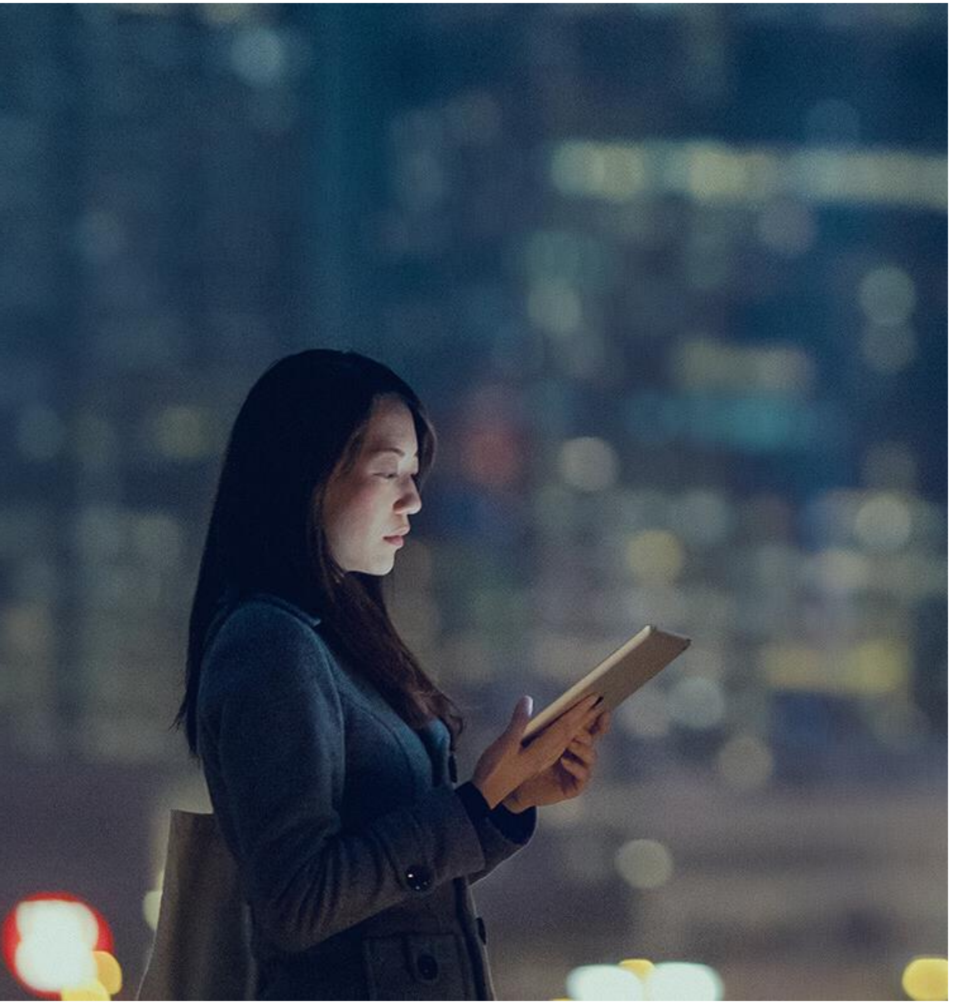
Integrated Resource Plan and Transmission Discussion PSAT Meeting

October 17, 2019

Agenda



Welcome / Safety brief	10:00 am
Recap on last PSAT Meeting	10:10 am
Memphis Load Forecast	10:25 am
Natural Gas Market Considerations for MLGW	10:45 am
Resource Options Updates	11:00 am
Initial LTCE Results	11:15 am
Transmission Discussion (Working lunch)	12:15 pm
Breakout Session	12:30 pm
Summary of Breakout & Next steps	1:30 pm
Meeting adjourn	2:00 pm

Recap on last PSAT Meeting

Recap on last PSAT Meeting

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- PSAT members provided comments/suggestions on mainly two questions:

1. List of generation options:
   - Group 1: research Nuclear (modular), and Hydroelectric w/ Mississippi River
   - Group 2: research Hydro, Residential / Commercial, Geothermal, Microgrids
2. Prioritize the recommended scenarios:

	Base Case	High Tech	High Reg.	No Inflation	Worst Historical	Best Historical	Climate Crisis	MISO Op. Change
Group 1	5	4-5	5	1	3	1	4-5	1
Group 2	4	4	4	5	2	2	4	

3. PSAT members generally concurred the comprehensiveness of other options presented:
   - Sensitivity, Stochastics, Transmission approaches
4. The highlighted scenarios are given priority in our LTCE runs.

Memphis Load Forecast

Energy and Peak Forecast Approach

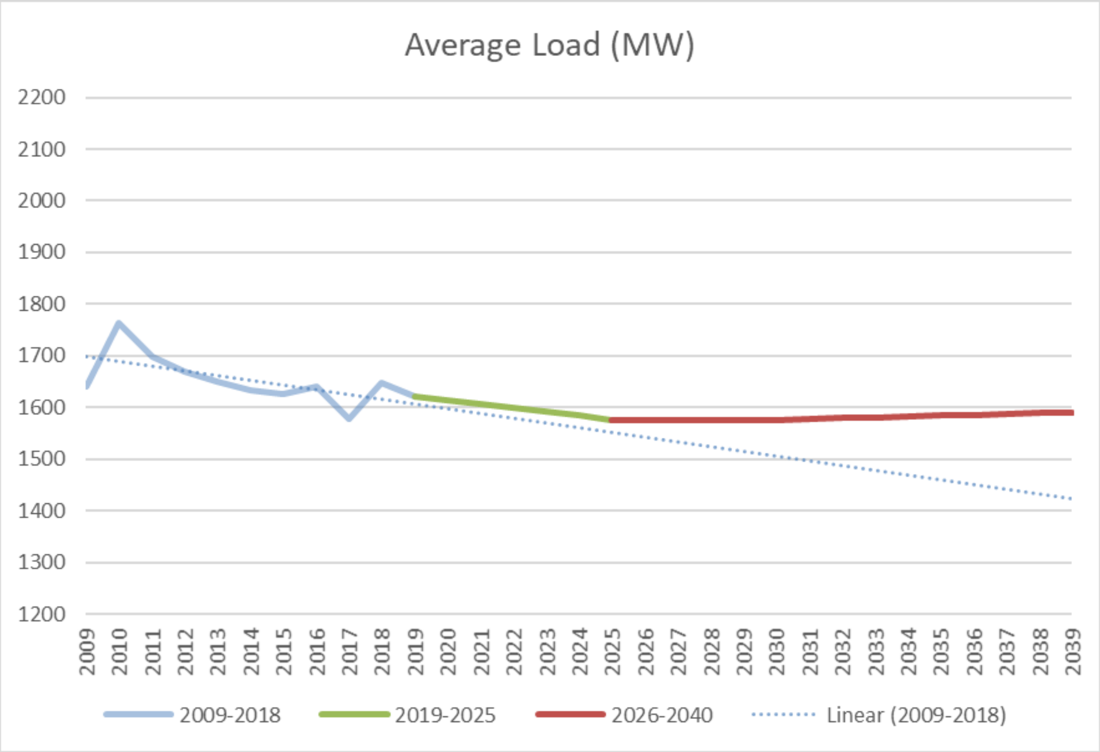
- Fit regression to ten years of historical and GDP data and develop forecast by applying forecasted independent variables to fitted model.
  - Historically, load has generally been decreasing for 10 years during a period of weak economic growth.
  - Included ten years of humidity and temperature data in regression analysis, and applied over 50 years of weather for forecast.
  - Including customer counts and limiting analysis to five-year data series (fitting to more recent trends) did not perform as well.
- Apply decrements based on Energy Efficiency and Distributed Solar Generation penetrations.
  - Program history would suggest limited impacts, and uncertain support for such programs in the future.
  - Little measured data on impacts or estimates of penetrations; need to apply targets.
- Apply increment based on Electric Vehicle penetration
  - Adoption is low in Tennessee compared to the country, and expected to be lower in Memphis than elsewhere in Tennessee.

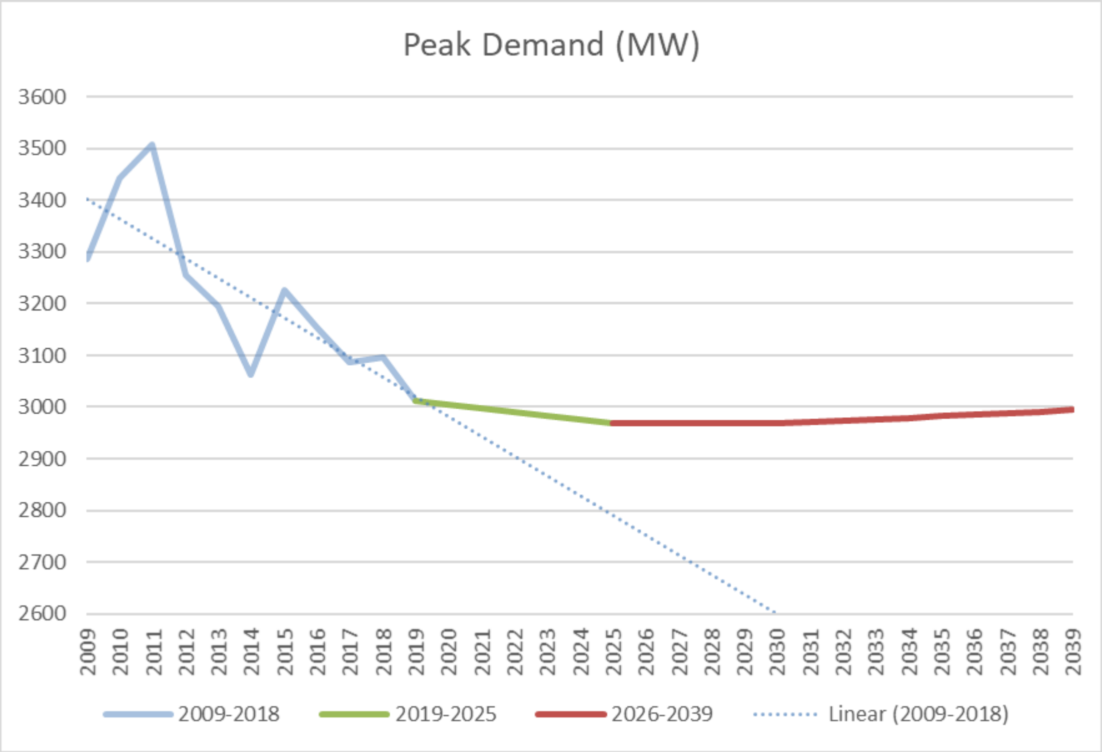
Modified Approach Based on September 25 Conference Call

- Forecast based on regression model showed continued load declines into future.
  - Continuous declines in load were unlikely for the entire period of analysis through 2040.
  - A trending analysis would substitute for the longer-term forecast, and the magnitude of it would be a consensus decision between Siemens and MLGW.
- Siemens requested additional detail on future program designs and support for energy efficiency and distributed solar resources.
- Electric vehicle forecasts could be incorporated into the load forecast.

Proposed Load Forecast Before EE/EV/DS Adjustments

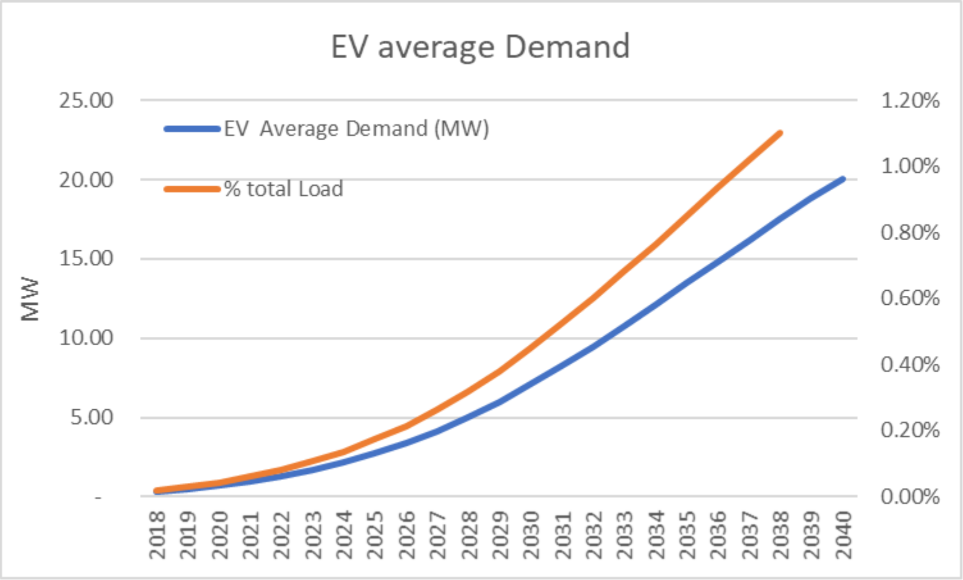
- Blue dotted line (2009-18) represents linear trend of historical average and peak load values
- Green (2019-25) is based on Federal Reserve forecast of GDP growth in regression equation.
- Red is flat (2026-30) but growing (2031-40) at 0.01% (TVA IRP assumption).





