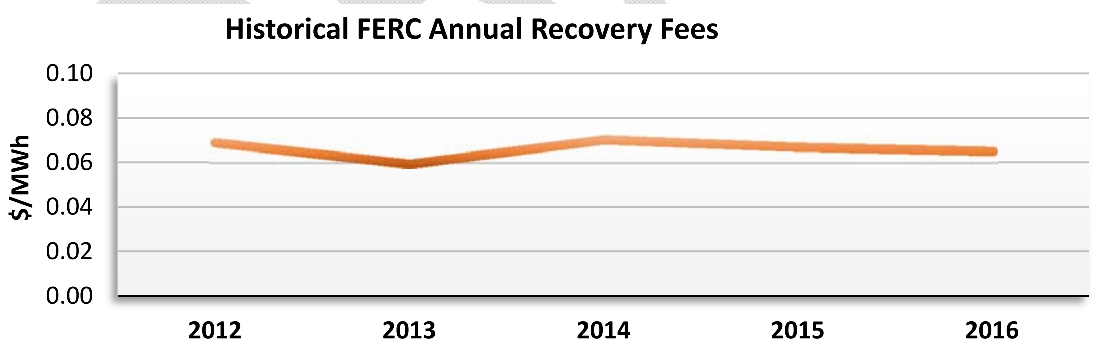
**2017 MISO and PJM administrative rates are based on the first 6 months of 2017 while SPP's is a projection*

***MISO administrative fees are the sum of the Day-Ahead and Real-Time Administrative Fees divided by the Real-Time Energy*

FERC Annual Recovery Fees

The FERC Annual Recovery fees are charged to customers based on their usage of the ISO/RTO's transmission system and recover costs incurred by the Commission in performance of its regulatory responsibilities. These fees remain constant across all ISOs and RTOs and ranges between 6 to 7 cents per MWh. Figure21 shows the FERC fees in dollars per MWh ($/MWh) over the five-year period, 2012-2016.

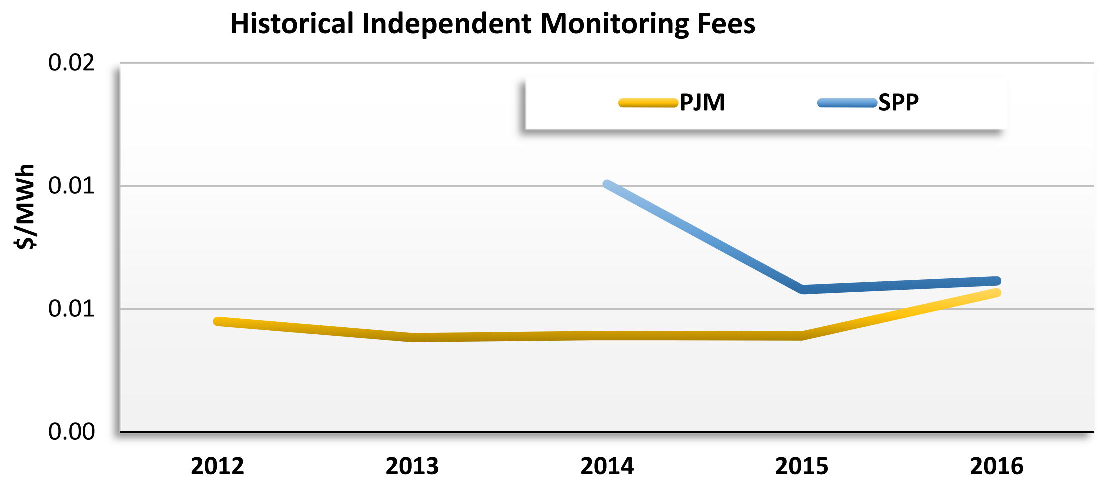
Figure 21: Historical FERC Annual Recovery Fees in $/MWh (2012 to 2016)



Independent Monitoring Fees

Each RTO/ISO charges its members an Independent Monitoring fee to recover the costs of objectively monitoring, investigating, evaluating and reporting on the markets, including, but not limited to, structural, design or operational flaws in the markets or the exercise of market power or manipulation in the markets. The fees related to MISO's Independent Monitoring are included in the general administrative fees. Figure22 compares the Independent Monitoring fees for the three RTOs in dollars per MWh ($/MWh) over the three-year period, 2014-2016.

