

Public Citizen

MONTICELLO AND BIG BROWN RETIREMENT HIGH LEVEL IMPACT STUDY

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Executive Summary

Background

An aging fleet of coal plants built between 1971-1989 in the Electric Reliability Council of Texas (ERCOT) region face pricing competition from cheaper natural gas, as well as renewable energy - particularly wind and solar. Compounded with environmental regulations, desire for less exposure to fuel cost volatility, as well as general current trends of clean energy initiatives.

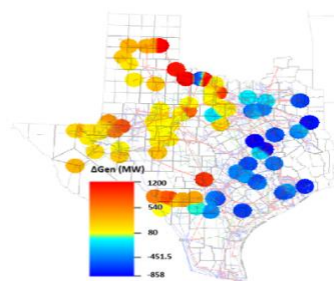


Figure 2 ERCOT 2031 LRP Wind & Solar Additions & Generation Retirements (latter in blue)- “Environmental Mandate”

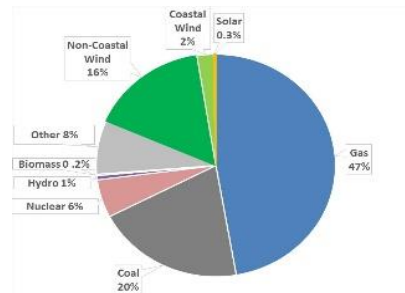


Figure 1 - ERCOT 2016 Fall Generation Mix (peak capacity)

ERCOT’s 2016 Long Range Plan anticipates that approximately 14 gigawatts (GW) of generators will retire, 9 GW of which are Coal, by 2031 under the “Current Trends” scenario, and 24 GW, 18 GW

scenarios, solar additions match or exceed coal retirement figures (9 GW and 28 GW), and assumes the addition of 2,871 MW of future gas generation.

Currently ERCOT has close to 19 GW of coal generation capacity, all in the eastern part of the ERCOT grid and ERCOT stakeholders have raised questions about whether the reliability of the grid could be compromised if many of the plants in East Texas were to retire. Looking at different scenarios of timing & phasing of coal retirement and being prepared to respond cost effectively to system reliability needs is critical, necessitating the study of phased retirements.

Public Citizen (Citizen) requested Electric Power Engineers, Inc. (EPE) to perform a transmission analysis study to evaluate the potential impact that the retirement of the Monticello and the Big Brown coal plant units (1,194 MW, and 1,830 MW respectively), may have on the steady state reliability of the transmission grid. The two-large coal-fired power plants owned by Energy Future Holding’s (EFH) merchant subsidiary, Luminant, are no longer economic to run, per a recent analysis by Guggenheim Securities LLC (Guggenheim), making it likely, per Guggenheim’s analysis, that Big Brown and Monticello will be the two assets in that fleet with the greatest probability of being shut down in the near term. A series of other studies by Moody’s Investor Services, UBS Financial, Brattle Group, and The Beginning of the End by David Shlissel for The Institute for Energy Economics and Financial Analysis, all conclude that these plants are too costly to continue, even without additional environmental upgrades being required¹.

¹ <http://ieefa.org/ieefa-texas-beginning-end-coal-fired-electricity-%E2%80%A8/>

Findings

This study analyzed the impact of the retirement of the Monticello and the Big Brown coal plant units on the 2021 Summer Peak EC base case model that ERCOT used in their 2016 Regional Transmission Plan (RTP) study, by running steady state and contingency analysis to identify thermal overloads as outlined in the “Assumptions” section of this report, resulting in the following conclusions and solutions:

- The retirement of Monticello will aggravate some pre-existing power flow loading constraints on the 30 mile, 345 kV Forney - Royse Switch line under certain system outage conditions, which however will be mitigated when Oncor’s upgrades of this line are completed (planned for May 2019).
- The retirement of Big Brown may push the power-flow loading on a couple of local 138 kV lines to their limits if the Monticello generation were to be dispatched at full capacity. Just dialing back generation at Monticello by a few MW as needed, or for that matter the retirement of Monticello will mitigate this concern.
- The simultaneous retirement of both Monticello and Big Brown units will not trigger any thermal overloads beyond what is already in the base case.

This study therefore determined that, by 2021, all steady state transmission thermal overloading constraints that the retirement of Monticello and/or Big Brown coal plants may trigger will be mitigated through reasonable upgrades along with re-dispatch of other generation on the grid, without the need for additional transmission upgrades beyond what is currently planned by ERCOT.