Load Adjustments from DER / EE / EV

- Load adjustments to MLGW forecast have three components:
  1. Electric Vehicles (EVs) add to load
  2. Distributed Solar (DS) and DER in general reduces load
  3. Energy Efficiency (EE) reduces load
- Need to estimate incremental adjustment because existing resources/ gains are “baked into” forecast.
- EV penetration was modeled based on limited market data.
  - Penetration is fairly low in Tennessee compared to country
  - Siemens modeling suggests it will be lower still in Memphis.
  - The impacts are modest (little over 1% increase)

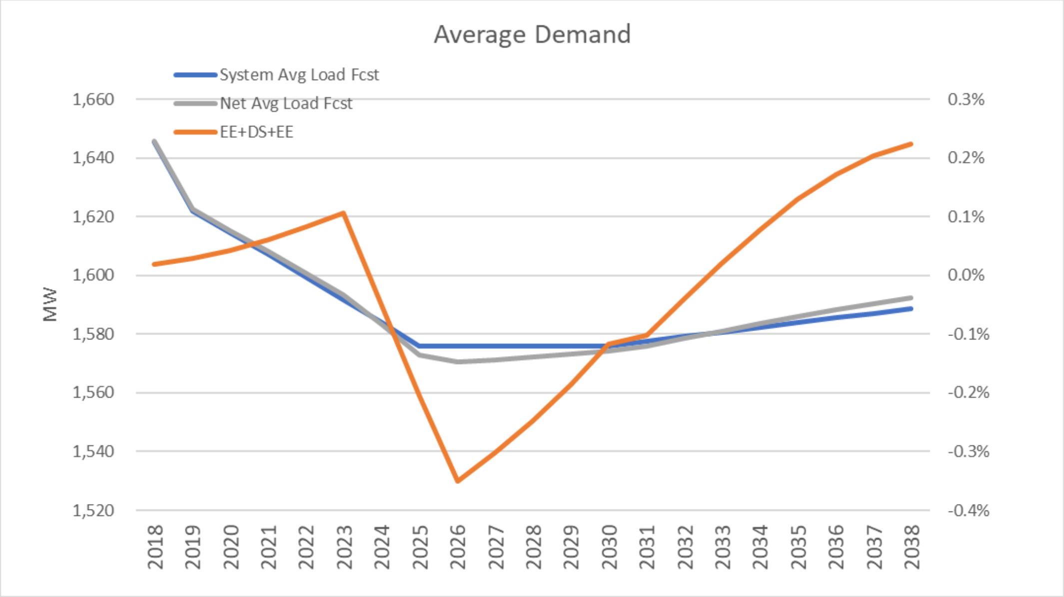


Load Adjustments from DER / EE / EV

- DS programs will terminate (namely Green Power Providers) but a replacement will be deployed to honor obligations under PURPA.
  - Siemens modeled a standard inflow-outflow metering design based on a comparable city in the Midwest, offering a $500 incentive for each KW up to 4 KW.
  - Estimated impacts are conservative.
  - These programs are projected to start by 2025.
- EE program history is limited, but MLGW intends to support limited programs
  - EE was modeled to begin in 2024, rise to 0.3% of annual consumption in 2026 and hold steady.
  - Higher levels will require additional funding.

Net Average Load Forecast

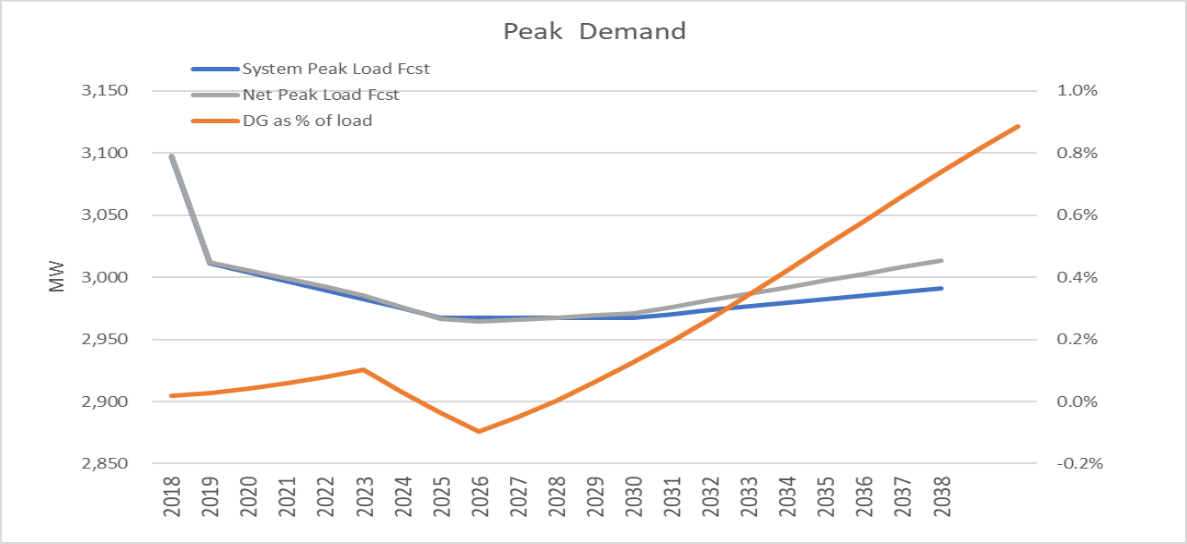
	2020	2025	2030	2035	2040
System-MW	1,614.64	1,576.04	1,576.04	1,583.94	1,591.88
EV-MW	0.70	2.72	7.07	13.46	20.07
EE-MW	0.00	5.94	8.90	8.95	8.99
DS-MW	-	0.01	0.02	2.47	7.84
Net System-MW	1,615.34	1,572.82	1,574.19	1,585.99	1,595.11
EV+EE+DS as %	0.0%	-0.2%	-0.1%	0.1%	0.2%



Net Peak Load Forecast

	2020	2025	2030	2035	2040
System Peak - MW	3,004.17	2,967.52	2,967.52	2,982.39	2,997.33
EV-MW	1.24	4.85	12.61	23.99	35.79
EE-MW	0.00	5.94	8.90	8.95	8.99
DS-MW	-	0.00	0.00	0.08	0.26
Net System Peak - MW	3,005.41	2,966.44	2,971.23	2,997.36	3,023.87
EV/EE/DS as %	0.0%	0.0%	0.1%	0.5%	0.9%

- Net impact in Peak Load is fairly small under the Base Case



Natural Gas Market Considerations for MLGW

U.S. Natural Gas Supply Growth is Expected Primarily in the Appalachian and Permian Basins

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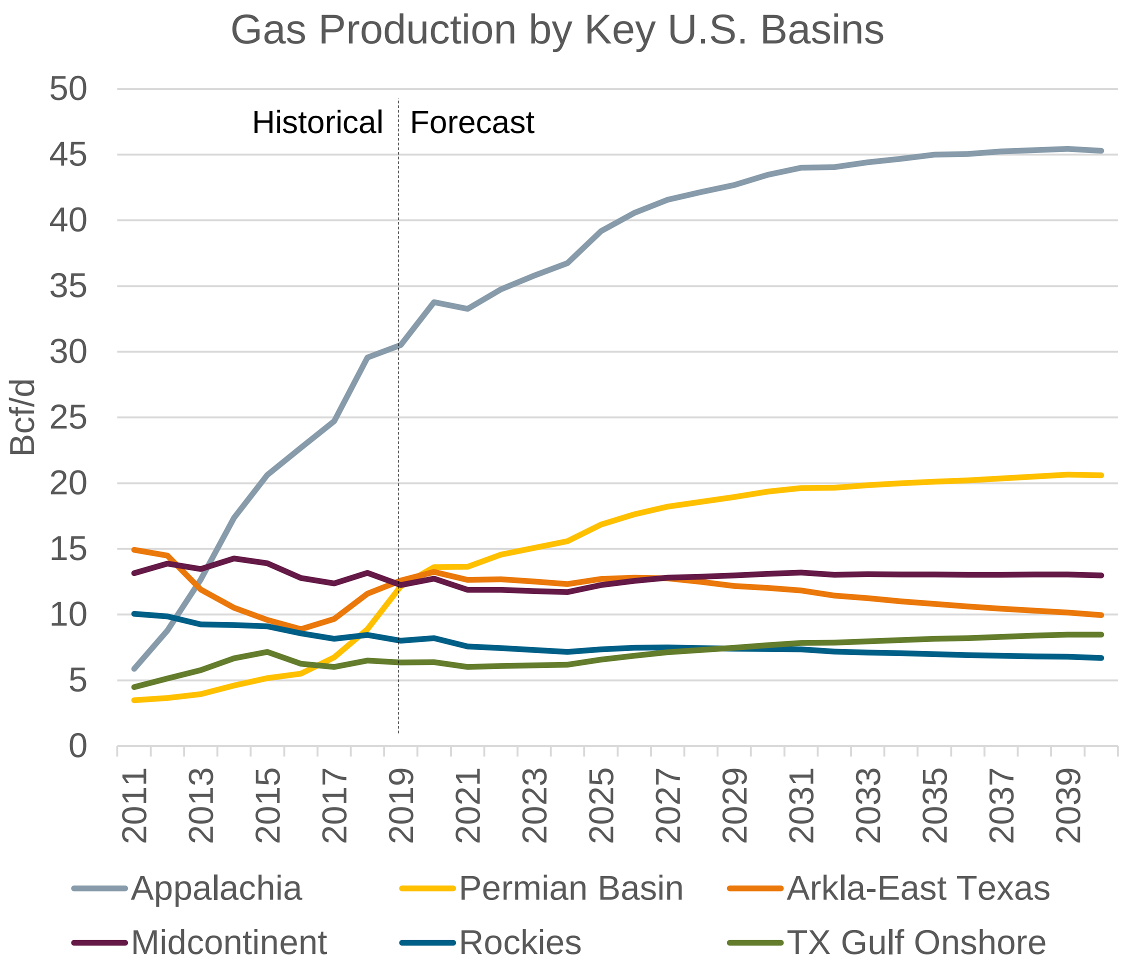
- Appalachia continues to see low breakeven costs due to high initial production from wells in “sweet spot” core acreage areas.
- Permian Basin supply growth is driven by associated gas, which allows gas to be produced at zero or even negative breakeven costs.

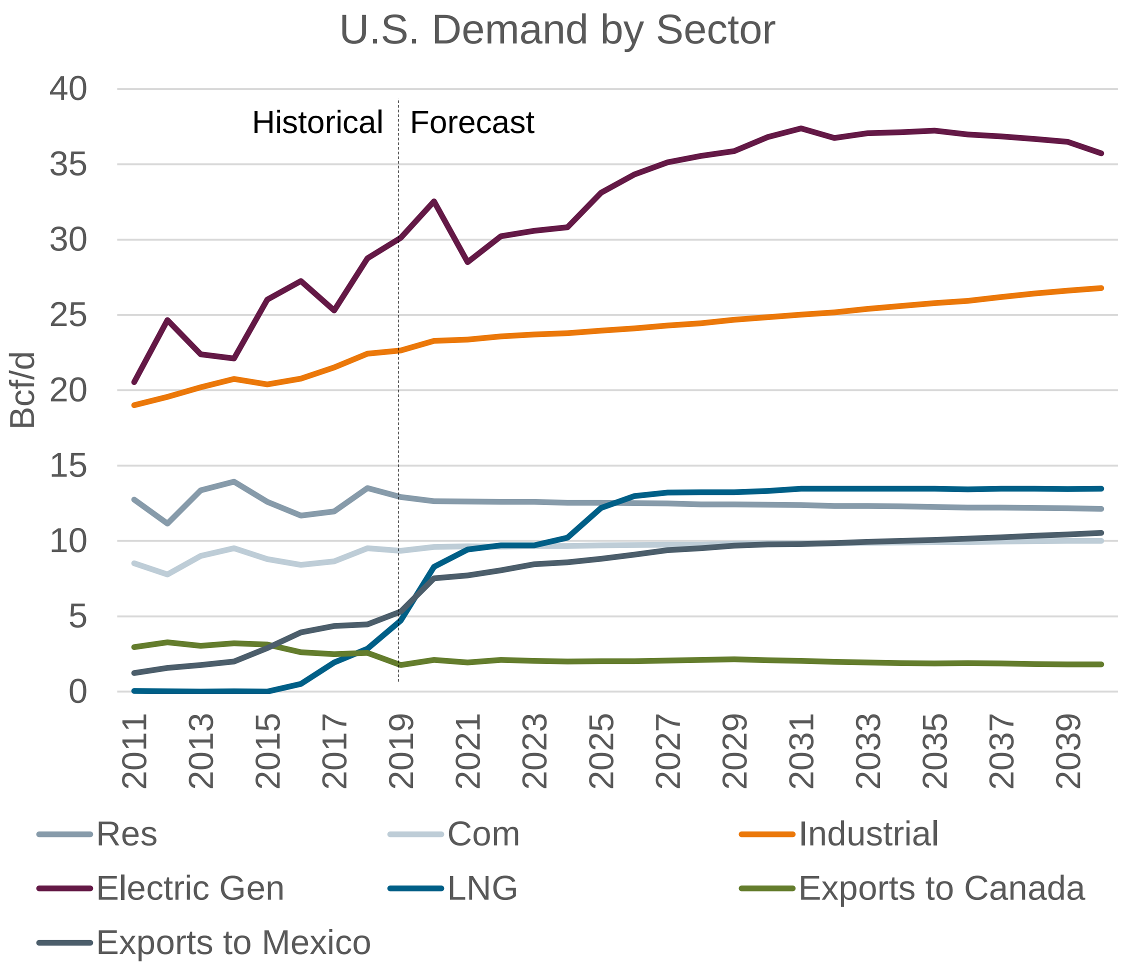
Gas Production by Key Regions (Bcf/d)

	2020	2030	2040	2020-40 CAGR
Appalachia (Pennsylvania, West Virginia, Ohio)	33.8	43.5	45.3	1.4%
Permian Basin (West Texas, New Mexico)	13.6	19.3	20.6	2.0%
Arkla-East Texas (Arkansas, Louisiana, Texas)	13.2	12.0	9.9	-1.4%
MidContinent (Oklahoma)	12.7	13.1	13.0	0.1%
Rockies (Colorado, Wyoming)	8.2	7.4	6.7	-1.0%
TX Gulf Onshore (Eagle Ford)	6.4	7.7	8.5	1.4%
Rest-of-U.S.	9.1	9.3	8.8	-0.1%
Western Canada (Alberta, British Colombia)	17.9	21.0	23.4	1.3%
Mexico	2.4	2.2	2.1	-0.5%



U.S. Natural Gas Demand is Driven by Exports in the Short-Term and by Industrial and Power Gen Demand in the Long-Term

- LNG export facilities are included in the outlook once FID is reached, including the most recent additions comprising a "second wave" (Golden Pass, Calcasieu Pass, and Sabine Pass T6).
- Exports to Mexico grow as pipelines and gas-fired IPP projects are completed in Mexico.
- Industrial demand grows steadily over time.
- Power generation demand is sensitive to gas prices and to competing forms of generation, but is expected to rise to 2030 before tapering to 2040.