Figure 22: Historical Independent Monitoring Fees in $/MWh (2014 to 2016)



Administrative Expenses Estimate

GDS developed an estimate of the annual administrative expenses for the 2018-2028 period using the average MLGW MWh load together with the most recent rates which in general were in recent years stable and therefore representative of future trends. As can be seen from table 6 the annual charge is the most for PJM, particularly after its recent increase in rates, and that MISO has the lowest administrative expenses charge.

Table 6: RTO Administrative and Other Fees

	SPP Rate *$/MWh*	Charge *$M*	MISO Rate *$/MWh*	Charge *$M*	PJM Rate *$/MWh*	Charge *$M*
General Administrative Fee	0.37	7.80	0.31	6.57	0.55	11.60
FERC Annual Recovery Fee	0.07	1.37	0.07	1.37	0.07	1.37
Independent Monitoring Fee	0.01	0.13	-	-	0.01	0.12
Total	**0.44**	**9.30**	**0.15**	**7.94**	**0.62**	**13.09**

Summary of Administrative Expenses

Table 7: Summary of Administrative Expenses

Summary: **Administrative Expenses**
• The administrative rates with MISO are among the lowest of the RTO'S located closest to MLGW. • The FERC annual recovery charge rate is the same for all utilities in the United States.

Staffing Requirements

Participation in any RTO will result in MLGW staff needing to develop new skills to maximize the benefits of being part of an integrated market. Coordination with the RTO results in many new touchpoints within the organization and may require a different allocation of staff resources to be competitive. In this section, the following topics will be addressed:

1. What new or changed functionality is required for RTO participation?
2. What is the impact of these changes on staffing requirements and staffing levels?

RTO Functions and MLGW Responsibilities

MLGW integration with the RTO will result in changes to the following areas:

- Day-Ahead Operations – MLGW will be responsible for the development of submittal of load bids and generator offers to provide both energy and ancillary services, outage coordination and evaluation, and review of the RTO unit commitment and day-ahead settlements.
- Real Time Operations – MLGW will be in communication with the RTO to respond to RTO market and reliability directives on a five-minute basis. At present, TVA serves as the Reliability Coordinator for MLGW, but the RTO usually prefers that members choose the RTO as their RC to simplify the communication requirements.
- Accounting and Settlements – Since each RTO has a two-settlement system (Day Ahead and Real Time), MLGW will be responsible for reviewing a greater volume of settlement data. Many RTOs have a multi-stage settlement process whereby there are up to five settlement periods for each day. In addition to energy transactions, the Settlements group will also be responsible for financial congestion rights settlement, ancillary services market settlement and virtual transactions (e.g. MISO FinSched).
- Transmission Planning – Since each RTO evaluates some projects based on their economic impact (Adjusted Production Cost), transmission planners will need to add production cost analysis to their planning toolbox. Also, the RTO stakeholder processes for transmission planning requires an extensive time commitment to monitor the activities of other along with internal load and reliability planning. MLGW already engages in this type of effort through coordination of TVA so this should not be seen as a barrier to RTO participation.
- Regulatory Support – MLGW will need staff committed to full participation in the stakeholder process. Many companies have dedicated staff members who have the responsibility to manage the RTO process and advance strategic objectives. Also, additional support is usually required to develop the rate filings on an annual basis for ATRR collection.

Impact of RTO Participation on Staffing Requirements

MLGW staff needs should particularly be evaluated with respect to the System Operations, Transmission Planning, Settlements and Regulatory Support functions as these areas require close coordination with the RTO to be effective. The increased volume of work due to additional responsibilities not currently enjoined by MLGW, such as Congestion Rights valuation, hourly settlement review, daily load and generation submittals, and the management of the stakeholder processes are new areas that require focused attention to be effective.

Jurisdictional Implications

At present, the MLGW Board has direct authority over many facets of MLGW's operations. However, were MLGW to become a member of an RTO, many aspects of its operation would fall under the purview of the respective RTO stakeholder process and ultimately may be decided by the FERC. This section will examine how state commissions may have a difference form of influence over decisions that would affect MLGW separate from state commission influence that exists today. Additionally, we highlight the pertinent issues that may require direct engagement with FERC.

