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MLGW

Evaluation of Long Term Power Supply Alternatives

February 2019

www.gdsassociates.com

GDS Associates

Background

- Founded in 1986, we serve a client base of municipal and cooperative utility systems with a variety of energy, gas, water and wastewater consulting services, as well as information technology, market research, and statistical services. Headquartered in Marietta, Georgia with 170 employees located throughout the U.S.

- Project Team:

- Seth Brown, P.E. – Vice President, Transmission Services
- Neil Copeland, P.E. – Managing Director, Power Supply Services
- John Chiles – Principal, Transmission Services
- Dr. Bill Jacobs, P.E. – Executive Engineer – Generation Services

Evaluation of Power Supply Alternatives

Objective

- Study Objective: Evaluate long-term power supply alternatives including Nuclear Development – Bellefonte Project Power Purchase Agreement
- Cost of Energy-only modeled
- Evaluate MLGW as both stand-alone and integrated into MISO
- 2022 Study Year
- Include 15% renewable (wind) portfolio
- Compare to current TVA wholesale power agreement – NOTE THAT STUDY DID NOT INCLUDE VALUE/COST OF CAPACITY OR COSTS ASSOCIATED WITH ANY NEW DEBT SERVICE

Methodology & Principal Assumptions

Energy Methodology & Principal Assumptions

- Utilized a large footprint (excludes Florida, New England, NE Canada, and Saskatchewan) containing load, generation, and nodal modeling (substation level analysis)
- Full nodal analysis using PROMOD IV production cost software and the latest MISO database for the Calendar Year of 2022
  - Produces a fully integrated, security constrained economic dispatch adhering to generation and transmission limitations simultaneously
- Captures unit generation metrics, transmission congestion, and load costs. <u>Does not include capacity costs/value</u>
- TVA Business-As-Usual Case represents continuation of current wholesale power agreement that includes capacity costs. PROMOD results for TVA fleet include production <u>costs only</u> (fuel + operations & maintenance)

Energy Methodology & Principal Assumptions

- In the "MLGW BA" scenarios, a production cost construct is used (production costs + purchases – sales)
  - These loads include losses in the production costs calculations
- In the "MLGW MISO" scenarios, a market based approach using Locational Marginal Pricing (LMP) is implemented (generator margins offset load costs)
  - System is dispatched to load with losses, but MLGW only pays substation loads
  - Generators participating in the market are paid a loss component of LMP to compensate for their additional generation to cover actual losses on the system
- Four additional renewable scenarios across the four primary scenarios included power purchase agreements of 700 MW of high capacity factor wind from the upper midwestern portions of MISO
  - Wind energy provided approximately 15% of MLGW energy requirements

Energy Methodology & Principal Assumptions

Scenarios

- Scenario A: MLGW as its own **BA** w/ Bellefonte
  - Bellefonte is delivered to MLGW via Firm PtP Transmission
  - MLGW holds Firm PtP to MISO for peak load (loss of Bellefonte)
- Scenario B: MLGW as its own **BA** w/ Bellefonte and new self-build resources
  - Bellefonte is delivered to MLGW via Firm PtP Transmission
  - MLGW holds hourly non-Firm service to and from MISO for sales and purchases
- Scenario C: MLGW in **MISO** w/ Bellefonte
  - Bellefonte is delivered to MISO via Firm Point to Point (PtP) Transmission
  - MLGW holds Firm PtP to MISO for peak load (Pseudo-Tie and loss of Bellefonte)
- Scenario D: MLGW in **MISO** w/o Bellefonte
  - MLGW holds Firm PtP to MISO for peak load (Pseudo-Tie)
  - Procures all energy from MISO

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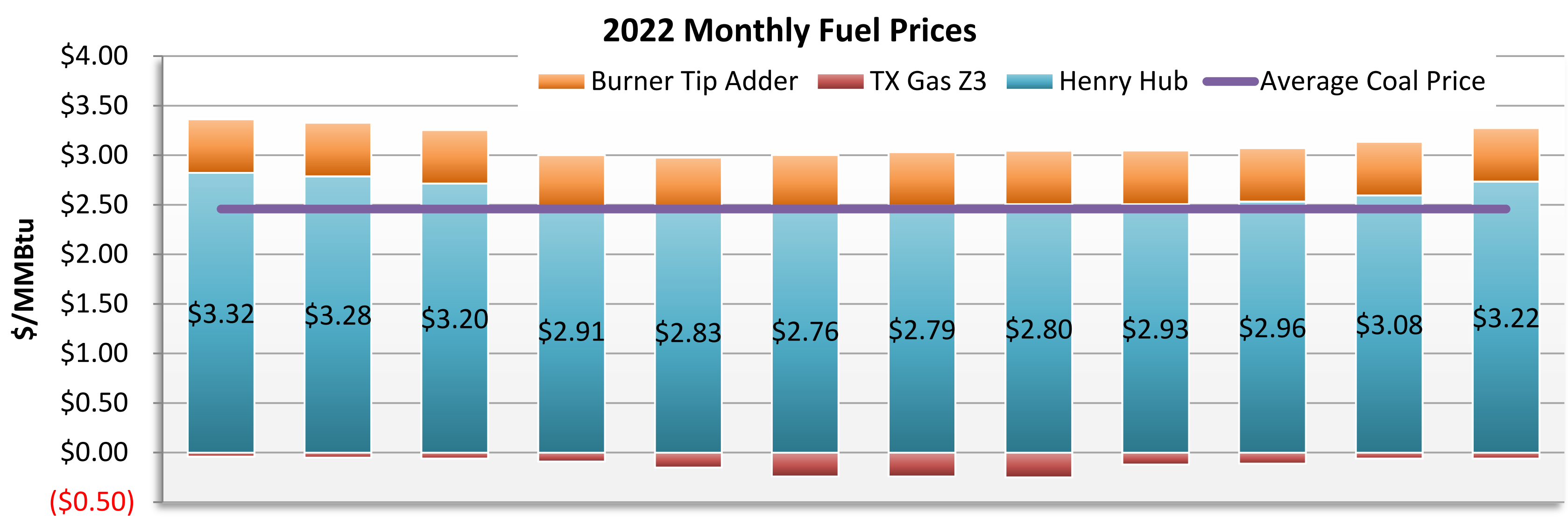
Energy Methodology & Principal Assumptions

