Addendum to 2022 Regional Transmission Plan (RTP) Economic Analysis

Version 1.0

Document Revisions

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1. Introduction

In the 2022 Regional Transmission Plan (RTP) economic assessment, ERCOT identified projected transmission constraints and transmission lines recommended for dynamic rating. However, at the time of the analysis, ERCOT's economic planning criteria for project evaluation were pending and potential economically driven transmission improvements were not evaluated in the 2022 RTP.

After the Public Utility Commission of Texas's (PUCT or Commission) amendment to 16 Texas Administrative Code (TAC) § 25.101,[1] defining the updated economic planning criteria for the ERCOT Region became effective in December of 2022, ERCOT staff commissioned a study to evaluate economically driven transmission improvement using the updated criteria. Overall, 14 selected transmission upgrades were evaluated. This report summarizes the results of this economic analysis.

The structure of this report is organized as follows. Section 2 presents the study assumptions and methodology. The transmission projects selected for evaluation are introduced in section 3. Section 4 summarizes the study results of the analysis while section 5 provides the conclusions and next-step plans.

2. Study Assumptions and Methodology

The start cases used in this economic analysis are the economic cases developed in the 2022 RTP. Top congestions from the start cases were reviewed, and the cases were updated with tier 4 transmission projects or approved Regional Planning Group (RPG) projects that are expected to resolve the congestion. For example, the ratings for the Adobe Meadow to Mockingbird 138-kV line were updated based on the Texaco Mabee Tap - Midland East 138 kV Line Rebuild Tier 4 Project (TPIT project number: 66571), which resolved one of the top congestions identified in the 2022 RTP. Some model corrections were also made in the start cases. Due to time constraints, no load or generation updates were made to reflect the most recent load forecast and new generators meeting the Planning Guide Section 6.9(1) requirements after the cutoff date of the 2022 RTP. The approved RPG projects and tier 4 projects that are not in the start cases and are not expected to relieve the top congestions were not incorporated. Detailed information of the case updates can be found in Appendix A sheet.

Pursuant to the amended 16 TAC § 25.101(b)(3)(A)(i), an economic cost-benefit study for economic projects must be performed under a congestion cost savings test and a production cost savings (PCS) test, and ERCOT is required to develop a congestion cost savings test in consultation with the Commission staff.

[1] https://interchange.puc.texas.gov/search/filings/?UtilityType=A&ControlNumber=53403&ItemMatch=Equal&DocumentType=ALL&SortOrder=Ascending

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While the congestion cost benefit test is being developed, § 25.101(b)(3)(A)(i)(I)(-b-) allows ERCOT to use the generator revenue reduction (GRR) test, which was used for evaluation of economically driven projects in the ERCOT Region during the 2006 to 2012 timeframe, as the congestion cost savings test.

To pass the PCS test, the levelized ERCOT-wide annual PCS attributable to the proposed project should be equal to or greater than the first-year annual revenue requirement (13.2%) of the proposed project. To satisfy the GRR test requirement, the levelized ERCOT-wide annual GRR attributable to the proposed project should be equal to or greater than the average of the annual revenue requirement for the first three years (12.9%) of the proposed project. These revenue requirements are reviewed annually and may vary from year to year.[2] ERCOT may recommend, and the Commission may approve, a transmission upgrade in the ERCOT Region that passes either a congestion cost savings test or a PCS test. The total production cost is the sum of the fixed operation and maintenance (O&M), startup, variable O&M, fuel, and emission cost of generators. The total generator revenue is equal to the sum of the energy production of the generator times its nodal price. Both the total production cost and the total generator revenue are adjusted to account for interchange adjustment, transmission violations, and the monetary value of voluntary demand curtailment in response to the price.

[2] The above revenue requirements (13.2% and 12.9%) are based on the review performed in 2023.

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3. Project Evaluation Overview

The economic analysis has continued to demonstrate a significant number of congestions for both the 2024 and 2027 study years. Based on the review of the initial congestion pattern and stakeholder feedback, ERCOT selected 14 transmission projects to conduct both the PCS test and the GRR test, as guided by the amended 16 TAC § 25.101(b)(3)(A)(i) outlined in Section 2.

3.1. Top Constraints for 2024 and 2027 Study Years

Table 1 shows the projected top 15 constraints ranked by the congestion rent on the ERCOT System based on the economic analysis conducted for the study years 2024 and 2027.