Jurisdictional Implications

At present, MLGW rates and decisions regarding expansion of their transmission system are set by the MLGW Board. As a member of an RTO, certain rates and decisions that directly affect MLGW will be made through the respective RTO stakeholder structures, and ultimately may be decided by the FERC. In addition to FERC regulation, representatives of the various state commissions sit on stakeholder committees and can have influence over decisions that would affect MLGW separate from state commission influence that exists today.

The RTO stakeholder structures are open and transparent processes, as required by FERC Order 1000. Participation by public utility commission representatives is not only allowed but encouraged. Generation and transmission siting decisions under review by public utility commissions will likely be influenced by MLGW participation in the RTO planning processes, as well as supporting filings from the respective RTO.

When disputes arise between RTO members, the RTO, along with various stakeholder groups, will file doc-less or plain vanilla interventions at FERC to monitor proceedings. There are also times when an RTO member is forced to litigate a matter against the RTO. In these cases, several affected parties will join in to protect their interests. Recent GDS experience includes litigation on implementation of market rules, creation of pricing zones, and cost allocation of specific regional transmission projects.

FERC Issues

FERC has promoted the development of the RTO through FERC Order 1000 and continues to encourage coordination between RTOs with a focus on seams issues. The establishment of joint operating agreements or JOAs between RTOs has seen extensive litigation. MLGW electrically and geographically sits in a very important position on the seams between the MISO and TVA.

RTO Entry & Exit

Joining or leaving an RTO is a committed process. This would be a big change for both MLGW and the RTO, so there are important considerations about the action of entry or exit into an RTO.

RTO Participation Negotiation Points

If MLGW makes the determination to participate in MISO, there are several points of negotiation that must be addressed prior to RTO entry. MLGW is in a unique position as it is not transferring from one RTO market construct to another but is converting from a non-market construct to a market-based construct. This requires fundamental changes in all aspects of the MLGW business and operating structure, and conversion of existing agreements and owned generation and transmission assets make up the bulk of the negotiation process. The following topics need to be considered:

- Conversion of Grandfathered Power Supply Agreements
- Conversion of Grandfathered Transmission Service Agreements
- Qualification of Generating Resources for Market Participation
- Qualification of Transmission Resources for Revenue Recovery
- Evaluation and Treatment of Physical Facilities Required for RTO Integration

Conversion of Grandfathered Power Supply Agreements

- Preserve Transmission Rights and Priority
- Ensure Risk Profile is Not Negatively Impacted
- Understand "Hidden Costs" of Conversion
- Alignment of Contract Provisions with RTO Processes

Conversion of Grandfathered Transmission Agreements

- Treatment of Point-to-Point (PTP) Service - Items to address include source and sink definition, ability to grant rollover rights
- Generating Asset Designation – How does the RTO treat any system purchases or third-party sales?
- Conversion of OATT Transmission Rights to Financial Congestion Products
    - Valuation of Congestion Rights Products

- Periodicity of Transmission Rights – Does the RTO offer quarterly or monthly ARR/FTR or is an annual auction the only hedging mechanism?
- Simultaneous Feasibility and Partial Congestion Rights Conversion
- Transmission Requirements for Resource Adequacy

Qualification of Generating Resources for Deliverability and Resource Adequacy

- Deliverability Assessment
- Treatment of External Resources
    - Need to assess firm transmission requirements for delivery into MISO since no direct interconnection exists. May require study from TVA for firm PTP for pseudo-tie and Bellefonte delivery.

Qualification of Transmission Assets for Revenue Recovery

- Qualification of Existing Transmission Facilities
    - MISO use of the FERC Seven Factor Test may exclude certain lower voltage facilities and radial transmission
- Establishment of MLGW ROE – Each RTO Transmission Owner gets 50 basis point adder.
- Pricing Zone Negotiations – Joint Pricing Zone or Individual Pricing Zone?