Fuel

- GDS used NYMEX HH futures from 9/25/2018
- Represents price of fuel burned by generators in the TVA region, and the new MLGW generation
- Coal prices represent the average coal prices from all coal plants in TVA



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MLGW

Market

Generation Supply

MISO Supply Stack

- The MISO market is well-supplied with generation and carries greater than 27% reserve margins (including non-firm load), allowing opportunities for interchange between control areas
- In 2022, combined cycle generating capacity is approximately 29,000 MW
- Low cost generation should be able to generate energy margins to offset load costs

Energy Results

TVA Business as Usual

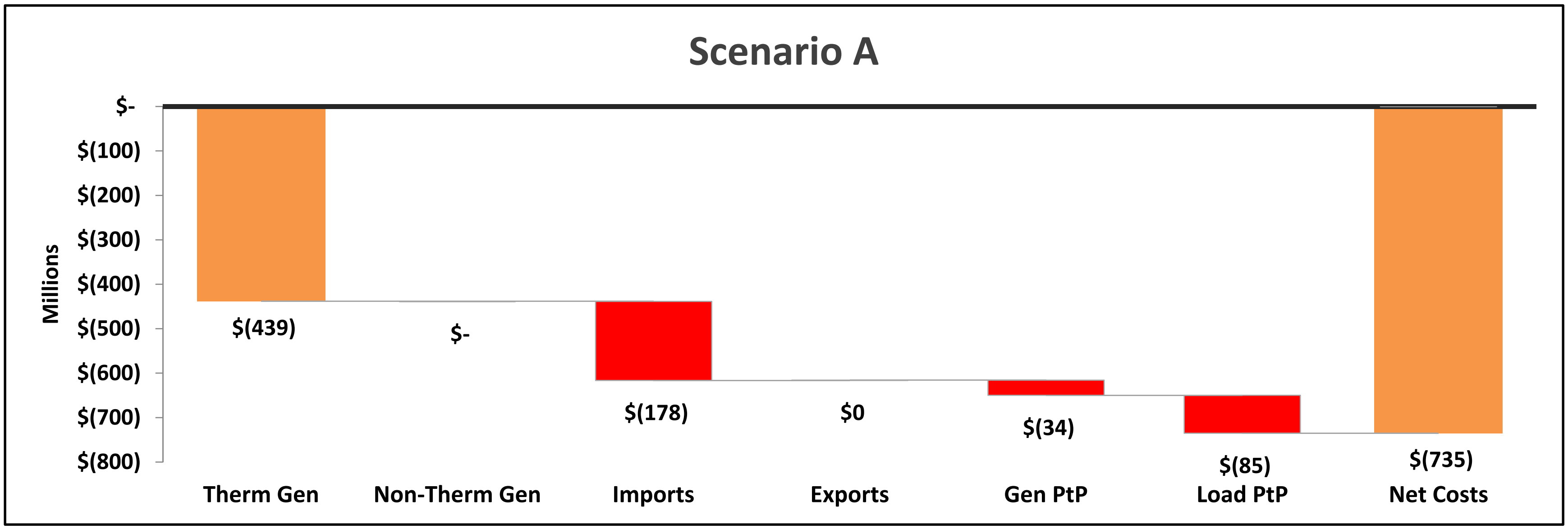
Costs

- PROMOD yields a TVA “energy only” cost of production of $18.50/MWh
- TVA SEC 10-K Filing indicates the full-delivered, all-requirements cost to serve MLGW is ~$66.00/MWh

Scenario A

Costs

- This "MLGW BA" scenario incurs the Bellefonte costs with no revenue offset
- Imports from MISO make up the balance of the native load requirements
- Import costs are priced at the load-weighted MLGW LMP to be consistent with the "MLGW MISO" scenarios