Henry Hub Is Expected to Stay Below $3 in the Short-Term, Fundamentals Suggest Longer-Term Price Rises

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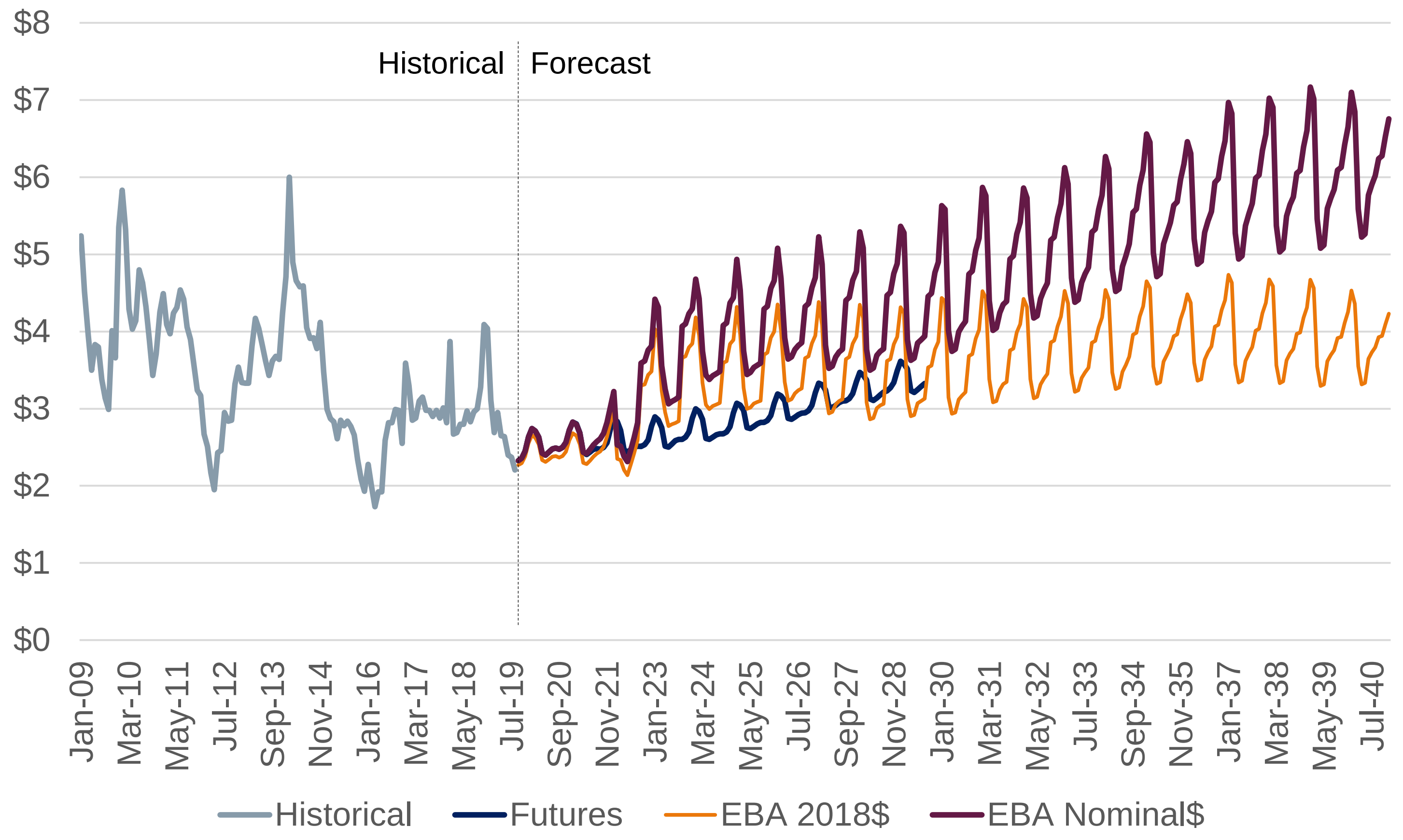
Henry Hub Price History, Futures, and Siemens EBA Forecast



Key U.S. Gas Market Drivers:

- In the short-term, supply outpaces demand, particularly as Permian associated gas reaches the Gulf Coast on new pipelines.
- Note: This price outlook begins with futures then transitions to fundamentals.
- In the medium-term, LNG exports, pipeline exports to Mexico, power generation, and industrial consumption drive up U.S. gas demand -- largely focused on the U.S. Gulf Coast region.
- Longer-term, the fundamentals outlook indicates seasonal prices will compare with history but still average less than $4/MMBtu (in constant dollars).

Potential Natural Gas Market Indices for MLGW Include Gas Hubs on Texas Gas, Trunkline, and ANR Pipelines

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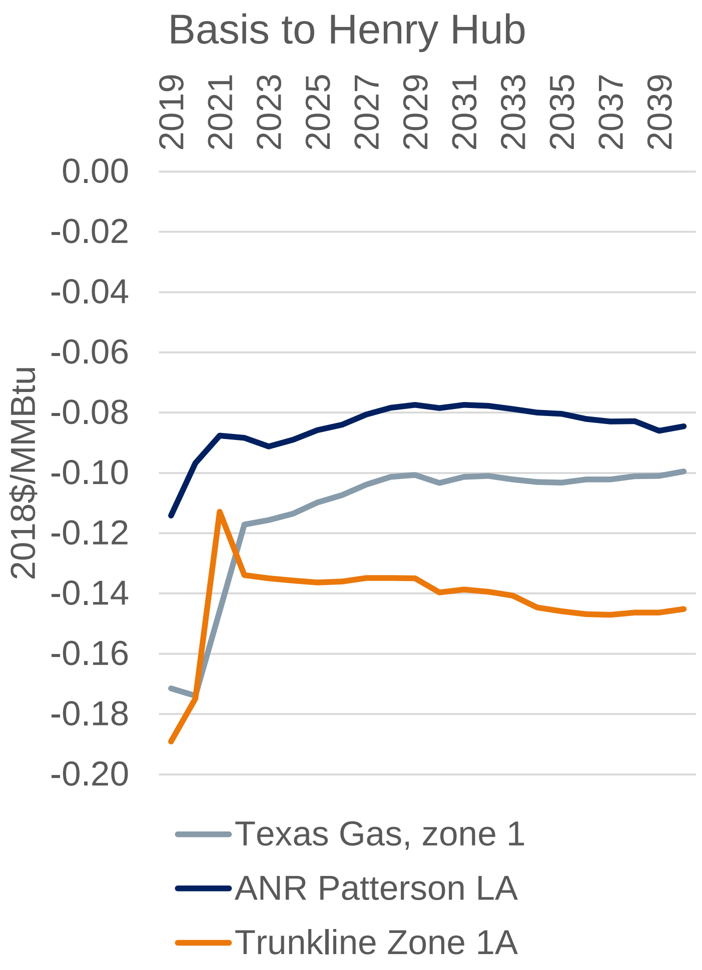
Trunkline: Basis at the Trunkline Zone 1A hub in southwest Louisiana is expected to be lowest of the three hubs (with the exception of 2021) and thus the most favorable index point from the point of view of the consumer. Basis is lower in part due to the 2.2 Bcf/d Permian Global Access pipeline that will deliver gas directly into southwest Louisiana.

Texas Gas: Basis at the Texas Gas Zone 1 hub near Greenville, MS rises from -0.17 to -0.12 (and eventually -0.10) as natural gas demand in the U.S. Gulf Coast increases from exports and power generation.

ANR: Basis at the ANR Patterson LA hub remains slightly less competitive (from the consumer point of view) compared to the other two hubs due to its receipt points (drawing on declining offshore production) as well as its positioning to provide supply to LNG export demand.



Gas Pipelines in MLGW Service Territory

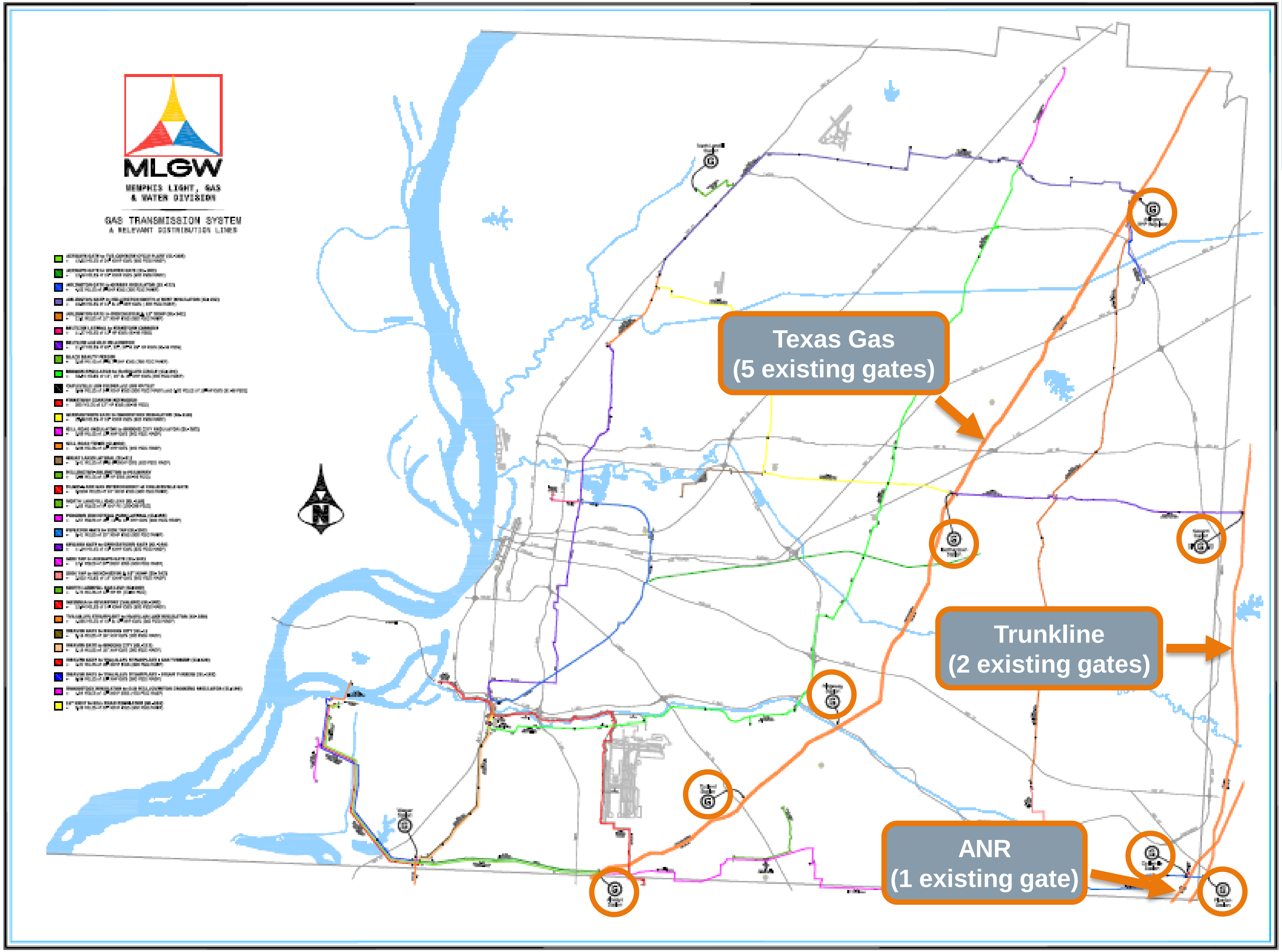
<u>Firm Transport Tariffs:</u>

Trunkline:
Field Zone to Zone 1A
Reservation: $0.2422/Dth*
Usage: $0.0079/Dth
Fuel: 0.88%