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Table 1: Top Congested Constraints from 2024 and 2027 Study Years

Index	Constraint	Congestion Rent[3] (M$)	
		2024	2027
1	Odessa EHV Switch to Rexall 138-kV line	336.0	-
2	West Texas Export Interface	104.1	72.0
3	Lewisville Switch to Dunham 345-kV line	63.9	73.4
4	North Edinburg to Lobo Interface	61.9	-
5	Nelson Sharpe to Rio Hondo Interface	42.1	-
6	South Texas Project to WA Parish 345-kV line	20.0	40.7
7	Lake Creek to Lake Hall Switch 345-kV line	12.5	31.3
8	Benbrook Switch to Decordova 345-kV line	15.2	26.1
9	Loyola Sub 138/69-kV transformer	8.6	26.0
10	Temple Switch to Tin Roof POD 138-kV line	22.9	24.9
11	Rocksprings to New Barksdale 69-kV line	22.5	0.8
12	George West Switching Station to Sigmor 138-kV line	20.7	0.1
13	Waco Northeast Tap to Waco North 138-kV line	5.3	19.1
14	Killeen Switch to Harker Heights South 138-kV line	8.7	16.8
15	Calaveras to Pawnee 345-kV line	16.1	2.8

Figures 1 and 2 show the top constraints in 2024 and 2027, respectively. The size of each bubble represents the relative capacity of each congested element over the study period.

[3] Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria.

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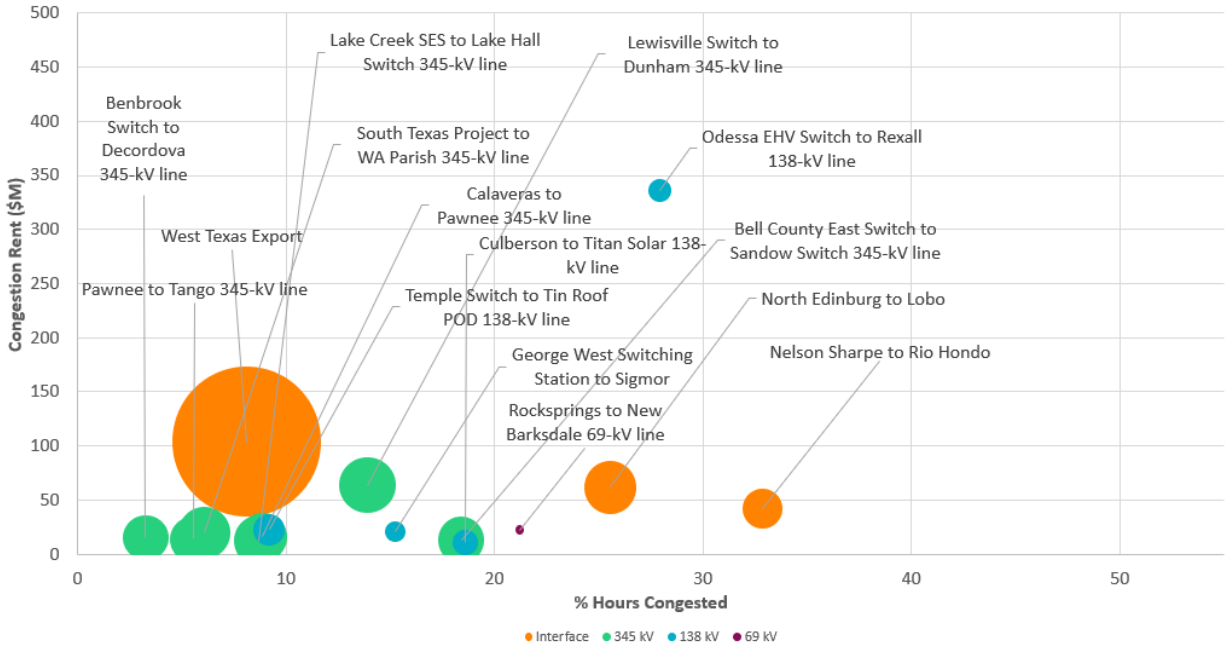