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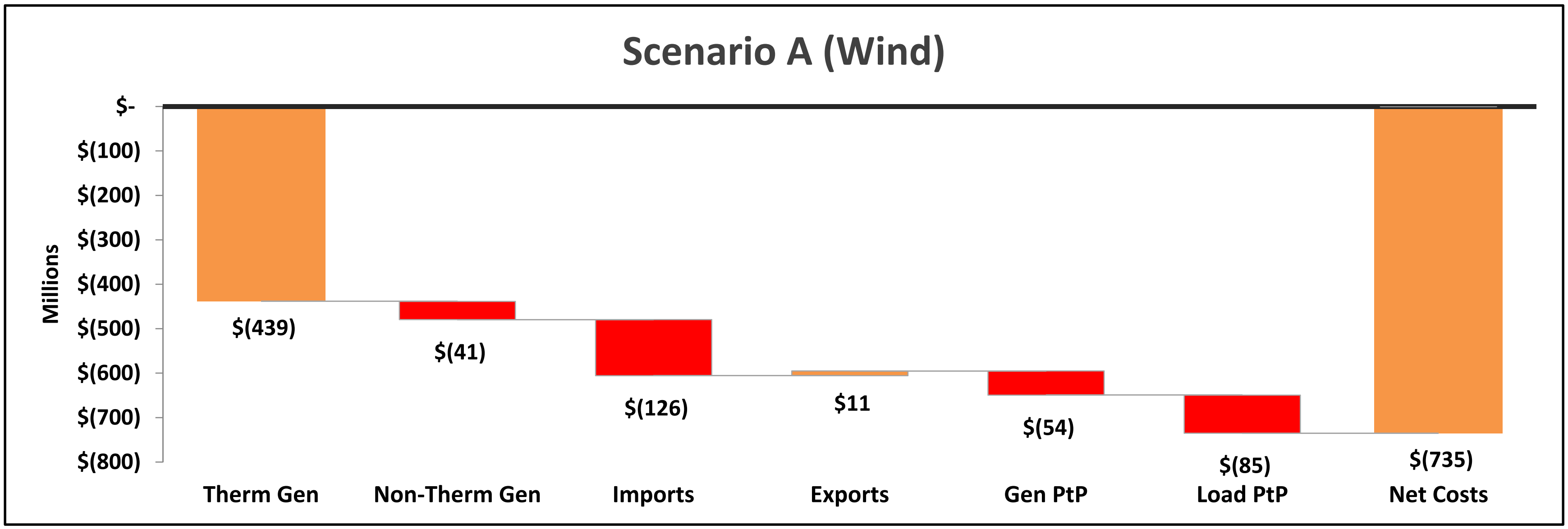
Scenario A (Wind)

Costs

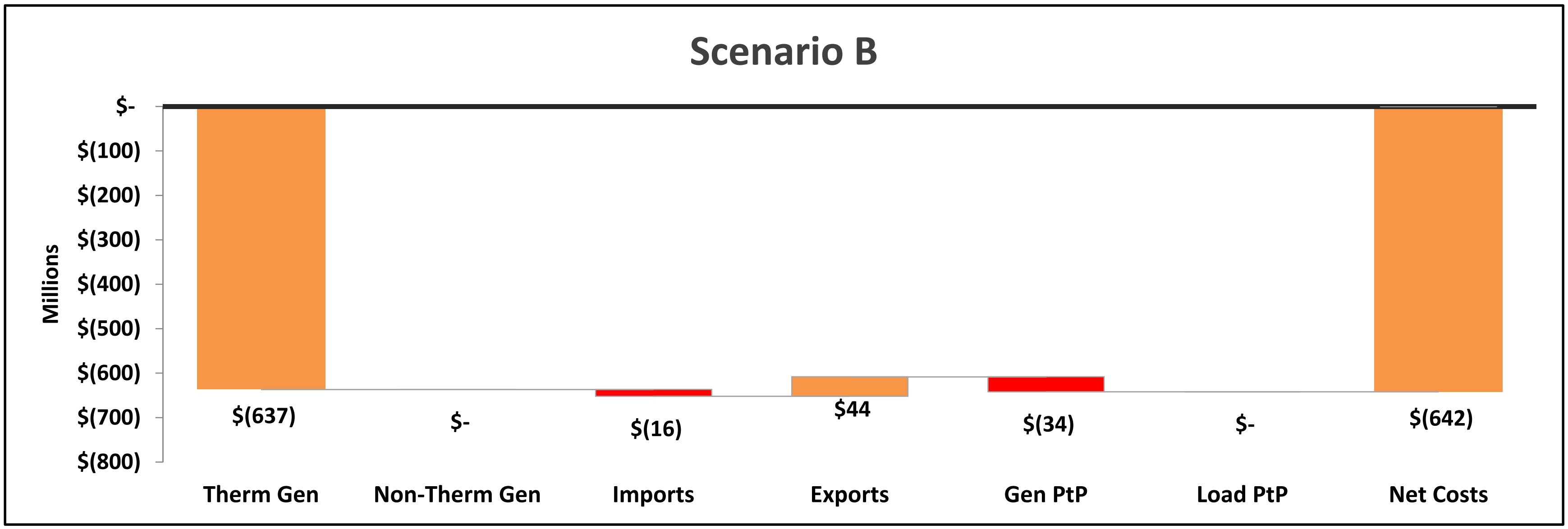
- As compared to Scenario A, imports from MISO are lower due to the purchase of renewable wind energy
- The reduction in import costs from the market are offset by the price of wind and the transmission costs to move the wind through MISO
- Net costs are almost identical to Scenario A without the wind