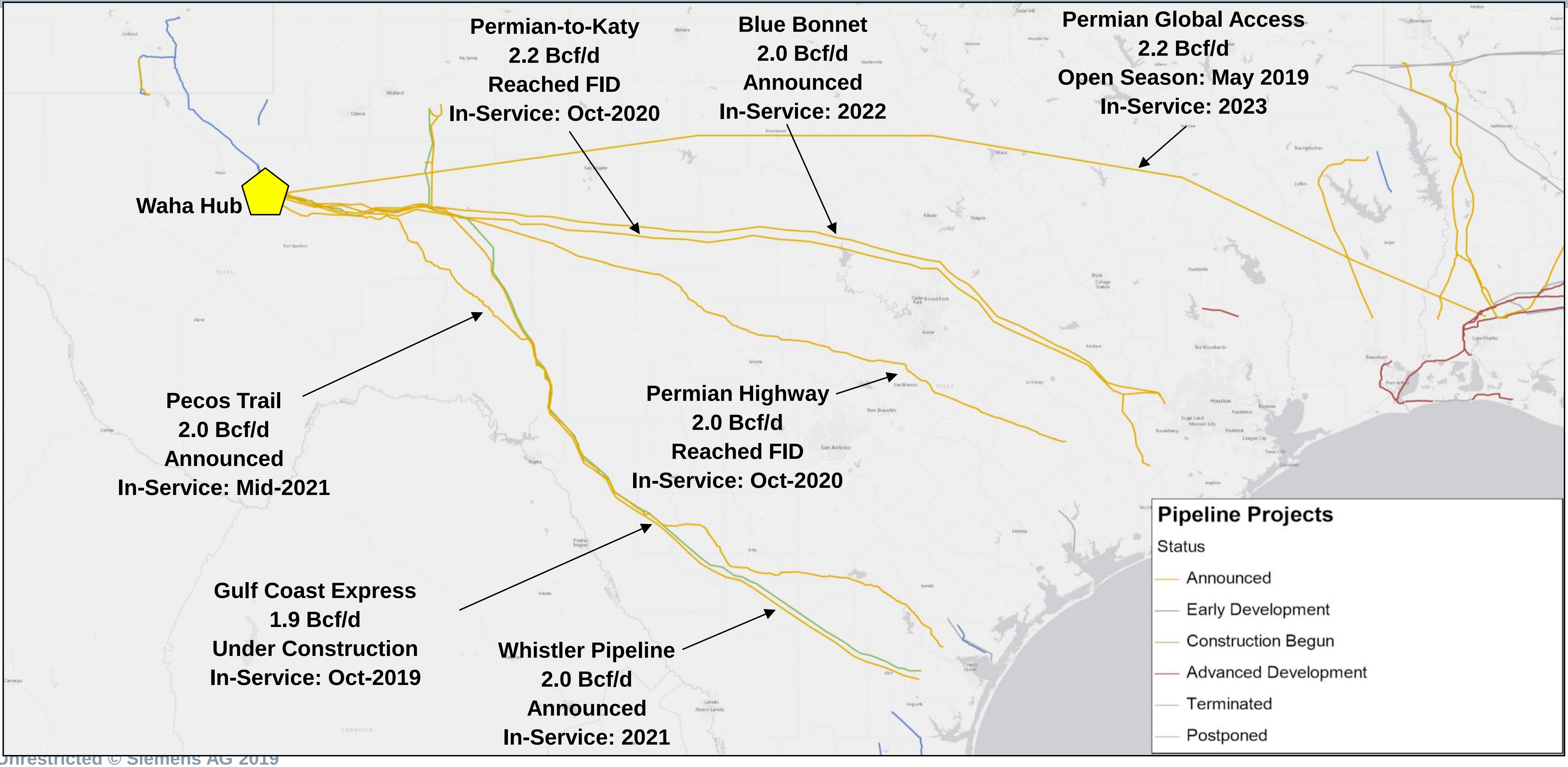
Texas Gas: *SL-1*
Reservation: $0.1552/Dth**
Usage: $0.0355/Dth
Fuel: 0.86%

ANR:
FTS-3 SE to SE Southern
Reservation: $0.1441/Dth***
Usage: $0.0142/Dth
Fuel: 1.46%

* Add $0.02 for EFT
** Add $0.0814 for EFT
*** Add $0.0954 for 2 hr notice



Several Pipelines Are Planned to Deliver Permian Gas to the U.S. Gulf Coast, though Not All May Be Built



Resource Options Updates

Resources Options Recap

Technology	Advanced 2x1 Combined Cycle	Conventional 1x1 Combined Cycle	Simple Cycle Advanced Frame CT	Simple Cycle Aero CT	Coal With 30% CCS	Utility Solar PV - Tracking	Onshore Wind	Lithium Ion Batteries - 4 Hour	Nuclear SMR
Fuel	Nat. Gas.	Nat. Gas.	Nat. Gas.	Nat. Gas.	Coal	Sun	Wind	Elec. Grid	Uranium
Construction Time, Yrs	3	3	2	2	5	1	2	<1	7
Size (MW)	950	350	343	50	600	50	100	20 MWh	50-1,200
Baseload Heat Rate (Btu/kWh), HHV	6,164	6,560	8,704	9,013	9,750	N/A	N/A	N/A	N/A
Average Heat Rate (Btu/kWh), HHV	6,536	7,011	8,704	9,013	9,750	N/A	N/A	N/A	N/A
VOM (2018$/MWh)	1.81	5.01	3.87	5.45	7.14	0.00	0.92	1.39	14.79
FOM (2018$/kW-yr)	15.90	17.41	9.53	15.70	73.45	20.70	36.56	32.21	165.42
CO2 Emissions Rate (Lb/MMBtu)	119	119	119	119	144	0.00	0.00	0.00	0.00
2019 Capacity Factor (%)	60%	55%	10%	10%	85%	22%	44%	15%	85%

Small Modular Reactor Technology

Background

- Technology originally developed for naval/shipping purposes and is being adapted for utility-scale generation; however, not yet demonstrated commercial viability in the US.
- SMRs, like conventional nuclear plants, are carbon-free resources

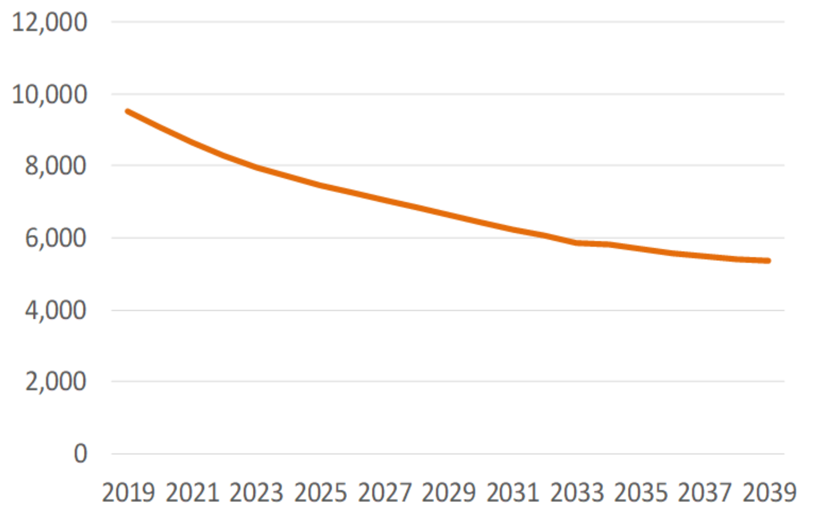
Design Differences

- Employ self-contained systems smaller than traditional nuclear reactors and thus capacity can be scaled by adding modules
  - Modularity permits greater load following capability than typical of conventional nuclear power plants
  - Modules from 10 to 300 MW compared to roughly 900 to 1,200 MW for conventional nuclear reactors
- Most of SMR technology is manufactured off-site in a controlled factory setting
  - May reduce construction cost and duration and risk of cost overruns while increasing quality
  - Designs include safety improvements by using underground containment designs and passive cooling systems

Commercialization

- NuScale Power LLC plans: SMR into commercial operation in Utah, a dozen 50-MW reactors
  - Only company with an SMR design certification pending before the US NRC
- NRC reviewing two SMR pre-applications from BWXT mPower, Inc. and SMR Inventec, LLC.
- Estimated costs are high for initial modules, but expected to decline rapidly with experience

SMR All-In Capital Cost, 2018$/kW



Bellefonte Units 1 and 2 Background

- Owned by TVA and located in Hollywood, Alabama.
- Two partially built 1,256 MW pressurized water reactors and construction suspended since1988, after a combined $6 billion investment.
- Subsequent asset recovery efforts resulted in both Units 1 and 2 being ***approximately 55% and 35% complete*** (mechanical - nuclear island only) respectively.
- October 2013, former TVA Chairman Dennis Bottorff and financier Franklin L. Haney proposed to finish the Bellefonte using private funds and federal tax credits, and in 2015 TVA determined that ***it would be unlikely to need Bellefonte for the next 20 years.***
- May 2016 TVA decided to auction the site, on November 2016, TVA entered into a sales agreement with Franklin Haney’s Nuclear Development LLC (ND) to sell the Bellefonte site and facilities for $111 million.
- On Feb 2019: TVA halt the sale because ND does not have construction permit/operating license from the NRC.
- On May 2019: Federal court rejects TVA move to cancel sale of Bellefonte to ND. Both Units are currently in Deferred Plant Status.
- May 2020: ND projected trial date.
- The NRC has not previously transferred a deferred construction permit on a nuclear plant to a private individual or a company that has not previously operated a nuclear plant.

Bellefonte Key Questions

What are the actual construction costs?

- SNC-Lavalin estimated the Total completion cost projected to be about half of what is projected for a similar size plant in Georgia. estimated completion costs
  - Unit 1 ~ $3 billion
  - Unit 2 ~ $10 billion (a few years later)
- TVA estimated in 2013 (SEC-10k) these costs to be substantially higher and that it would take 7 to 10 years to complete:
  - Unit 1 ~ $7.6 to 8.7 billion
  - Unit 2 ~ $9 billion
- TVA indicated that this 2013 estimate is likely to be low due to the changes in standards and the need to overhaul now outdated technology.

Cost and Financing to Complete Bellefonte Units 1 and 2

Will there be adequate cost support? Reported additional cost support

- The following has been proposed:
  - Over $2 billion in production tax credits obtained from the IRS
  - Negotiating for federal loan guarantees from the DOE to cover 80% of cost
  - Remaining 20% of cost via equity contributions
- ND claims they should be able to finish the reactors at a cost allowing him to deliver power as much as $500 million a year cheaper.
- The transfer of the power to MLGW, will require TVA to provide wheeling or the power to be wheeled to MISO (this is ok under TVA practices) and then the same considerations discussed later in this presentation will apply

Hydro Generation Technology Variants

Types	Description

Reservoir storage	Moderate to large storage capacity behind a dam, generation dependent upon stored volume and head
	• Large Reservoir/ Dam - traditional large scale hydro based on damming river to build an impoundment
	    • Not considered environmentally friendly because of the significant land alterations, impacts on wildlife, etc.
	    • Little to no remaining potential in the lower 48
	• Low-Head Hydro - similar to traditional large dam based hydro, except on smaller scale
	    • Lower head requirement, significant potential remains unexploited

Run of River Hydro	No, or very little, storage capacity behind the dam/ “pondage” with storage for a few hours/ days • Generation dependent on the timing and size of river flows and elevation drop of a river • More common in hilly/ mountainous regions with fast moving rivers, often seasonal
Pumped Storage Hydro	Moderate storage at top and bottom of elevations • Allows off-peak electricity to pump water from a river or lower reservoir to a higher reservoir to allow its release during peak times • Requires reasonable elevation difference between reservoirs
Hydrokinetic	Essentially a propeller generator anchored to the river floor over which water flows • A few U.S. projects, the most notable is in the East River, high capital and operating costs have slowed development. • February 2019 FERC study for a 70kW system in Alaska estimated levelized energy costs could exceed other local options by $322/ MWh with a total system energy cost of $787/MWh • June 2019 the U.S. DOE Advanced Research Projects Agency (ARPA) released an RFI seeking industry insight into this technology

Initial LTCE Results

Supply Options

- **Self Supply Strategies**
  - **Self Build – On Hold**
    - Select and screen various resource self-build options with input from MLGW on the various types of generation technologies, demand-side and energy efficiency, and other known available capacity and energy alternatives.
  - **Self Build + MISO**
    - Select and screen any combination of self-build and MISO market transactions to maximize cost savings to MLGW over the study period.
- We present next the initial results of the Self Build + MISO.
  - The Results are representative of an initial “unconstrained” optimization and provides information on what constraints should be in place for a practical application.