Figure 1 Top Constraints in 2024

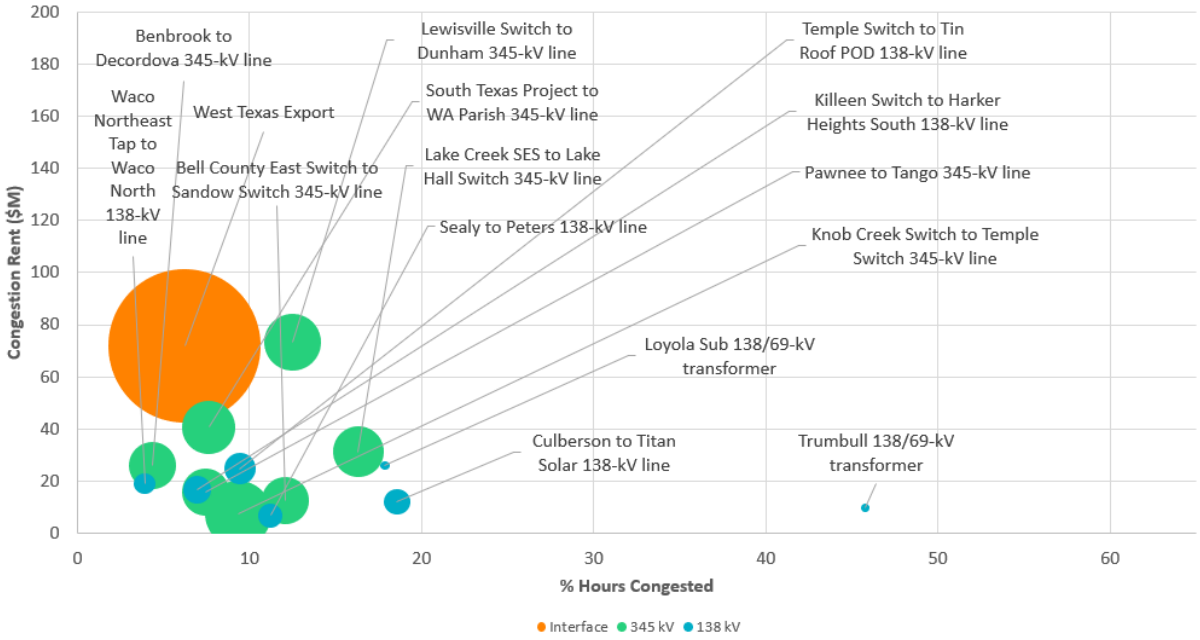

Figure 2 Top Constraints in 2027

3.2. Projects Selected for Evaluation

The congestion patterns observed for the 2024 and 2027 study years served as the main basis for identifying potential economic projects for further evaluations. Projects with

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significant drop in congestion rent in 2027 study year in comparison to 2024 were excluded from the potential projects list to be evaluated.

The West Texas (WTX) Export interface was one of the top congested elements observed for both the 2024 and 2027 study years. The interface transfer limit used in the 2022 RTP economic study was set at 11,016 MW based on the results from ERCOT's Long-Term West Texas Export Special Study.[4] In the base case, this interface was congested approximately 8.1% and 6.2% of hours in the 2024 and 2027 study years, respectively. Table 2 includes details of the congestion on the WTX Export interface.

Table 2: WTX Export Interface Congestion Details

Congested Element	WTX Export Interface			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	11,016[5]	2024	8.1	104.1
		2027	6.2	72.0

Due to the increased renewable generation in the Lower Rio Grande Valley (LRGV) area, the North Edinburg to Lobo interface and Nelson Sharpe to Rio Hondo interface experienced high congestion in the 2024 study year. The ERCOT Board of Directors endorsed the LGRV System Enhancement Project in December 2021 with a projected in-service date of early 2027. The PUCT also approved the construction of a new second circuit on the double-circuit-capable 345-kV transmission line that runs from San Miguel to Palmito and new transmission facilities to close the loop from Palmito to North Edinburg. As the LRGV System Enhancement Project is scheduled to enter service in the summer of 2027, these LRGV interface limits are expected to become no longer binding so that they are not modeled in 2027. As such, the LRGV area was only heavily congested in 2024 and will no longer be congested in the 2027 study year.

The congestion for the Lewisville Switch to Dunham 345-kV line, South Texas Project to WA Parish 345-kV line, Benbrook Switch to Decordova 345-kV line, Loyola Sub 138/69-kV transformer, Temple Switch to Tin Roof POD 138-kV line, and Killeen Switch to Harker Heights South 138-kV line has been seen for both 2024 and 2027 so that the upgrades in those areas were evaluated to resolve the congestions observed.

In addition to the projects outlined above, transmission service providers (TSPs) also recommended a list of projects for evaluation. ERCOT also reviewed historical congestion observed in those areas and took its experiences with these constraints in past economic models into consideration to select several additional projects for further evaluation.

Table 3 shows the list of all transmission projects that were evaluated in this economic analysis. Figure 3 shows the location of each of the projects. Detailed descriptions of these projects are included in Appendix B sheet.

[4] https://www.ercot.com/files/docs/2022/01/14/Long-Term-West-Texas-Export-Study-Report.pdf
[5] 90% of the calculated stability limit is applied in the economic assessment, which is consistent with the Transmission and Security Operating Procedure.