Evaluation and Treatment of Physical Facilities Required for RTO Integration

- Determination of Incremental Facilities Due to Differences in RTO Criteria
    - Experience indicates not a problem in MISO due to allowance for Transmission Owner specific criteria.
- Cost Assignment of Incremental Facilities

RTO Exit Requirements

Just as choosing to join an RTO has certain negotiation points for entry, choosing to depart from the RTO will also require the unwinding of all the touchpoints that would now exist under RTO participation. In the history of RTO formation, the two most relevant examples of RTO exits are when ATSI, a subsidiary of FirstEnergy, initially made the decision to leave MISO and join PJM in 2009. In 2010, Duke Energy Ohio (DEO) and Duke Energy Kentucky (DEK), as subsidiaries of Duke Energy (Duke) reached the same conclusion that participation in PJM made more sense for them so all transmission assets could be placed into a single RTO (see 133 FERC 61,058 and ER10-1562-000/ER10-2254-000). Through a settlement agreement at FERC, each company was required to pay only $<u>1.8MM each as an exit fee</u> to leave MISO and pursue RTO membership with PJM.

In the ATSI case (FERC Docket No. ER11-2814 and ER11-2815), ATSI claimed that “there are no new costs as a result of ATSI’s withdrawal from the MISO because the MISO withdrawal obligation comprises the long-term liabilities that are normally collected through the MISO Ancillary Services Market (ASM) Tariff.”

Even though precedent exists in the cases for a MISO exit fee of less than $2MM per entity, it should be noted that the value reached by FERC was the result of a settlement proceeding. It may not be reasonable for MLGW to assume that the same conclusions reached by FERC for a MISO RTO exit would be the same for MLGW if they chose to leave MISO and return to TVA, for example.

Possible areas where the RTO could choose to seek to recover exit fees could come from:

- Commitments made by MLGW to fund transmission upgrades as a condition of joining the RTO
- Commitments made by MLGW as a member of a Joint Pricing Zone (JPZ)
- Commitments made by MLGW to fund regional transmission projects as part of the MISO Transmission Expansion Plan (MTEP)
- Make whole payments to load serving entities where MLGW generating resources are committed under a resource adequacy construct

If MLGW were to exit one RTO and seek to join another RTO, the unwinding of RTO participation will also require the renegotiation of transmission service agreements granted under the current RTO, which could result in additional transmission facilities needed to grant service even though system topology is unchanged.

Should MLGW decide to exit and RTO and return to an arrangement like its current structure (i.e., a full standalone entity or under a renegotiated power supply arrangement with TVA), many of the considerations in a change-to-another-RTO scenario apply. Fundamentally, the RTO that MLGW exits will seek to recover from MLGW compensation sufficient to hold harmless the RTO and its remaining members with respect to both the immediate and long-term cost of MLGW departing the RTO.

MLGW would also have to fund the cost to establish those services and functions that were being performed by the RTO and that are still needed under standalone operation. Attempting to establish those services and functions will be more difficult in the future due to loss of institutional knowledge, outdated or obsolete infrastructure, learning new rules and regulations and changes to existing rules and regulations, the need to hire additional personnel, and other similar considerations.

Another potential issue is that after several years in an RTO market, MLGW's power supply structure may not be adequate for standalone operation. For example, MLGW may choose to rely on the RTO for a portion of its capacity and energy needs. Therefore, prior to commencing standalone operation MLGW would have to construct or purchase new generation to supply the capacity and energy that was provided by the RTO market. While no changes to the transmission and distribution infrastructure is anticipated to be needed for a return to standalone operation, there does exist the possibility that transmission projects in MLGW may need to be constructed. This could occur if the forecasted generation dispatch in a standalone operation differs significantly than that seen while participating in RTO energy markets.