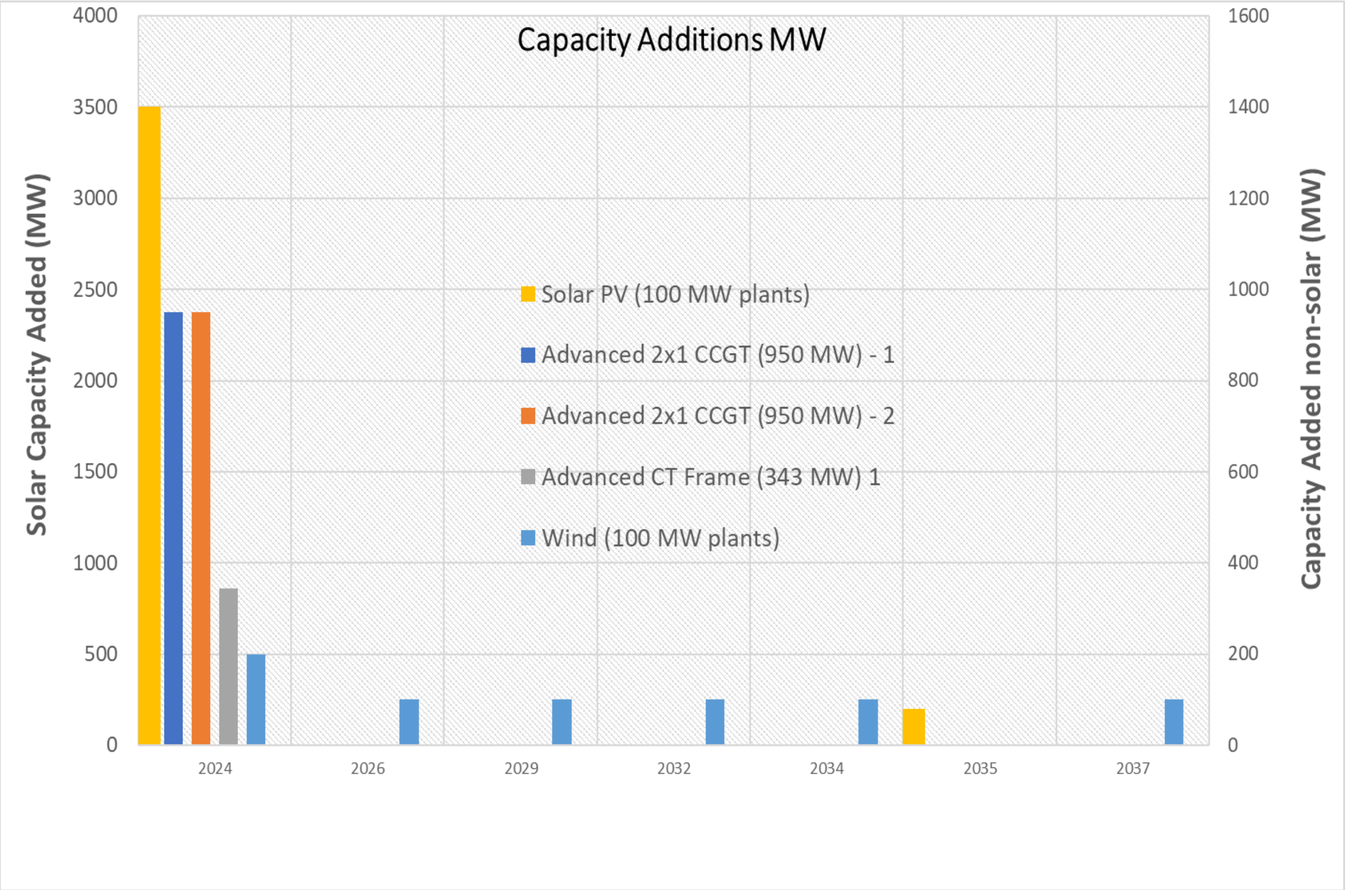
LTCE Requirements

- **RPS (Renewable Portfolio Standard)**
  - The Memphis Area Climate Action Plan calls for decarbonizing the electric grid with renewable energy, increasing the percentage of carbon-free energy in electricity supply from the baseline of 60% in 2020 to 75% by 2035 and 100% by 2050, focusing on renewable sources such as solar and wind.
- **CO2 Emissions**
  - Reduce emissions 21% by 2020, 54% by 2035, and 81% by 2050. We modeled annual emission targets based off the slopes from the targets from 2020 to 2035 and from 2035 to 2050. We used the 2016 Business as Usual Emissions from the 2019 Memphis Area Climate Action Plan to baseline our emission targets.
- **Reserve margin target**
  - We set a minimum installed capacity requirement of 15%, which is the same reserve margin that Tennessee Valley Authority uses.

Objective: Increase the percentage of carbon-free energy in our electricity supply to 75% by 2035 and 100% by 2050, focusing on renewable sources such as solar and wind

Results of the Long Term Capacity Expansion Plan (LTCE)

- The LTCE identified a Portfolio made of two large Combined Cycle plants, one Simple Cycle Gas Turbine, Solar PV, 37 x 100 MW solar plants and 7 x 100 Wind Turbine plants.



Year	Advanced 2x1 Combined Cycle	Advanced Simple Cycle Frame CT	Solar	Missouri Wind	Total MW
2024	1900	343	3500	200	5943
2026	0	0	0	100	100
2029	0	0	0	100	100
2032	0	0	0	100	100
2034	0	0	0	100	100
2035	0	0	200	0	200
2037	0	0	0	100	100
Total	1900	343	3700	700	6643

The Portfolio is Made of Combined Cycle Plants, Simple Cycle Gas Turbines Solar PV and Wind Turbine Generation.

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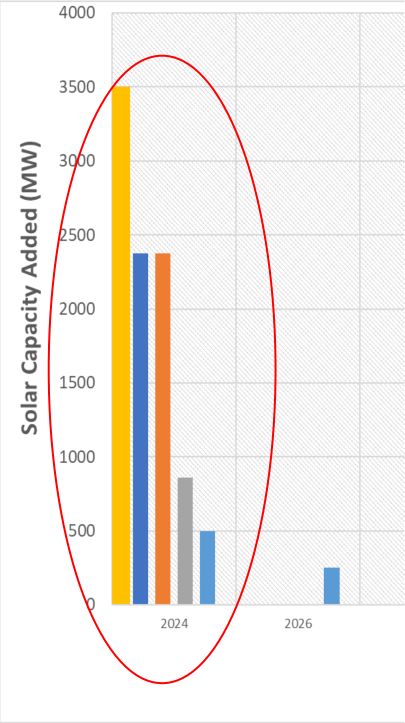
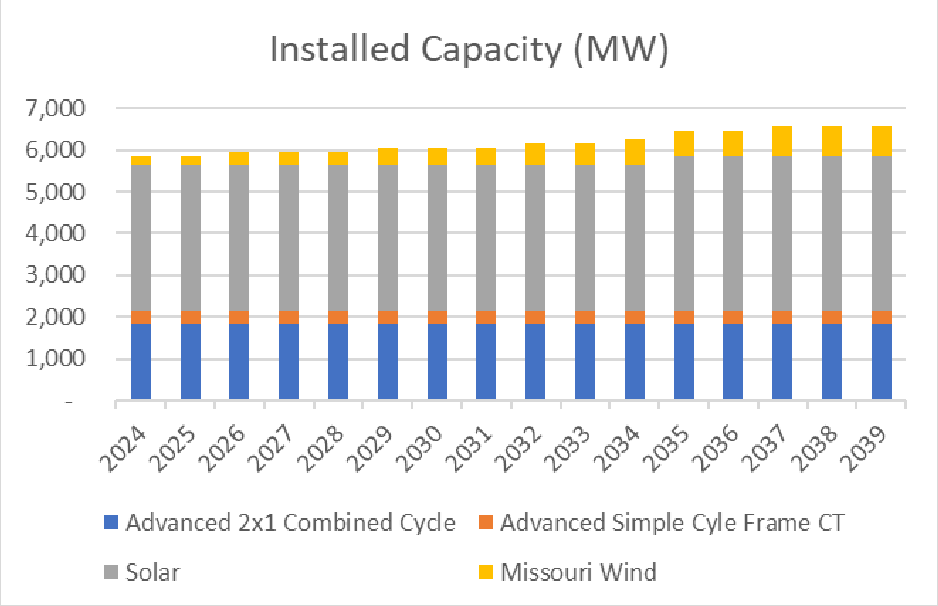
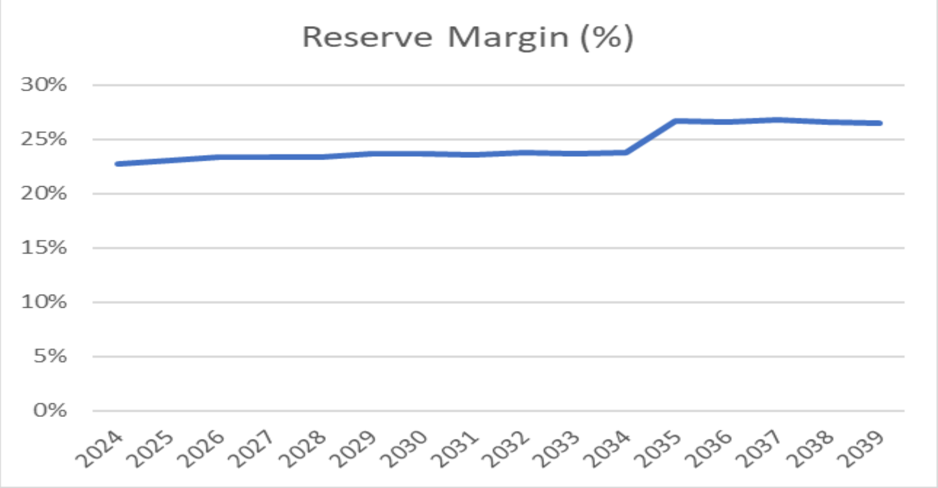


- The LTCE is installing almost everything it needs in the first year it can; 2024.
- This seems to be “bound” by meeting the renewable target of 65% by 2024
- We also see this situation with flat or declining load, combined either with aging generation fleet that is to retire as soon as possible, or as in the case of MLGW, that there is no pre-exiting generation and the optimization is free to install or purchase as required.
- Another aspect to be noted is that the optimization is installing more generation than required to attend MLGW load but this is compensated by sales into MISO; (Cost of Supply = Total Fleet Cost + Purchases – Sales).
- This rises various questions:

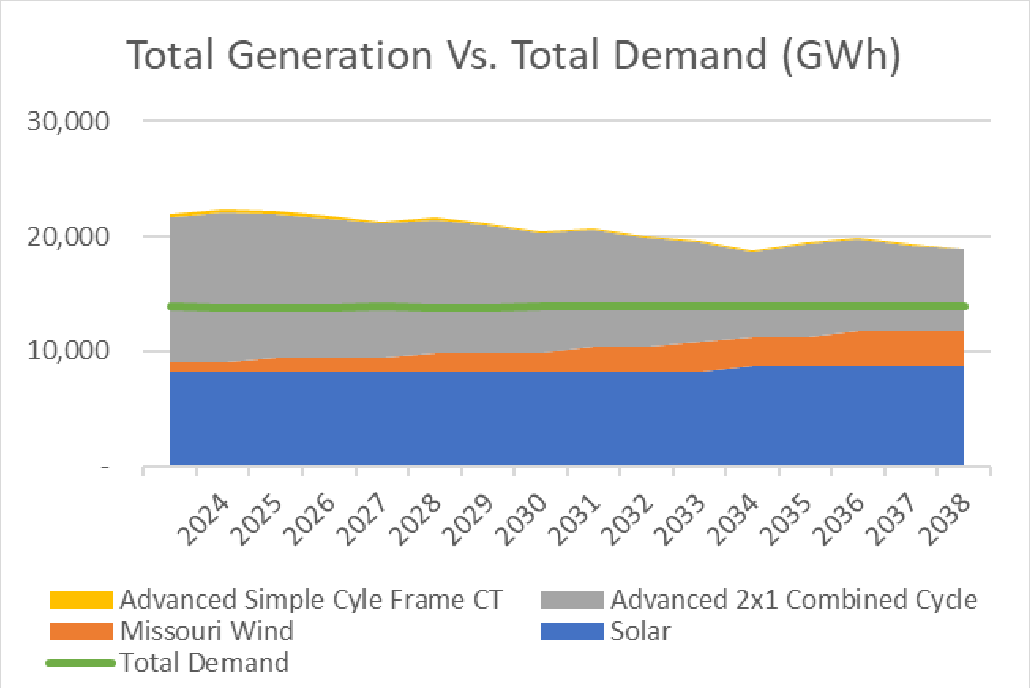
  a. What are the practical limits of installations per year? Clearly less than what was selected by the LTCE.
  b. Can the RPS targets be relaxed to achieve a more realistic installation rates?
  c. What are the limits on capital expenditure by MLGW, if any?
  d. Is it a valid strategy to over install to sell into MISO and lower the supply costs?

LTCE Results - The Portfolio is Oversized for the MLGW Demand Alone

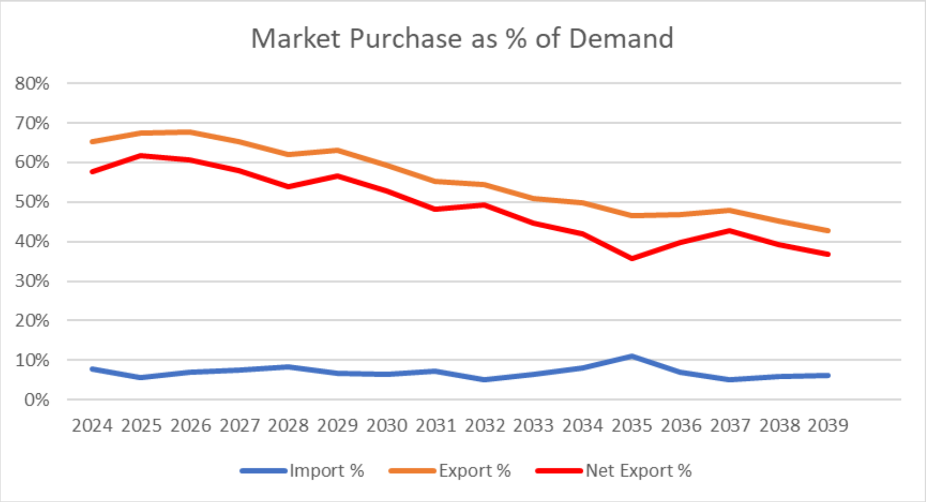


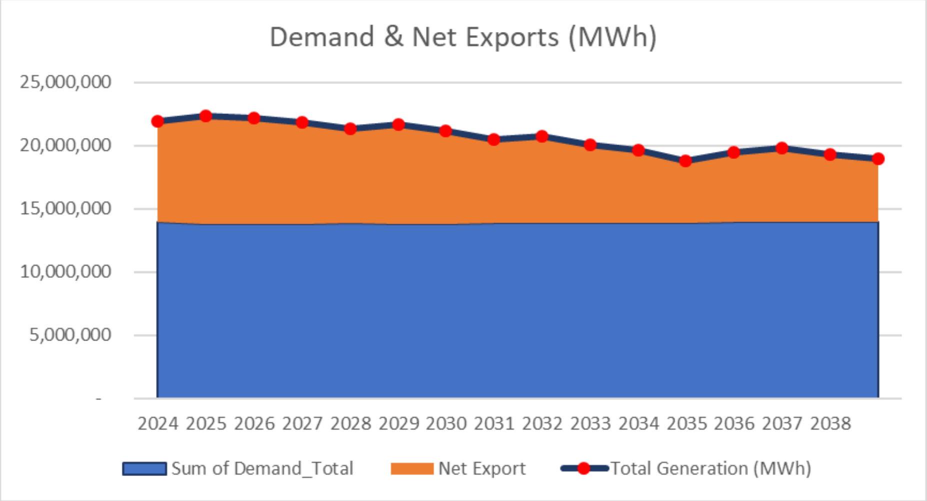


- Under this LTCE, installed Capacity results in a reserve margin of 23%, increasing to 27%, which is much higher than 15% required.
- The energy production is greater than the demand for all years, resulting in net sales.
- There is no energy not served or loss of load hours (LOLH)