More details on the analysis may be found in the section title “Detailed AC Contingency Analysis and Results”.

It is to be noted that this study consists of a high level thermal analysis to identify thermal constraints due to the retirement of the Monticello and Big Brown plants. This study did not include any voltage violation or stability limit analyses, which otherwise may identify system limitations due to the retirements evaluated in this analysis.

Results of this study are a snapshot in time and largely depend on the generation dispatch and transmission system configuration. Any change in the assumptions underlying this study may greatly impact the findings in this report.

Other Studies

While this study report was being finalized, ERCOT released its Regional Transmission Plan (RTP) Environmental Regulation (ER) Study, which looked at the impact of retiring 6,114 MW of coal-fired generation consisting of the following:

- 1,860 MW Monticello,
- 1,195 MW Big Brown,
- 2,410 MW Martin Lake, and
- 650 MW Colecto Creek

The results of the RTP ER Study identified several transmission system overloads, showing that the retirement of Martin Lake along with Monticello and Big Brown, will introduce thermal constraints (where these findings are the assumptions underlying that study).

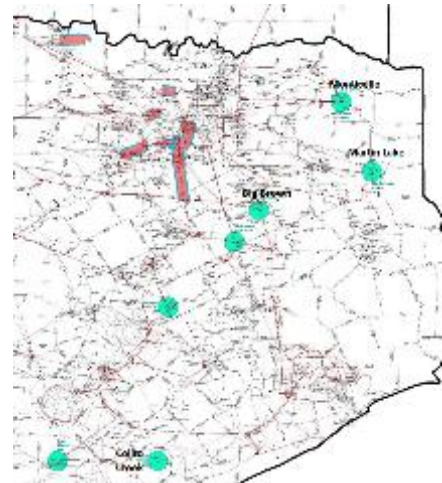


Figure 3 Illustration of RTP 2016 Environmental Regulation

specific to

Evaluating Assumptions & Recommendations for Further Study

Phasing and timing of coal retirements vs. future generation and system upgrades:

The assumptions underlying the analysis in this report are summarized under the “Assumptions” section and include the incorporation of the proposed construction and commissioning of 2,871 MW of future gas generation, 1,197 MW of future solar projects and 4,482 MW of future wind projects that have signed Interconnection Agreements (IA) and that meet ERCOT's planning requirements.

The report assumptions also incorporate all relevant transmission projects planned by ERCOT for completion by 2021 to be in the base case analysis that were known to ERCOT at the time the 2016 RTP study base case was built (June 2016, which did not include the 345 kV Forney - Royse Switch line upgrade which was not included in the ERCOT plans until July 2016).

While these are solid planning assumptions, considering the way the ERCOT market operates, the coal retirements may very well happen before the assumed transmission upgrades are in place or the planned generation is built. Future generation modeling and inclusion of future transmission projects in this analysis significantly attenuate the impact that the Monticello and Big Brown units’ retirement may have on the grid.

The 2,871 MW of natural gas generators that are planned to be completed require a lengthy process that includes permitting requirements which may not be accelerated to quickly be deployed to satisfy system needs on demand such as in the case of early coal retirements than 2021. Transmission upgrades in turn also require several years to build. This makes the study of the different scenarios of phased retirements of coal critical to the reliability of the grid, and

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further accentuates the need to identify alternative solutions that may be swiftly deployed in case of early retirements key to cost effective maintenance of the reliability of the grid.

System Stability concerns:

The retirement of Monticello and Big Brown will reduce the conventional generation (contributing to system inertia and stability) by only around 4%. This study assumed that system stability will not be a concern in case of retirement of Monticello and Big Brown, however, this is recommended to be carefully studied particularly when combined with large amounts of wind and solar import from west and north Texas into load centers in central and south Texas. This will be more critical moving forward when significant amounts of coal may retire.

Recommendations for further study:

As a next step to this high level steady state analysis, EPE recommends the following:

- Run production cost modeling of certain scenarios of coal retirements and identify alternative solutions to mitigate system reliability constraints beyond transmission line upgrades or additions. In certain scenarios, when system reliability concerns are only triggered for a few hours in the year for example, energy storage or storage with wind and solar may be a natural fit in lieu of transmission upgrades. These solutions may be deployed much faster than conventional generation or transmission line expansions.
- Analyze voltage stability constraints particularly under conditions of large import of generation into load centers from other zones into Dallas and into the South, combined with significant capacity of coal retirements.