Scenario B

Costs

- This "MLGW BA" scenario includes the Bellefonte, 2 new CC's, and 6 new CT's (new capacity of 2,606 MW), and provides a 16% planning reserve margin
- Increased exports provide additional revenue opportunities
- MLGW holds non-firm hourly transmission service since their load is covered by internal generation



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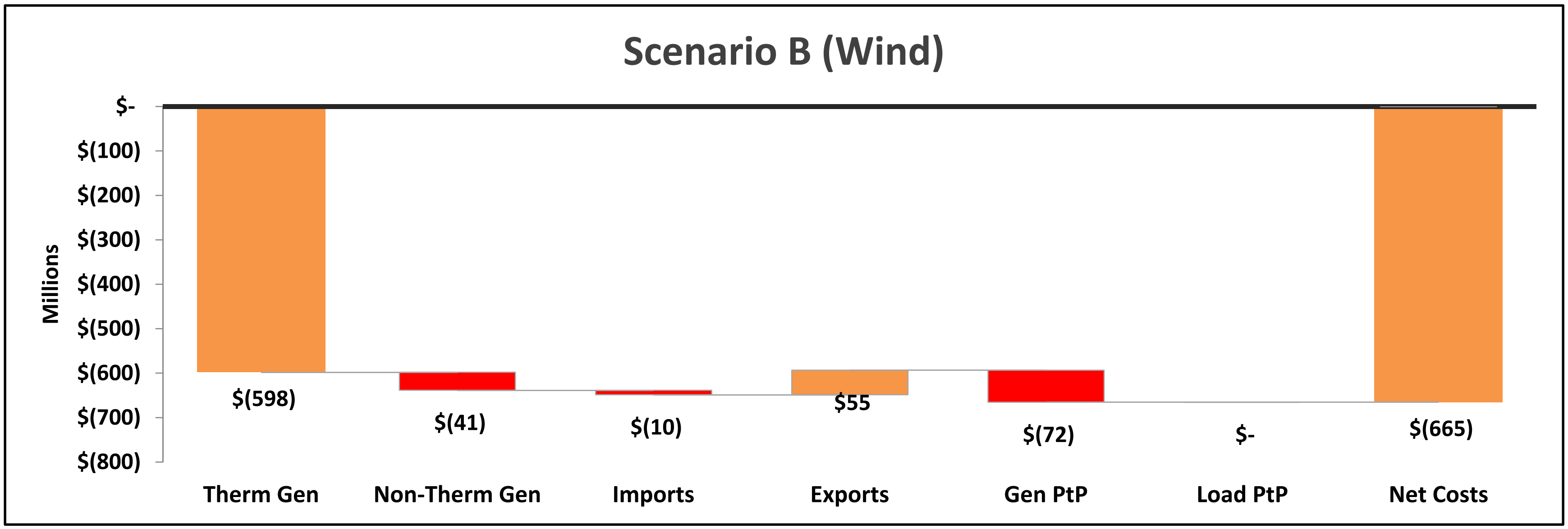
Scenario B (Wind)

Costs

- Using the wind to serve load provides more opportunities for additional generation exports as compared to Scenario B
- Increased energy margins cannot overcome the cost of procuring and transporting the wind across the MISO system
- Net costs are $23MM higher when compared to Scenario B without the wind