LTCE Results - Market Transactions

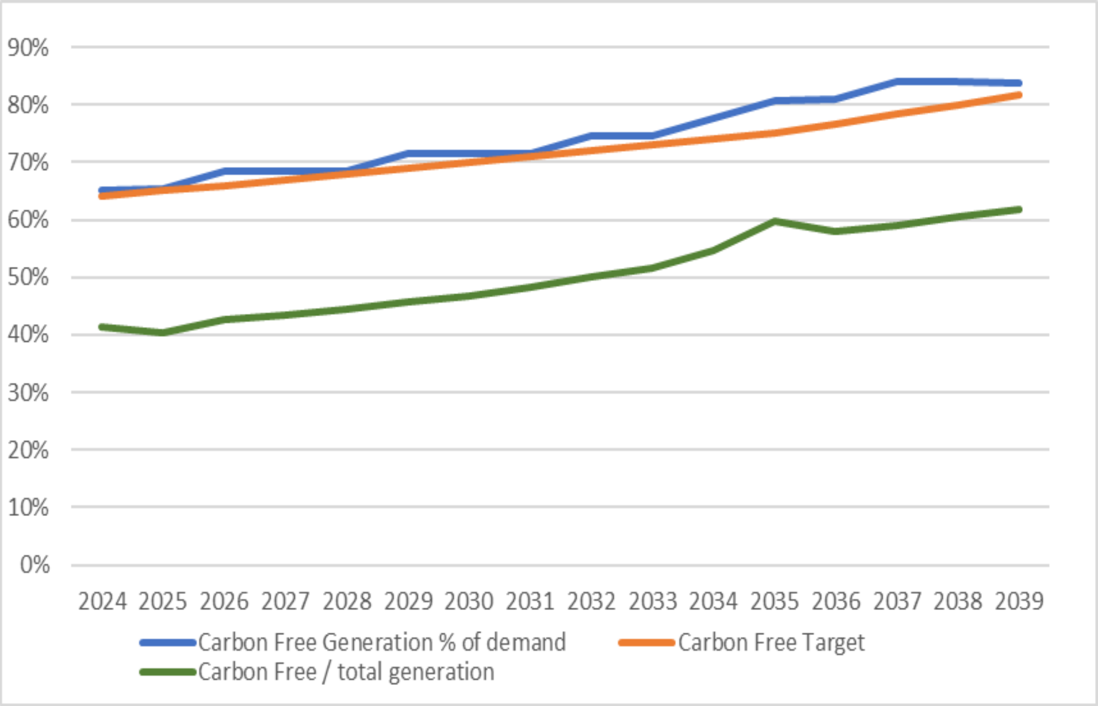




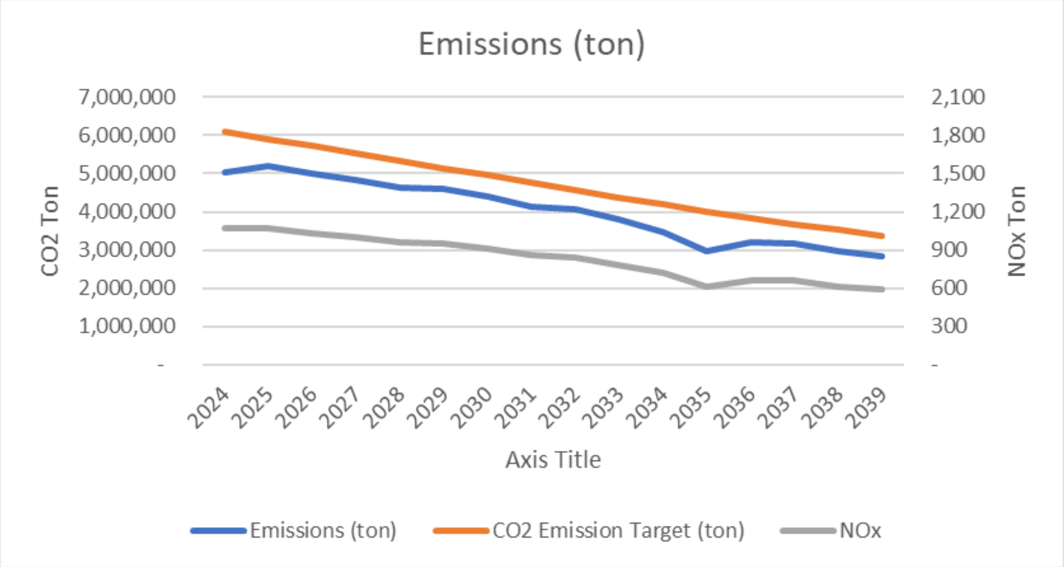
- Under this LTCE, MLGW exports excess energy into the market.
- The exports reach almost 70% of the internal MLGW demand but drop over time as the combined cycle plants dispatch less.
- There are some smaller levels of import (less than 10% of the MLGW demand), so there are net sales into the market starting at close to 60% of MLGW demand and dropping to 40% by the end of the period.
- The sales into MLGW however are flat as shown in the figure to the left.

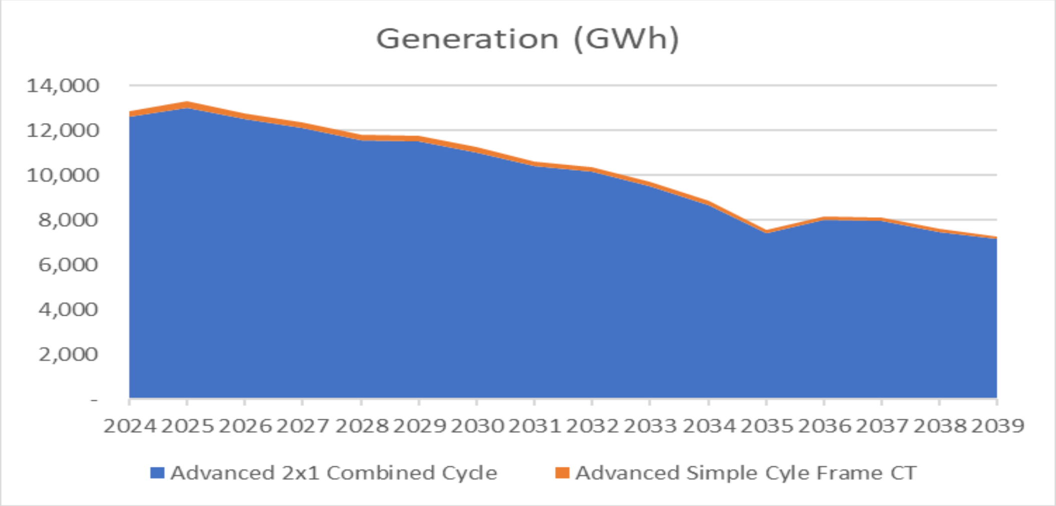
LTCE Results - Renewable / Carbon-Free Energy

- The Memphis Area Climate Action Plan calls for decarbonizing the electric grid with renewable energy, increasing the percentage of carbon-free energy in electricity supply from the baseline of 60% in 2020 to 75% by 2035 and 100% by 2050, focusing on renewable sources such as solar and wind. (*Note: it's not part of the base case*)
- The portfolio meets this target when expressed renewable energy divided as a percentage of MLGW total energy load.
- When expressed as a percentage of the total generation in MLGW (including sales), the percentage is below the target.
- Is this okay, provided that the internal supply meets the target?



CO2 Emissions (tons)

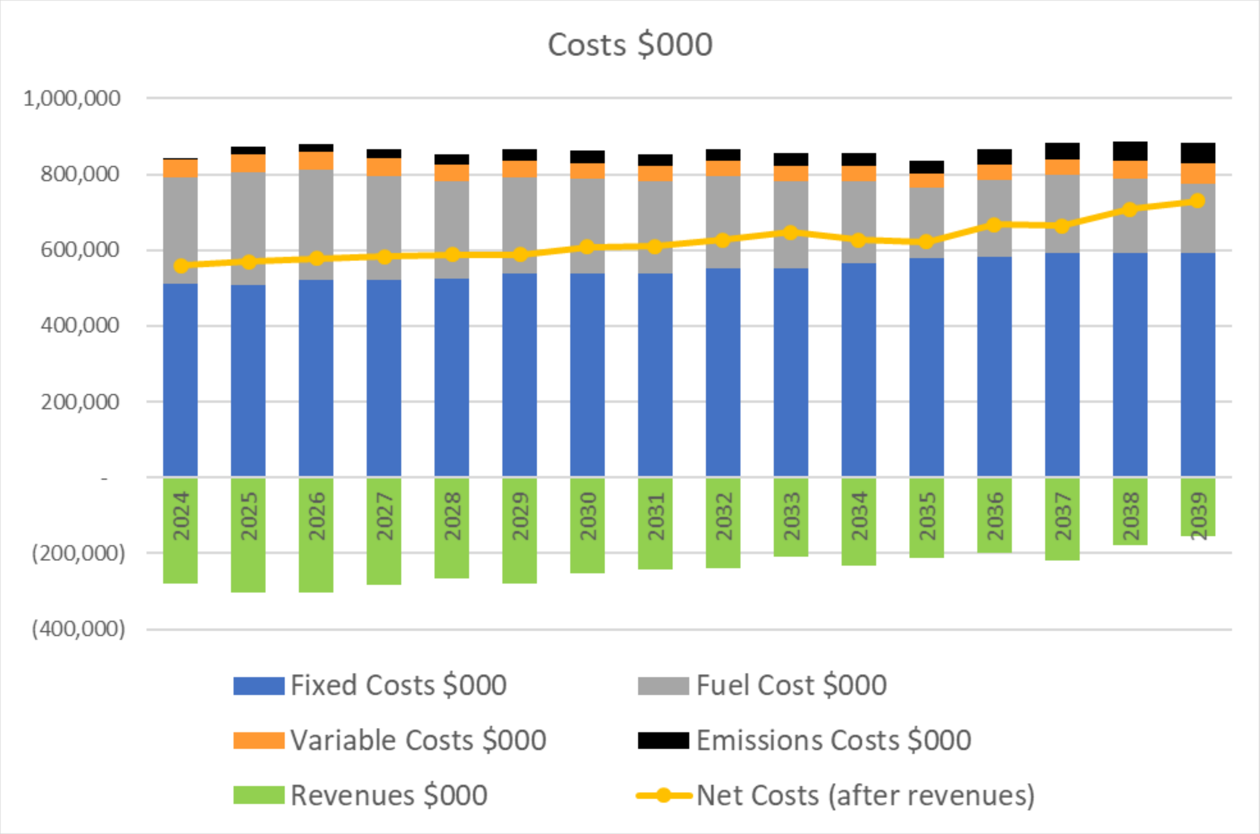


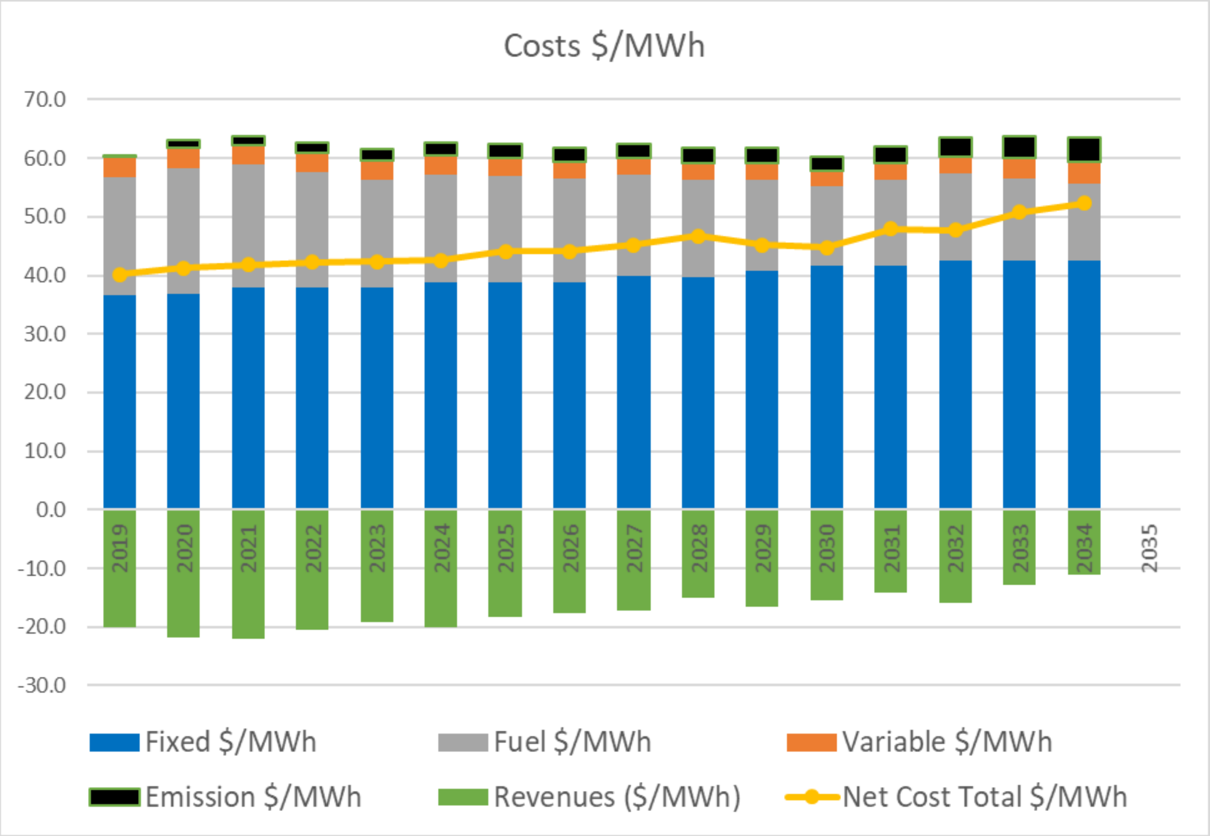


- The Memphis Area Climate Action Plan calls for reducing Memphis area's stationary energy CO_2 emissions by 21% by 2020; 54% by 2035; and 81% by 2050. Year 2016 is the baseline with 7,900,671 tCO_2e.
- The Generation Portfolio meets this target with a good margin, due to the fact that the generation from the Combined Cycles is dropping over time.
- Other effluents (NOx) are also reduced.
- Are the Emission Limits, driving down the production from efficient low emission units?
- Would be valid to see the exports in the context of the overall MISO or the generation (e.g. coal) displaced?