Detailed AC Contingency Analysis and Results

AC Contingency power-flow calculations were run on the 2021 Summer Peak EC base case without any modifications, with both Monticello and Big Brown Plants modeled at 1,860 MW and 1,194 MW respectively. Calculations were also run on the base case under study after retiring the Monticello units and after retiring the Big Brown units. Planned solar and wind generation were re-dispatched to offset the retirement of the Monticello units and Big Brown units as outlined in the section titled “Assumptions”.

The AC power-flow was run at steady state conditions for system-intact (N-0), single-contingency (N-1) as well as multiple-contingency conditions, and results of cases were compared to determine the system thermal constraints that are introduced due to the retirement of either the Monticello units, the Big Brown units, or both projects simultaneously. The detailed findings for the thermal overloads due to the retirement scenarios are summarized in the spreadsheet embedded in Table 1 below, and summarized as follows:

- The Monticello units’ retirement will exacerbate overloading of the 345 kV Forney Switch - Royse Switch line, rated at 956 MVA by around 15%, from 127% to 142%, under multiple-contingency conditions.

The upgrade of the 345 kV Forney Switch – Royse Switch line, by re-conductoring the existing 30-mile circuit, will mitigate this constraint. Per the latest ERCOT Transmission Project and Information Tracking (TPIT) report, this upgrade is a Tier 4 transmission project, with an in-service date of May 2019 (note that the 2016 RTP base case model, dated June 10, 2016, was prepared before this upgrade was first listed in the ERCOT TPIT in July 2016, and therefore, it did not include this upgrade). Although the estimated cost for this upgrade is not available yet from public records, however it is expected to be below \$15M being a Tier 4 ERCOT category,

- The Big Brown units’ retirement was identified to trigger the marginal overload of the following 138 kV lines:
 - 138 kV Monticello Tap – Sulphur Bluff line
 - 138 kV Sulphur Bluff – Brinker line



EPE identified that in the absence of the Big Brown units, flow is fed from Monticello through the 138 kV Monticello Tap – Sulphur Bluff – Brinker line to serve the loads in the area of, or passing through, the Big Brown units. Re-dispatch of generation in the area would mitigate the overloads at these lines; namely reducing Monticello units to 1,830 MW or below would bring the loading on these lines to below 100%. The retirement of Monticello also would mitigate these overloads.

- The simultaneous retirement of both Monticello and Big Brown units will not trigger any thermal overloads beyond what is already in the base case.

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In conclusion, this study determined that, by 2021, all thermal overloads that the retirement of Monticello and/or Big Brown coal plants may trigger are mitigated through reasonable re-dispatch of generation on the grid, without the need for additional transmission upgrades beyond what is currently planned by ERCOT.

Table 1 – Thermal overloads due to the Monticello and Big Brown retirements

Monticello and Big Brown Retirement		
Monticello Retirement Overloads	Big Brown Retirement Overloads	Monticello and Big Brown Retirement Overloads
 AC Contingency Findings - Monticell	 AC Contingency Findings - Big Brow	None

Assumptions

Generation Projects Dispatch

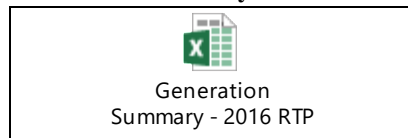
The 2021 Summer Peak EC base case model, dated June 10, 2016, was used in this analysis without any modifications to evaluate the grid when Monticello units and Big Brown units are operating at 1,860 MW and 1,194 MW respectively, as initially modeled by ERCOT in their RTP study.

To offset the retirement of Monticello and Big Brown units, generation was added to the base case beyond what ERCOT has modeled in the original RTP case. The additional generation consisted of future wind, solar, or conventional generation projects that have signed an IA per the August 2016 Generator Interconnection Status Report as available from ERCOT using the same dispatch methodology that ERCOT adopted in their RTP case; namely additional future IA solar projects were added at 70%, wind at 10% of their nameplate capacity, and conventional generation at 100% of their nameplate capacity. Where additional generation was needed beyond what has signed an IA, solar generation was assumed to be interconnected in the general area, where currently solar development is shown per the ERCOT GIS.