RTO Entry & Exit Summary

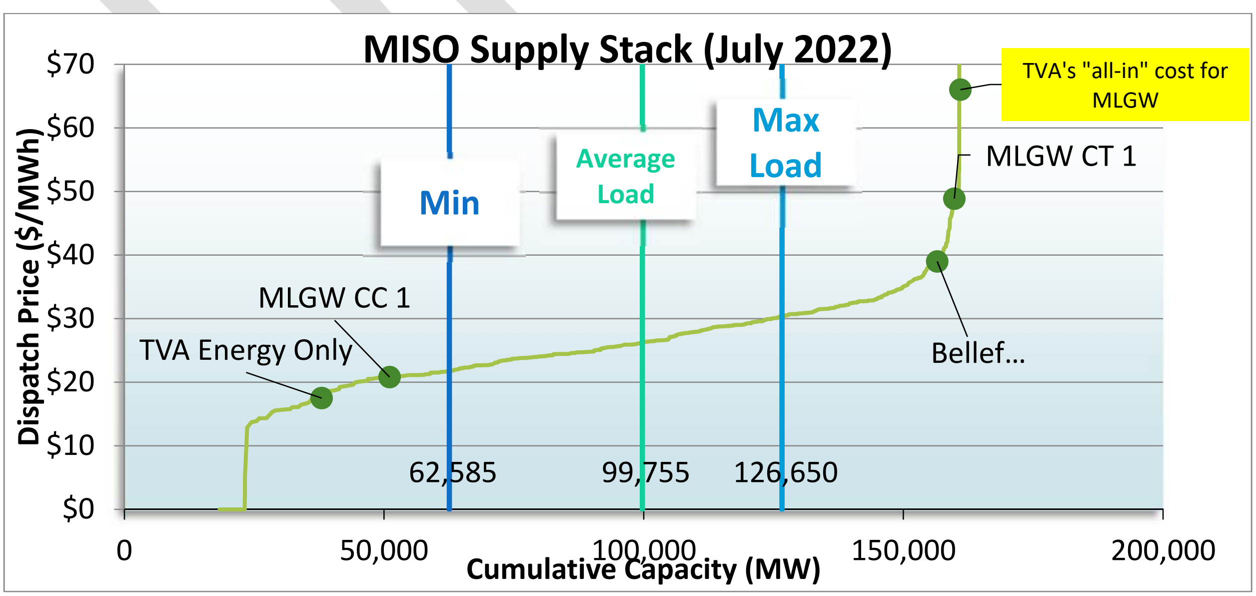
Table 8: Summary of RTO Entry and Exit

Summary: **RTO Entry and Exit**
• MISO has extensive experience in the integration of new members. • Major entry negotiation points center around conversion of transmission rights, qualification of capacity resources and determination of transmission facilities inclusion for ATRR. • Very little information on Exit Fees exists, but, at a minimum, MLGW should assume a cost of not less than $2MM to cover the FERC-mandated exit fee based on the ATSI and DEO/DEK cases.

8. GDS Recommendation

A representation of the MISO supply curve is shown in the graph below along with the dispatch price of the various discrete power supply options. The graph indicates a wide variation between TVA's generation production cost to its all-in WPA cost to MLGW. Various alternatives including the Bellefonte PPA and MLGW self-build generation options show significant differences in energy pricing (Figure 23).

Figure 23: MISO Supply Stack (July 2022)



It is GDS' recommendation that MLGW proceed with developing a complete Integrated Resource Plan ("IRP") which would enumerate the cost of owning and operating various resource portfolios over a 20-year study period. MLGW, on a net present value basis, would identify the most cost-effective resource portfolio to meet its total capacity and energy requirements on a reliable basis. The IRP would include a long-range financial forecast which evaluates the financial impacts of the various generation resource alternatives capex (e.g., impacts on cash flows, financial metrics, and retail rates) as well as possible demand response and energy-efficiency measures. In addition, risks associated with serving one-third of MLGW's capacity and energy needs with a single generator (e.g., Bellefonte) as well as transmission and reliability issues would be examined in detail. The core issue that the IRP process will address is whether MLGW should continue to purchase all of its capacity and energy through a wholesale power agreement with TVA.

9. Appendix A: Contributors

Seth W. Brown, P.E.

Seth W. Brown, Vice President - Transmission Services, GDS Associates, Inc.

Bachelor of Electrical Engineering, Georgia Institute of Technology, 1985

Registered Professional Engineer, State of Georgia

Mr. Brown has more than thirty years of electric utility and consulting experience. He has managed various functions at the largest generation and transmission cooperative in the country. Included in this experience is management of engineering design, test engineering, project management, operations and maintenance, electric tariff services, regulatory compliance and litigation. Recently, Mr. Brown has provided consulting services in a wide range of areas for transmission and distribution cooperatives and municipal electric systems. This has included consulting on NERC and Regional Entity Compliance issues, transmission contracts for services, analysis of system impact studies, transmission queue issues and developing policies and performing analysis for clients on complex issues such as transmission congestion management, financial transmission rights, locational marginal pricing, ancillary services and generator operations.

Neil Copeland, P.E.