LTCE Results - Portfolio Costs and NPV ($000)

Under this LTCE run, the net cost after market revenues are $623 million per year (real), increasing towards the end of the period due to the reduction in dispatch of the thermal units.
This results on an average cost of generation of $ 45/MWh rising towards the end to $ 52/MWh





LTCE Results - Portfolio Costs and NPV ($000)

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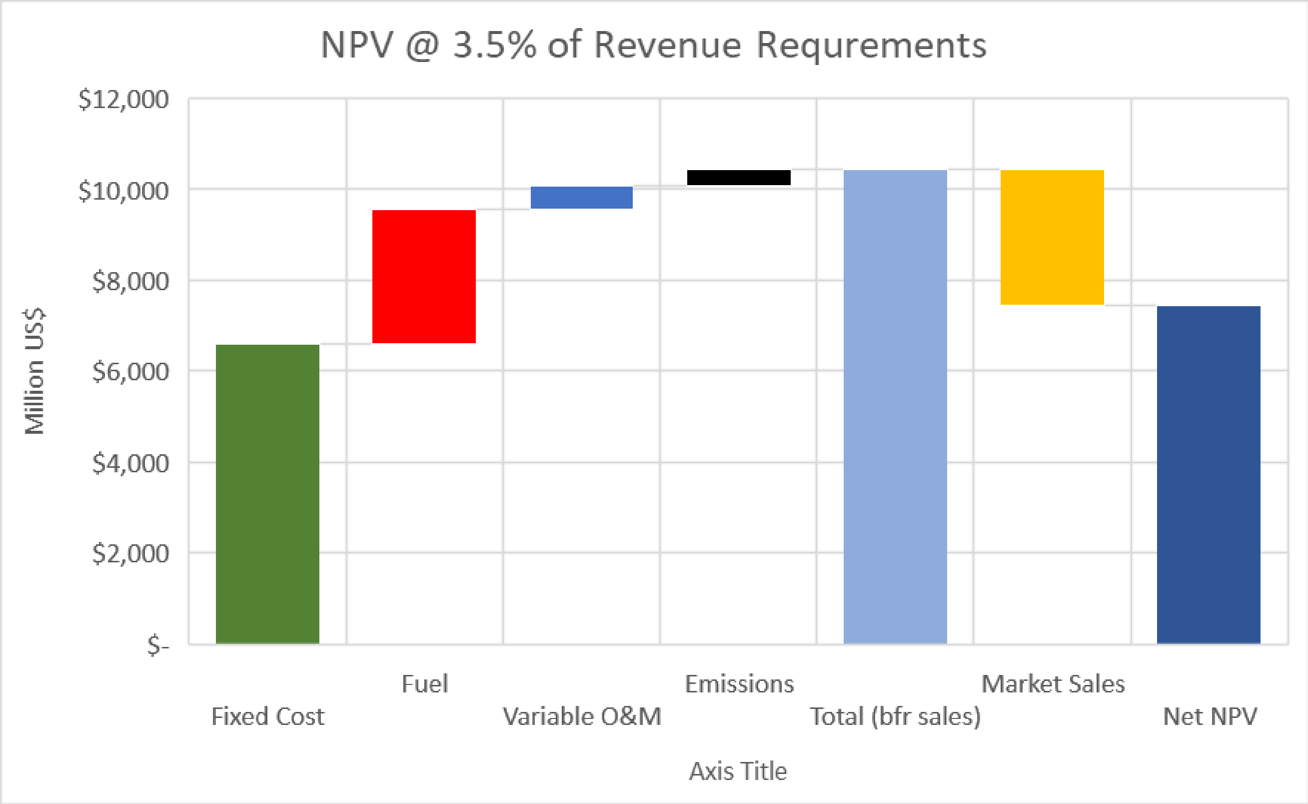
Under this LTCE run, the NPV of the total costs is $ 7.6 Billion, where we observed that the highest contributor is the Fixed Costs (mostly investments in renewables), followed by fuel and Market Sales represent 40% reduction in the total costs.

NPV @ 3.5% of Cost($ Million)

Fixed Cost	$	6,601	89%
Fuel	$	2,944	39%
Variable O&M	$	533	7%
Emissions	$	369	5%
Total (before Mkt sales)	**$**	**10,447**	**140%**
Market Sales	$	(2,990)	-40%
Total (after Mkt sales)	**$**	**7,457**	**100%**



Transmission Discussion

Transmission Discussion

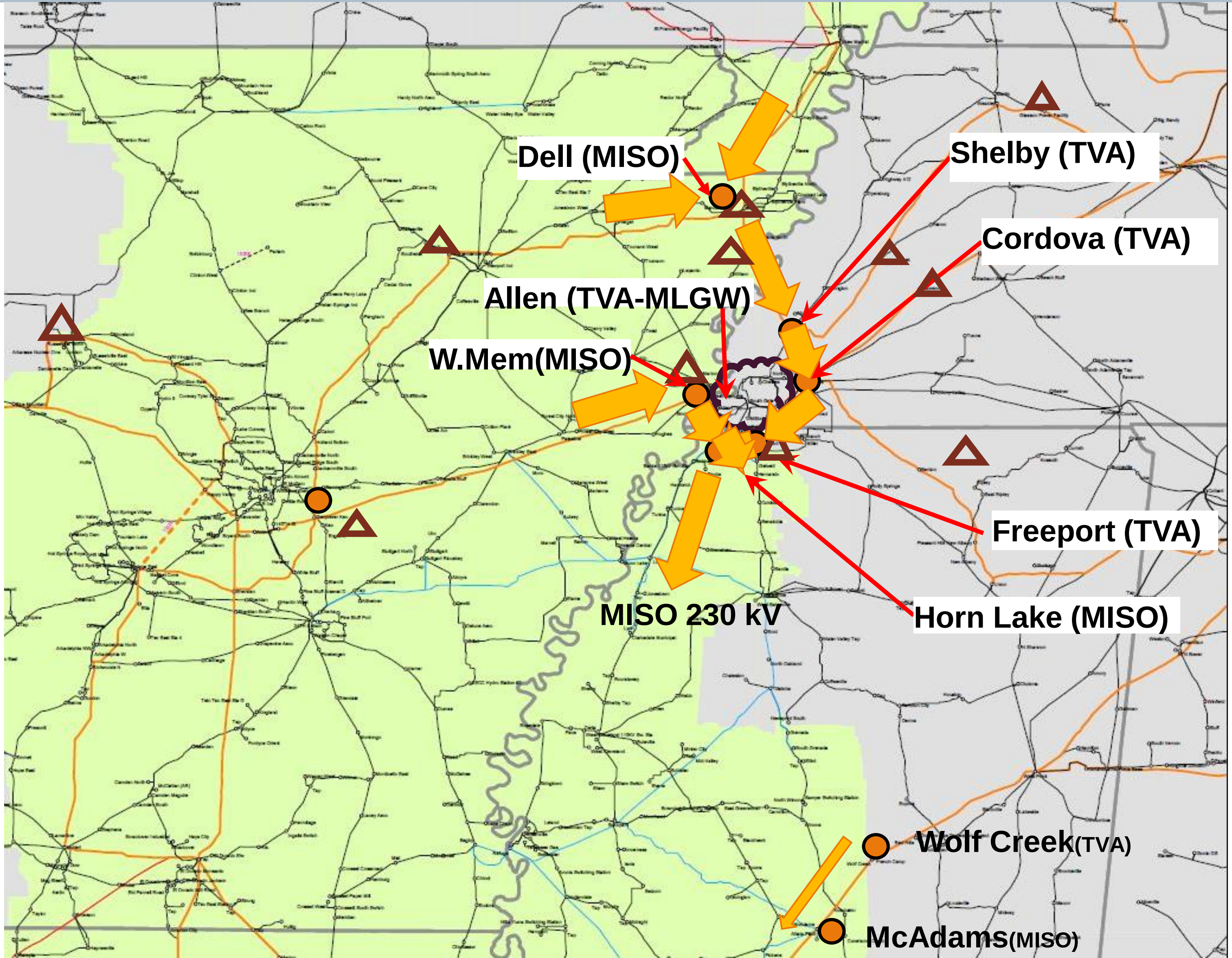
- Understanding from Siemens' discussion with MISO:
  - MLGW and Siemens had a conversation with MISO on the opportunity to join MISO
  - It was identified that a physical connection to MISO is required to join as a MISO Transmission Owner (TO)
    - MISO does not have position on the capacity on the interconnection.
    - Historically this interconnection should be sufficient for the "firm" imports required to reliably serve the load.
    - Total capacity of interconnection needs further investigation with TVA/MISO
    - Cost of transmission mostly responsible by MLGW
    - Small membership fee
  - A physical interconnection is not required to join as a "Load Serving" member but in this case TVA would need to accept to provide "Wheeling". (see next)

Transmission Discussion

SIEMENS

- Understanding from Siemens’ discussion with TVA that:
  1. Physical connection is required for MLGW to join MISO
     - Reliability needs to be as good if not stronger than present
     - Detailed cost assessment is necessary
  2. Three outcomes to be considered:
     - **Deal:** TVA provides wheeling & MLGW makes up the balance of customer’s hole by Exit fees & wheeling payments (can be controversial). Minimal connection to MISO needed
     - **No Deal:** MLGW disconnects completely from TVA; more expensive for MLGW due to lack of mutual support with TVA , TVA customers will see a rate increase and their system not as reliable as it could be. Multiple duplicated facilities around MLGW system.
     - **Middle Ground:** MLGW makes a stronger connection, pays some services to TVA for parallel flows and support. TVA customers see reduced impact and both system increase reliability. There would be market dispatch flows between MLGW & TVA.

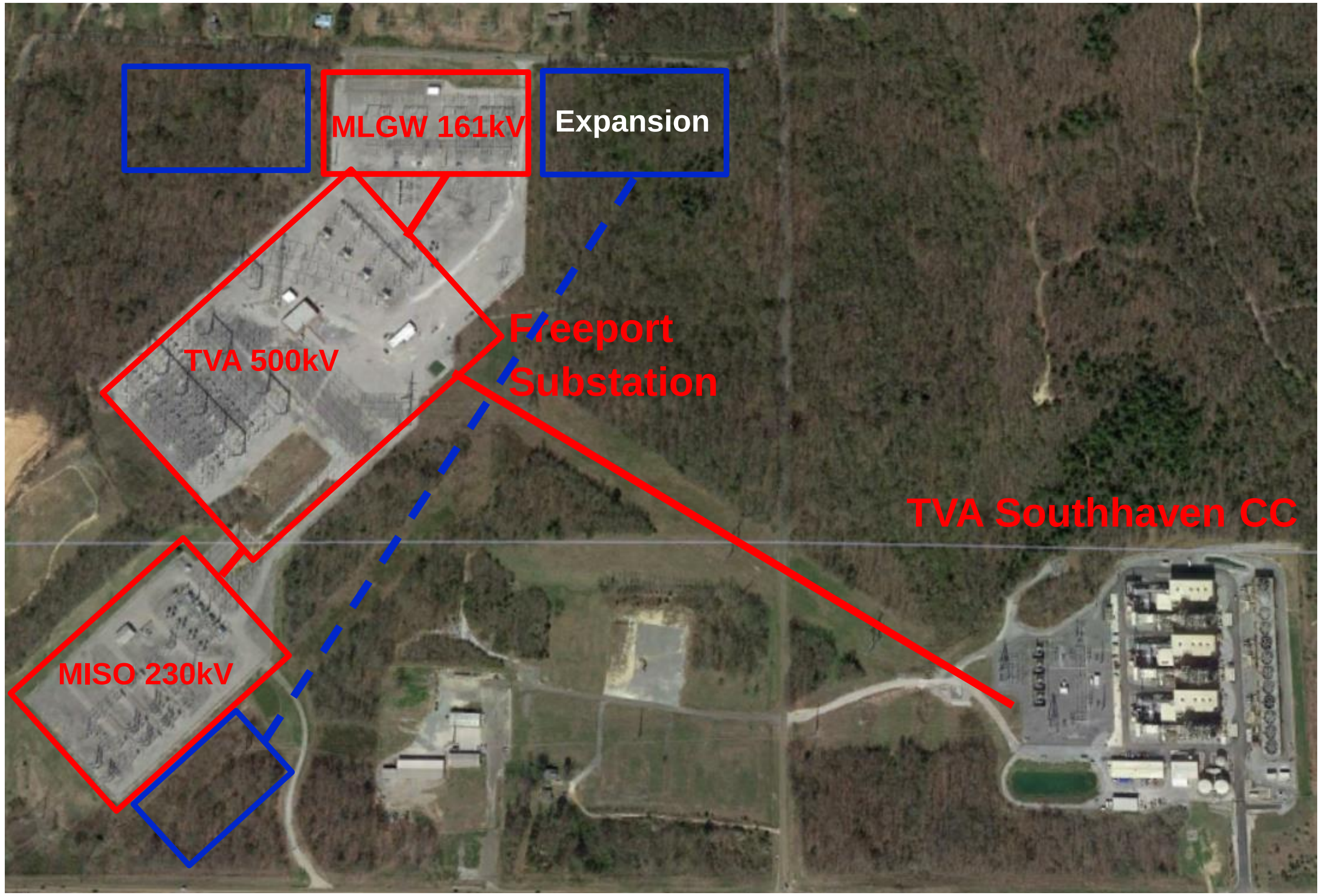
Transmission Parallel Flows



- Under normal conditions, there are power flowing from MISO to TVA and back to MISO.
- These are parallel (loop) flows and normal in operations.
- Examples:
  - Dell (MISO) to Shelby -Cordova - Freeport (TVA) to Horn Lake - Twinkle Town (MISO) – Stronger if generation near Freeport is out.
  - West Memphis (MISO) to Birmingham Steel – Freeport (TVA) to Horn Lake (MISO)

Interconnection Opportunities

- Freeport Substation



- 500 MVA potential capacity
- Available space for new breakers and transformer
- Estimated cost $8 m*.