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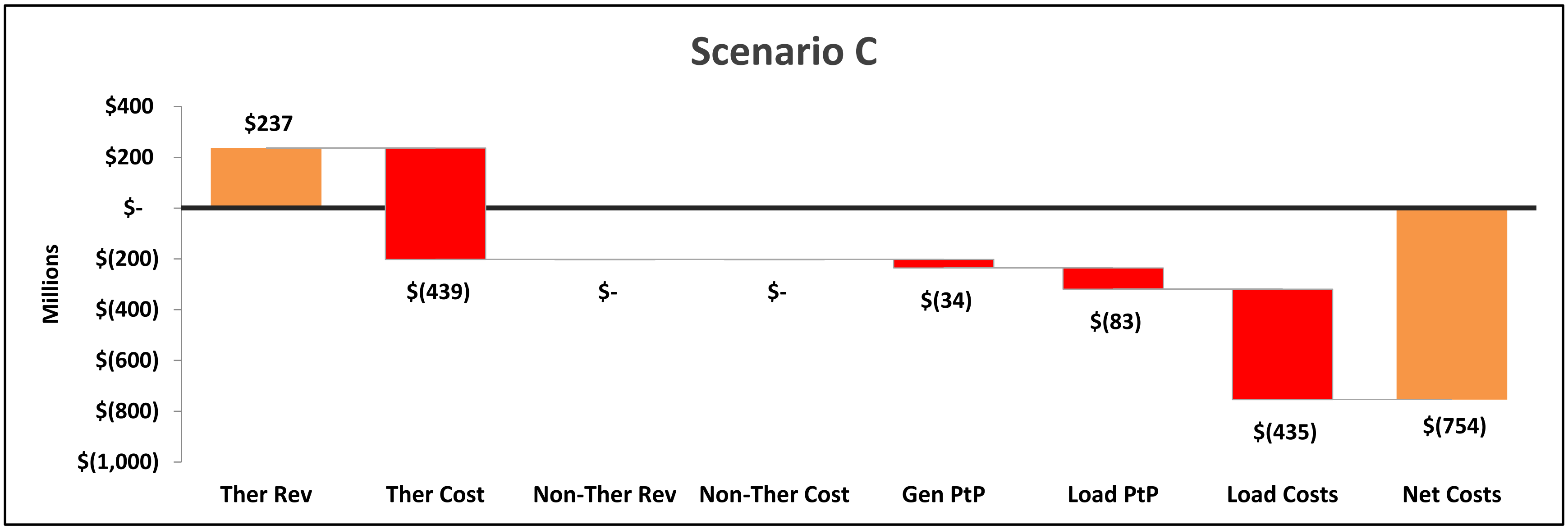
Scenario C

Costs

- In this “MLGW MISO” scenario Bellefonte receives revenue from the MISO market, which offsets some of the PPA costs
- PtP transmission costs are incurred to integrate into the MISO market since MLGW has no direct electrical transmission connections to MISO



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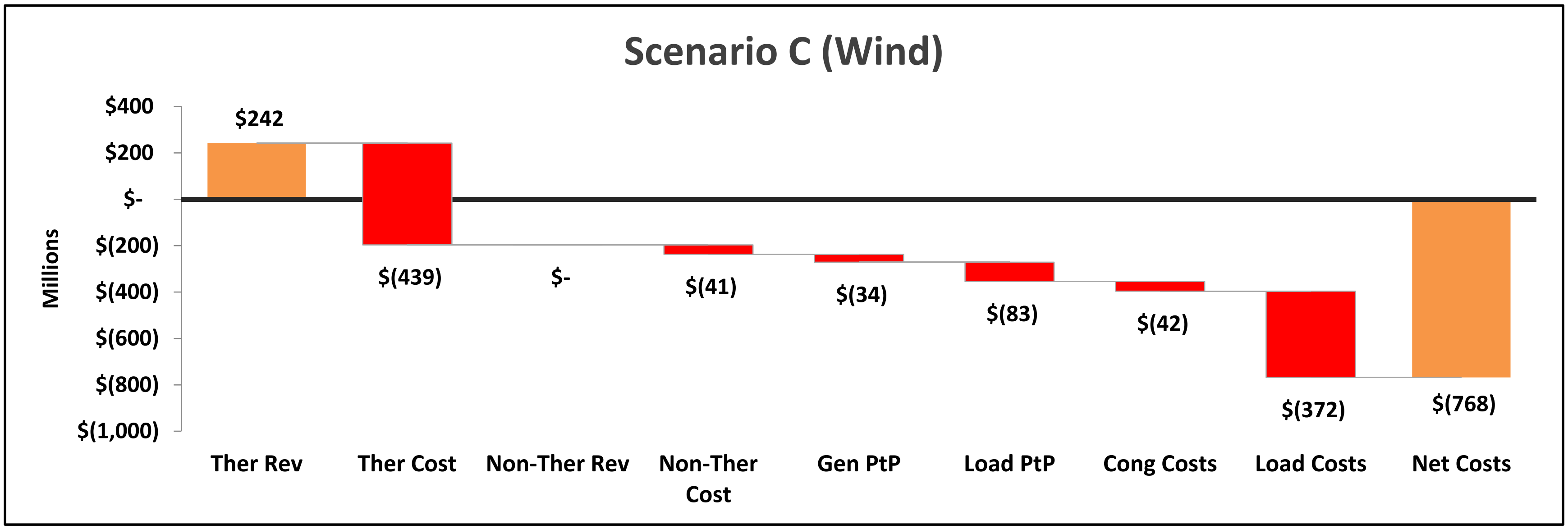
Scenario C (Wind)

Costs

- With MLGW and the wind in MISO, MLGW would pay the congestion costs to move the wind across the MISO system as compared to firm PtP in the MLGW BA wind scenarios
- Hourly load is reduced by the hourly schedules of the wind, which is then multiplied by the MLGW hourly load-weighted LMP to arrive at the Load Costs
- Net costs are $14MM higher than Scenario C without the wind