The spreadsheet embedded in Table 2 provides the following, which is also summarized in Table 3:

- Tab titled “Future Generation” lists the future generation that ERCOT has included in their 2016 RTP case, at their nameplate capacity
- Tab titled “Mothballed and Retired” lists the mothballed and retired generation as assumed by ERCOT in the 2016 RTP case
- Tab titled “Offsetting Generation” lists additional future wind and solar projects that have signed an IA per ERCOT Generator Interconnection Status (GIS) Report, dated August 2016, and that were not included in the RTP case. These generators were modeled by EPE to offset the retirement of the Monticello and Big Brown units

Table 2 – Generation Summary in MW of rated capacity



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Table 3 – Summary of Future Generation rated capacity modeled in the base

	MW for Grid			
	Gas	Solar	Wind	Total
West	0	1,197	840	2,037
Coastal	11	0	924	935
Panhandle	369	0	1,462	1,831
South	1,373	0	1,160	2,533
North	1,118	0	96	1,214
Total	2,871	1,197	4,482	8,550

Table 4 and Table 5 summarize the total system generation capacity breakdown per weather zone and type, at the MW levels dispatched in the case, including the Monticello and Big Brown units, in the 2021 base case underlying this analysis. Figure 4 and Figure 5 graphically illustrate this breakdown.

Table 4 – Total Generation breakdown per Weather Zone and Type at the Dispatch Levels in the base case under study

Weather Zone	Solar	Wind	Other	Total
East	0	0	12,247	12,247
North	74	684	4,425	5,184
Far West	663	406	1,646	2,715
South	0	1,743	5,125	6,868
Coast	0	0	22,594	22,594
West	93	612	609	1,313
North Central	0	220	19,629	19,849
South Central	46	39	12,777	12,862
Total	876	3,703	79,052	83,631

Table 5 – Total Generation breakdown per Type at the Dispatch Levels in the base case under study

Generation Type	Generation Dispatched	Percentage
Combined Cycle	29,147	35%
Wind	3,703	4%
Nuclear	4,977	6%
Equivalent Units in Mexico	420	1%
Self Serve	1,735	2%
Self Serve Economic Units	5,928	7%
Solar	876	1%
Coal and Lignite	17,211	21%
Natural Gas	18,373	22%
Other	1,260	2%

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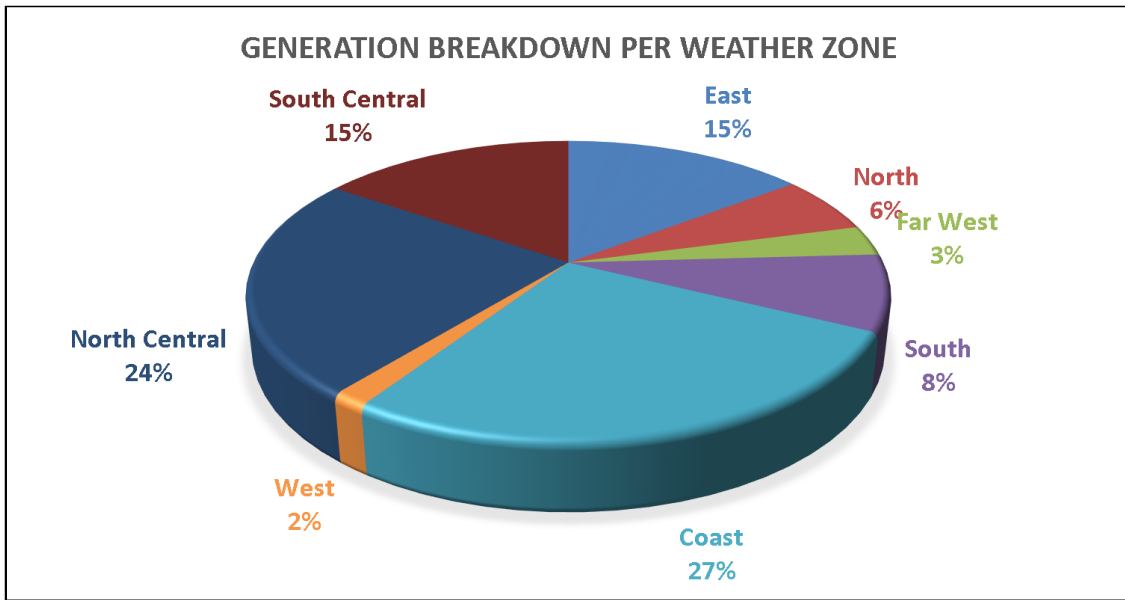


Figure 4 – Generation Breakdown per Weather Zone (as dispatched in the base case under study)