**Cost estimate is subject to refinement*

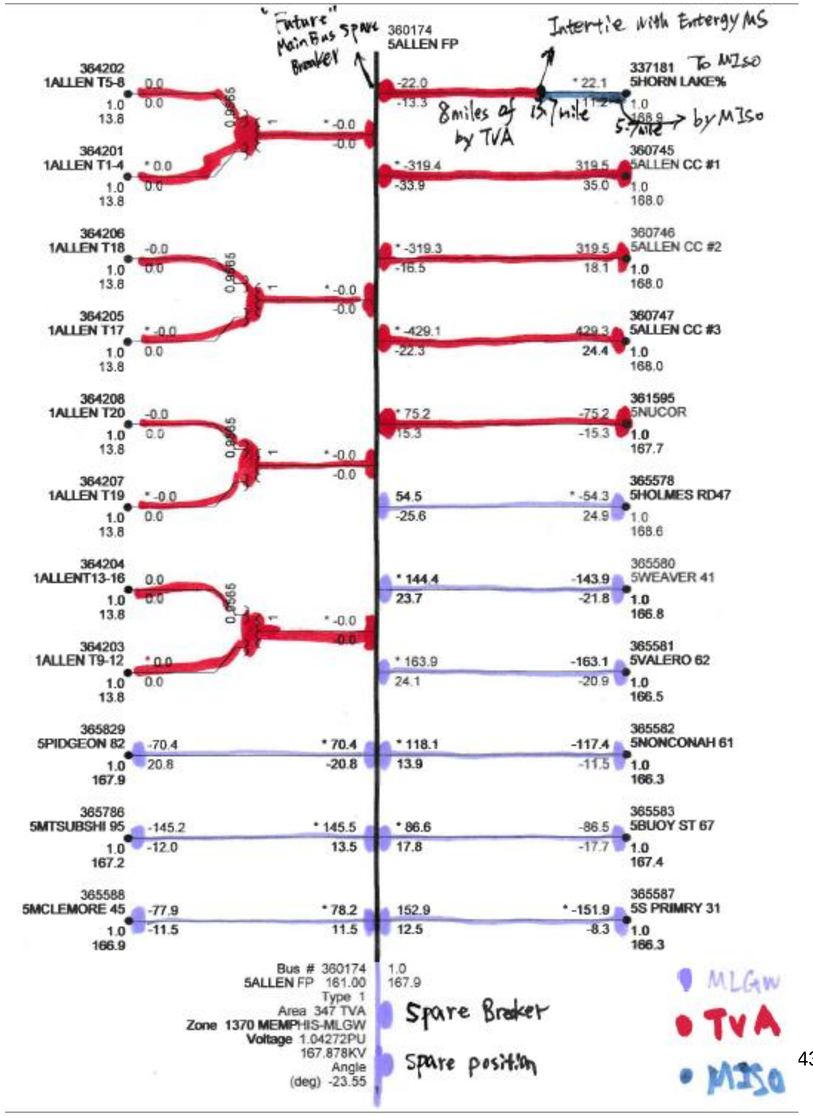
Interconnection Opportunities

- Allen Option 1:

Purchase 8 miles Allen to TVA-Entergy Intertie161 kV line from TVA to create Allen (MLGW) to Horn Lake (MISO) connection or build new 8 miles line above (200~500 MVA potential capacity, est. cost $5~11 m*)

- Allen Option 2:

Build ~4.5 miles 500 kV line from West Memphis to Allen (include MS river crossing and new transformer) (1700 MVA potential capacity, est. total cost $ 45 m*)



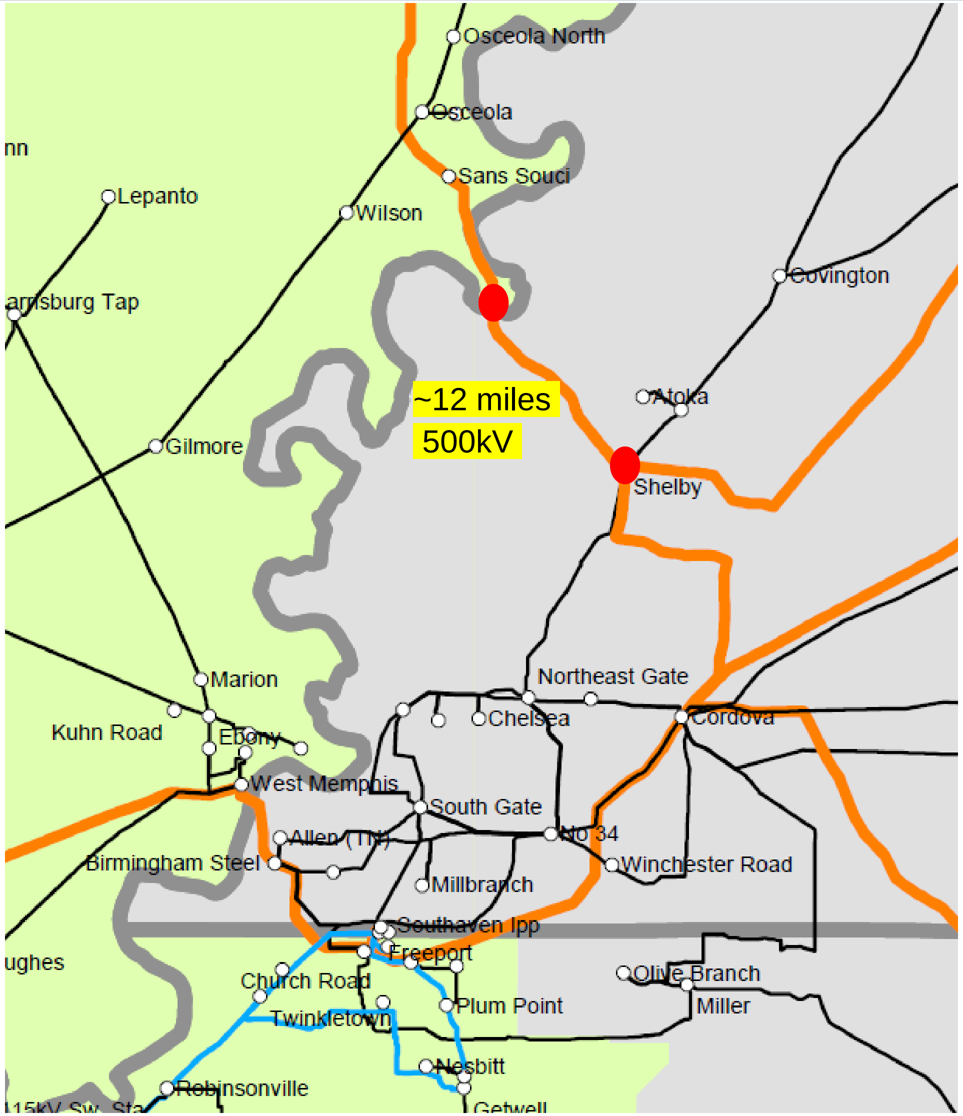
43

*Cost estimate is subject to refinement

Interconnection Opportunities

SIEMENS

- Shelby 500 kV Options
  - Purchase ~12 miles 500 kV line from TVA-MISO intertie to Shelby and two 500/161 kV transformers from TVA, ~2500 MVA capacity, est. cost $30~35 m*.
  - Build new ~12 mile 500 kV above including river crossing and two new 500/161 kV transformers, new substation, ~2500 MVA capacity, est. cost $90 m*.



*Cost estimate is subject to refinement

Breakout Session

Breakout Session

Demand Forecast Topics

1. Our Base Load Forecast (before EE and Distributed Resources) shows a flat to very slightly increasing load over the long term. Is this consistent with PSAT expectations? If not how would you see the load to evolve?

2. EV forecasts and electrification in general show a very modest levels of adoption. What are the PSAT views on this? Are the base forecast too conservative?

3. EE programs require objectives / mandates and funding. What is the PSAT opinion on effective programs for EE, levels of reduction?

4. What are the views on levels of rooftop solar? Our forecast again is showing very low impact. Note that this is different than community solar which can be utility scale.

Breakout Session

Gas Topics / Supply Topics

1. Gas forecast identify the possibility of developing large combined cycle plants within the MLGW territory possibly towards the east. Provided that issues related to water use are addressed, does the PSAT have views or concerns of developing these plants in this area?
2. Small Modular Reactors (SMR) were investigated as well as hydro kinetic. It seems that SMR could become feasible in the future, but it is unlikely to be selected. Same with hydro. Would the PSAT have concerns if these options are dropped?
3. What are the main concerns about the Bellefonte option in the PSAT opinion?

Long Term Capacity Expansion Topics

1. The plan without constraints is installing most of the new generation in the first year. Does the PSAT agrees that we need to define practical limits? Can the RPS targets be relaxed to achieve a more realistic installation rates?
2. Should there be limits on capital expenditure by MLGW, even if this drives higher long term costs?
3. Is it a valid strategy to over install to sell into MISO and offset the supply costs?

Breakout Session

Long Term Capacity Expansion Topics

1. Does a new generation mix largely driven by combined cycle units, PV and wind be within the expectations of the PSAT? Is there something missing that should be added as “hard wired”, storage?
2. Would it be acceptable to have a total generating fleet where the ratio of total renewable energy to total energy produced is less than the RPS, provided that the ratio of renewable to load is at or above the RPS?
3. How should the CO_2 limits be applied? Does this apply to energy that is produced internally but sold into MISO market?

Glossary

Glossary

- All-in Capital Cost = The capital costs for building a facility within the plant boundary, which includes equipment, installation labor, owners costs, allowance for funds used during construction, and interest during construction.
- Appalachia Basin = Marcellus Shale Play and Utica Shale Play.
- Average Demand = Average of the monthly demand in megawatts.
- Average Heat Rate = The amount of energy used by an electrical generator to generate one kilowatt hour (kWh) of electricity.
- Baseload Heat Rate = The amount of energy used by an electrical generator to generate one kilowatt hour (kWh) of electricity at baseload production. Baseload production is the production of a plant at an agreed level of standard environmental conditions.
- Breakeven Cost = Average price of gas required to cover capital spending (ideally adjusted to regional prices).
- BTU = British Thermal Unit = unit of energy used tipicaly for fuels.
- CF = Capacity Factor. The output of a power generating asset divided by the maximum capacity of that asset.
- CC = Combined Cycle
- EE = Energy Efficiency
- CCS = Carbon Capture and Sequestration
- CT = Combustion Turbine
- DER = Distributed Energy Resources, distributed generation, small scale decentralized power generation or storage technologies
- DS = Distributed Solar
- Dth = Dekatherm (equal to one million British Thermal Units or 1 MMBtu)
- EFT = Enhanced Firm Transportation (varies by pipeline but can include short- or no-notice changes to day-ahead nominations of fuel delivery
- FID = Final Investment Decision
- FOM = Fixed operations and maintenance costs
- FT = Firm Transportation. FT capacity on a natural gas pipeline is available 24/7 and is more expensive than interruptible transportation (IT) capacity but unused FT capacity can be sold on secondary market.
- Futures = Highly standardized contract. Natural gas futures here are traded on the New York Mercantile Exchange (NYMEX) or Chicago Mercantile Exchange (CME).
- GT = Gas Turbine
- PPA = Power Purchase Agreement; contract to purchase the power from a generating asset
- IPP = Independent Power Producer
- IRP = Integrated Resource Plan

Glossary

- LNG = Liquified natural gas
- LOLE = loss of load expectation
- LOLH = loss of load hours,
- LTCE = Long Term Capacity Expansion Plan; optimization process to select generation.
- MMBTu = million British Thermal Units, unit of energy usually used for fuels.
- MWh = unit of energy usually electric power = 1 million watts x hour
- MW = unit of power = 1 million watts
- Peak Demand = The maximum demand in megawatts (MW) for a year.
- PV = Photovoltaic
- Reserve Margin = The amount of electric generating capacity divided by the peak demand.
- SMR = Small Modular Reactor
- “Sweet Spot” Core Acreage = Areas within a natural gas play that offer the highest production at least cost.
- Utility Scale = large grid-connected power generation, could be solar, gas, diesel, etc.
- VOM = Variable operations and maintenance costs
- Wheeling = a transaction by which a generator injects power onto a third party transmission system for delivery to a client (load).