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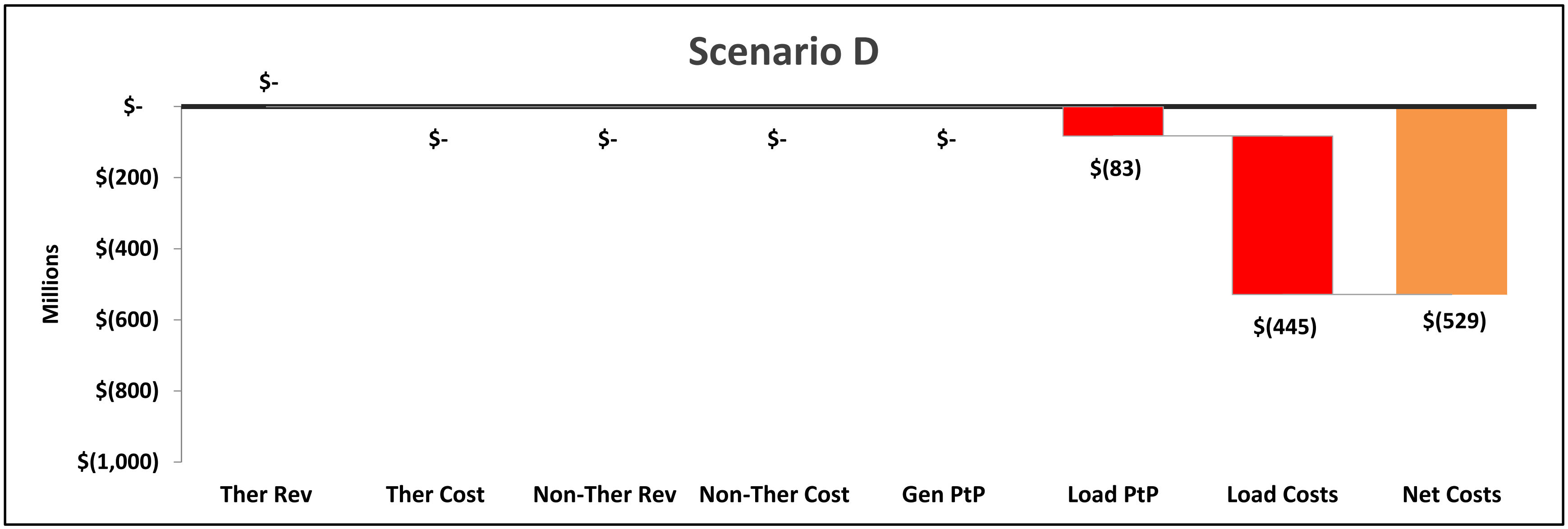
Scenario D

Costs

- This “MLGW MISO” scenario purchases all energy from the MISO market, and shows the lowest energy costs of all scenarios
- With no hedges, MLGW would be subject to market scarcity energy pricing



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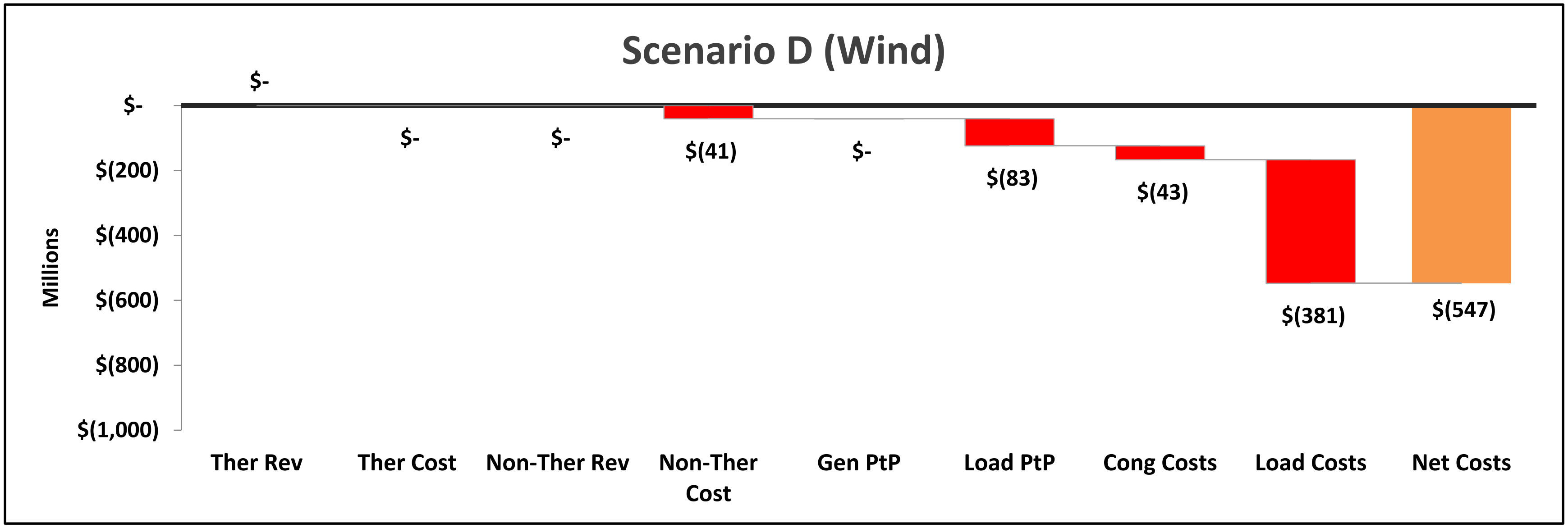
Scenario D (Wind)