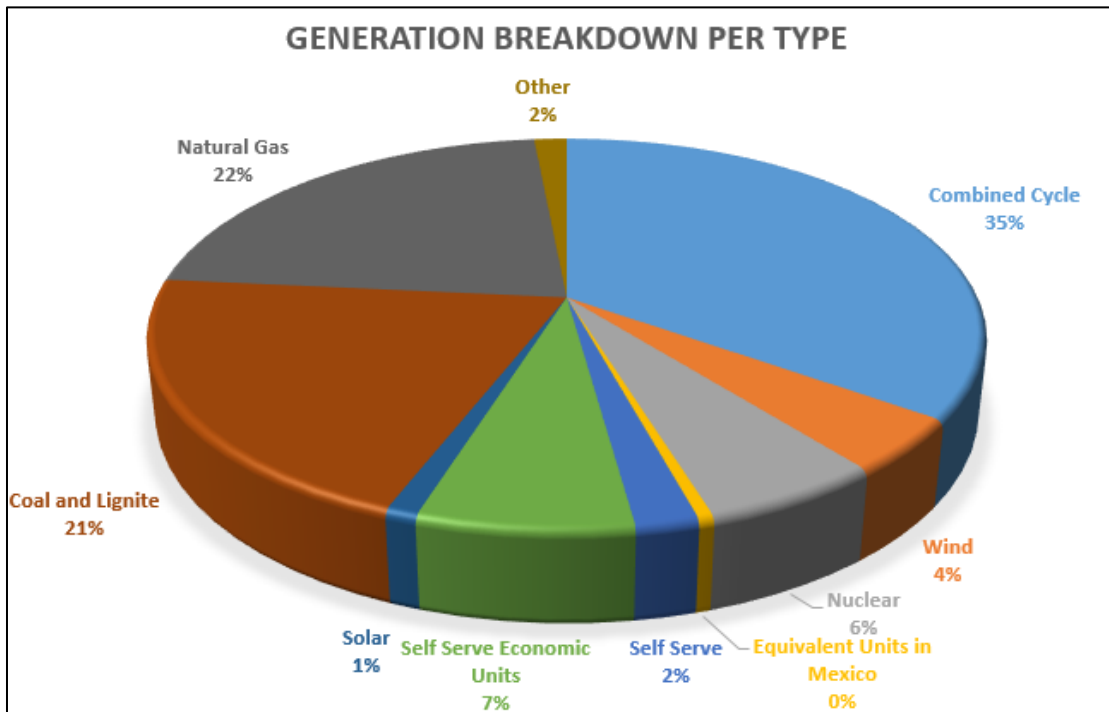


Figure 5 – Generation Breakdown per Type (as dispatched in the base case under study)

Other Assumptions

- This study used the 2021 Summer Peak EC base case model that ERCOT used in their 2016 RTP. This case is dated June 10, 2016 and represents the East and Coast weather zones, in which the Monticello units fall, for the 2021 study year.
- Thermal overloads were identified under system-intact (N-0), single-contingency (N-1) as well as multiple-contingency conditions.
- Single (N-1) contingencies were run for all transmission elements in ERCOT. A single contingency is either the forced or planned outage of one single transmission element (line or transformer) on the grid. A multiple-contingency is the loss of two or more transmission elements on the grid due to planned or forced outages; multiple-contingency conditions were retrieved from ERCOT and were evaluated in the RTP study.
- Thermal overloads were monitored for every transmission element in ERCOT.
- Thermal constraints were based on thermal overloads above 100% of Rating A of each transmission element rated at 60 kV or higher for system-intact conditions, and on thermal overloads above 100% of Rating B for contingency conditions. Rating A is the limit on equipment rating and Rating B is the conductor rating for most transmission elements.
- An overloaded line was introduced due to the retirement of Monticello units and Big Brown units if the percentage loading change after the retirement is greater than or equal to 3%, or the element was not overloaded when the generation units were online. This is the same methodology adopted by ERCOT in the RTP studies.
- Generator step-up transformers are ignored as limiting constraints.
- The AC Calculations in this report identified that there are several transmission elements thermally overloaded in the base case before the retirement of the Monticello and Big Brown units all through the ERCOT grid. If the retirement of Monticello and /or Big Brown units did not have significant contribution to these overloads, then they were not reported in this analysis.
- The calculations underlying this report are a snapshot in time, and are based on the RTP load-flow model available from ERCOT. Any changes in the configuration of the transmission system, or in the load or generation dispatched in the model will influence the results of this study, and new load-flow calculations must be run for the new configuration.

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Transmission Map