J. Neil Copeland, Managing Director, Power Supply, GDS Associates, Inc.

Bachelor of Mechanical and Nuclear Engineering, Georgia Institute of Technology (Georgia Tech), Atlanta, GA, 1994

Mr. Copeland brings more than 16 years of experience in testimony, preparing energy and capacity price forecasts, providing detailed assessments of market fundamentals, analyzing transmission investment, providing nodal congestion and curtailment analysis, developing integrated resource plans, managing data gathering and price forecasting databases, and performing asset valuations for various power plants. Mr. Copeland has supported project development and financing for construction of new generation, acquisition, divestiture, refinancing, and bankruptcy proceedings. Mr. Copeland has completed numerous consulting engagements for diverse stakeholders, including regulatory agencies, project developers, load-serving entities, generating companies, private equity and investment banks. Mr. Copeland also has extensive experience with the use of commercial price forecasting tools such as the ABB/Ventyx *PROMOD IV®* and *MarketPower™* software.

John Chiles

John W. Chiles, Principal, Transmission Services, GDS Associates, Inc.

John holds a Bachelor of Science in Engineering from the University of South Florida.

Mr. Chiles has over 25 years of electric utility and consulting experience. He has worked in several sectors of the energy industry, including cooperatives, municipals, investor-owned utilities, and merchant energy companies. Included in this experience is generation and transmission planning, RFP bid evaluation, market design analysis, transmission access issues, locational marginal pricing, regulatory litigation, control area operations and next-day transmission trading. He was responsible for managing the daily transmission portfolio for the two largest merchant power plants in the United States and coordinated a generator-only control area in the WECC region. He has represented multiple companies at Regional Transmission Organizations and has provided technical guidance on issues before state commissions and the FERC such as generator operating limits, generator imbalance protocols, RTO transmission issues, transmission facility need determination and transmission access. Mr. Chiles was involved in transmission analysis for several companies in their RFP process which included power flow analysis, review of system impact study results, and evaluation of operational and contractual issues.

Dr. William Jacobs, P.E.

Ph.D., Nuclear Engineering, Georgia Tech 1971

MS, Nuclear Engineering, Georgia Tech 1969

BS, Mechanical Engineering, Georgia Tech 1968

Dr. Jacobs has over thirty-five years of experience in a wide range of activities in the electric power generation industry. He has extensive experience in the construction, startup and operation of nuclear power plants. While at the Institute of Nuclear Power Operation (INPO), Dr. Jacobs assisted in development of INPO's outage management evaluation group. He has provided expert testimony related to nuclear plant operation and outages in Texas, Louisiana, South Carolina, Florida, Wisconsin, Indiana, Georgia and Arizona. He currently provides nuclear plant operational monitoring services for GDS clients. Dr. Jacobs was a witness in nuclear plant certification hearings in Georgia for the Plant Vogtle 3 and 4 projects on behalf of the Georgia Public Service Commission and in South Carolina for the V.C. Summer 2 and 3 projects on behalf of the South Carolina Office of Regulatory Staff. His areas of expertise include evaluation of reactor technology, EPC contracting, risk management and mitigation, project cost and schedule. He is assisting the Florida Office of Public Counsel in monitoring the development of four new nuclear units in the State of Florida, Levy County Units 1 and 2 and Turkey Point Units 6 and 7. He also evaluated extended power up rates on five nuclear units for the Florida Office of Public Counsel. He has been selected by the Georgia Public Service Commission as the Independent Construction Monitor for Georgia Power Company's new AP1000 nuclear power plants, Plant Vogtle Units 3 and 4. He has assisted the Georgia Public Service Commission staff in development of energy policy issues related to supply-side resources and in evaluation of applications for certification of power generation projects and assists the staff in monitoring the construction of these projects. He has also assisted in providing regulatory oversight related to an electric utility's evaluation of responses to an RFP for a supply-side resource and subsequent negotiations with short-listed bidders. He has provided technical litigation support and expert testimony support in several complex law suits involving power generation facilities. He monitors power plant operations for GDS clients and has provided testimony on power plant operations and decommissioning in several jurisdictions. Dr. Jacobs represents a GDS client on the management committee of a large coal-fired power plant currently under construction. Dr. Jacobs has provided testimony before the Georgia Public Service Commission, the Public Utility Commission of Texas, the North Carolina Utilities Commission, the South Carolina Public Service Commission, the Iowa State Utilities Board, the Louisiana Public Service Commission, the Florida Public Service Commission, the Indiana Regulatory Commission, the Wisconsin Public Service Commission, the Arizona Corporation Commission and the FERC.