Costs

- The purchase of wind lowers the Load Costs, but is not able to overcome the cost and transportation of the wind across the MISO system
- Net costs are $18MM higher than Scenario D without the wind



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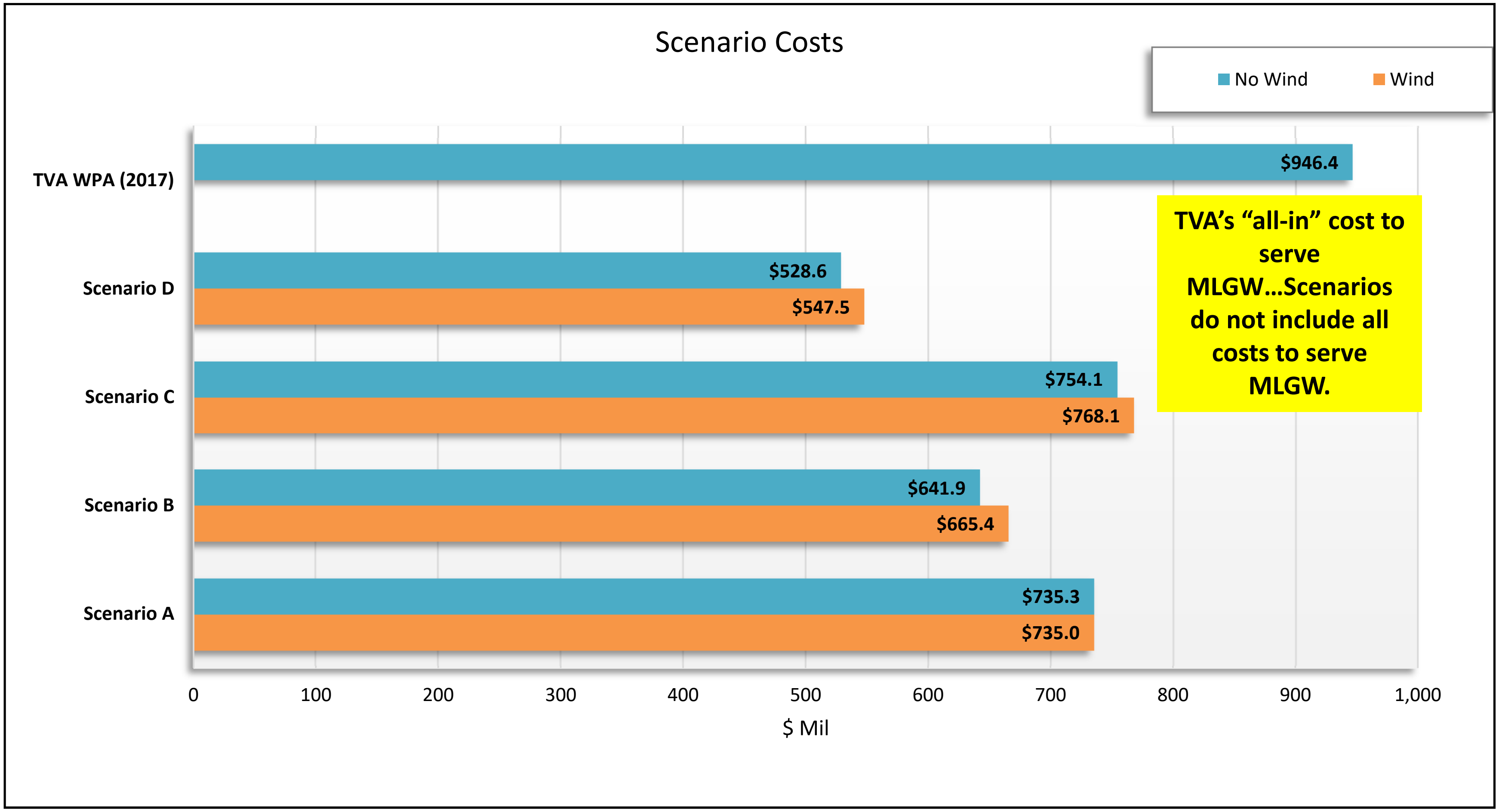
Summary of Scenarios

Costs



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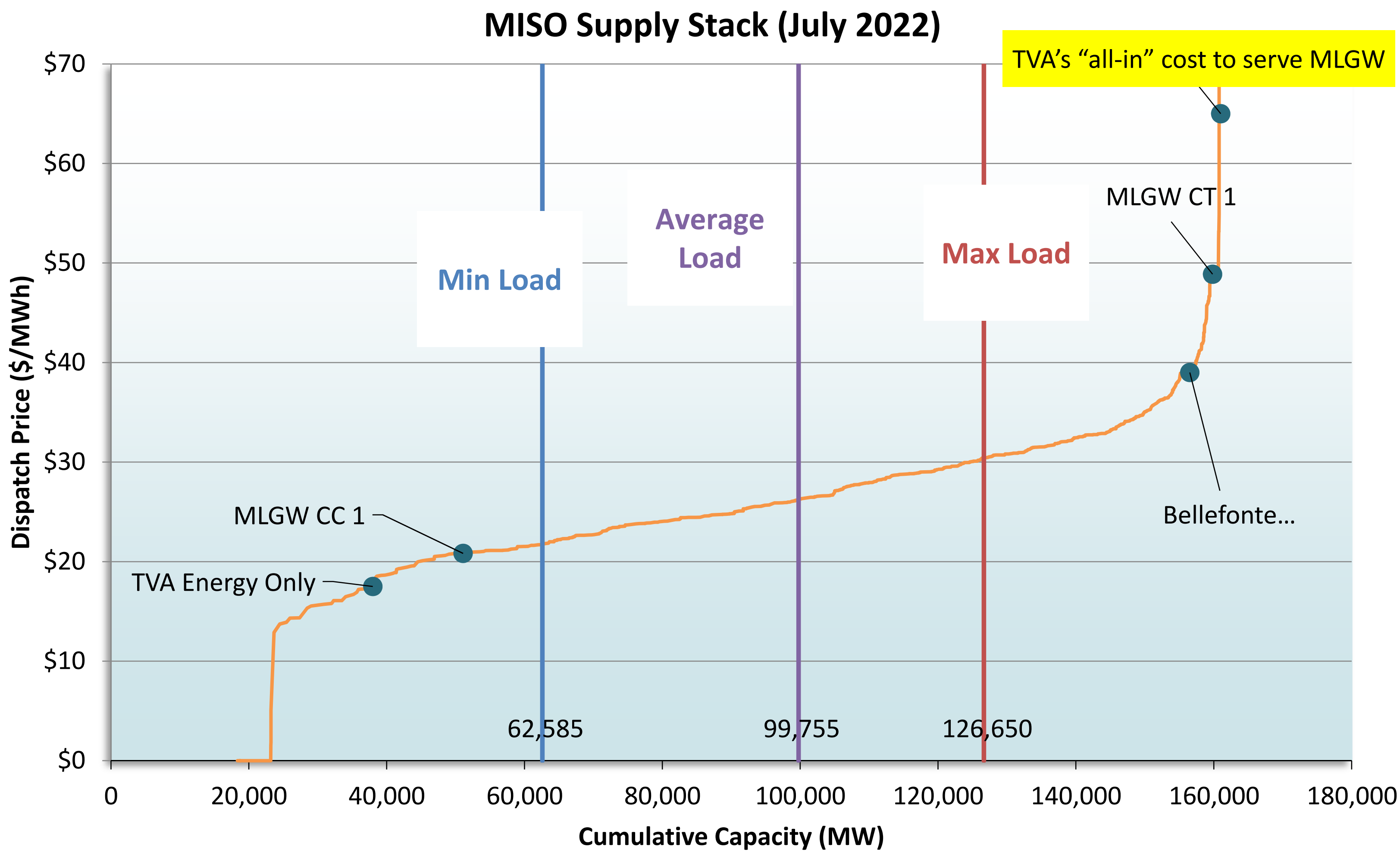
Summary of Scenarios

- Bellefonte costs are well above market energy prices under modeled gas prices. Comparison of MISO scenarios (D minus C) shows a **($200MM)** differential owning Bellefonte in MISO vs MISO-only. Bellefonte and TVA provide a capacity benefit.
- New, efficient thermal generation provides hedges against market prices, and should provide energy margins to offset load costs, but requires capital
- Purchasing strictly from the market provides opportunities for low-cost power, but provides no protection from scarcity energy pricing. Capacity can be procured from the MISO market but prices fluctuate annually

Generation Supply

MISO Supply Stack



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Bellefonte Project

Risks

Issues associated with Bellefonte Project viability

- Framatome's technical expertise with this reactor design
- Many original equipment vendors no longer in existence requiring reverse engineering of components
- Lack of a detailed engineering analysis of the existing plant systems and equipment
- Use of Maximum Guaranteed Price (MGP) contracts with penalties assessed to the contractors for schedule delays may be unrealistic
- Progressing from fuel load to commercial operation in three months may be unrealistic
- Ability to hire and train operators and development of a plant simulator may be problematic

Possible Next Steps

- Obtain data from TVA on the incremental cost of capacity, energy, transmission, and ancillary services required to serve MLGW
- Conduct a "discovery session" with MISO
- Identify transmission transfer limitations with TVA and MISO
- Review the need to develop an Integrated Resource Plan:
  - Identify corporate goals for renewables, demand response and energy efficiency
  - Identify the most cost-effective resource portfolio
  - Develop long-range financial forecast associated with new resources (cash-flow impacts, debt service limitations, financial metrics, customer rate impacts)
- Conduct a Request for Proposals for new resources