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Table 3: Projects Selected for Evaluation (Green: ERCOT-selected projects based on the congestion observed for 2024 and 2027; blue: TSP-recommended projects)

Index	Description
Project 1	WTX Export Option 1 (4AC)
Project 2	WTX Export Option 2 (3AC+HVDC)
Project 3	STP – WAP CKT 39 345-kV line upgrade
Project 4	Lewisville Switch – Dunham 345-kV line upgrade
Project 5	Comanche Switch – Comanche Tap – Shiloh – Hasse – Dublin 138-kV line upgrade
Project 6	Bergheim 345/138-kV transformer upgrade
Project 7	WAP – Bellaire CKT 50 and Smithers – Bellaire CKT 98, 345-kV double circuit line upgrade
Project 8	WAP – Obrien 345-kV double circuit line upgrade
Project 9	Barton Chapel Wind Farm – Oran Sub 138-kV line upgrade
Project 10	North Laredo Switch to Piloncillo 138-kV rebuild
Project 11	Loyola Sub 138/69-kV transformer upgrade
Project 12	Benbrook Switch to Decordova 345-kV line upgrade
Project 13	Temple Switch to Tin Roof POD 138-kV line upgrade
Project 14	Killeen Switch to Harker Heights South 138-kV line upgrade

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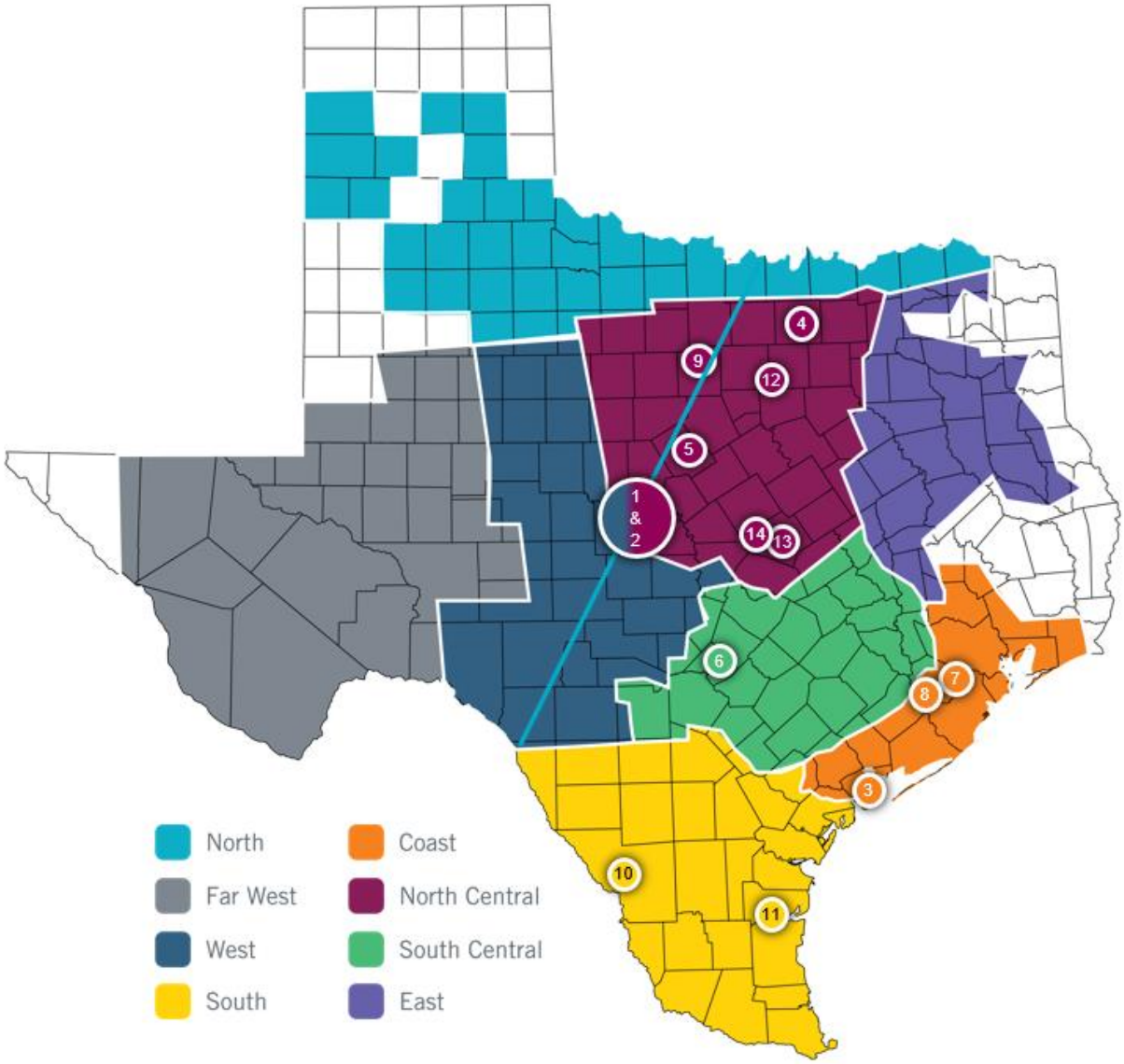

Figure 3 Project Locations

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4. Project Evaluation Results

This section describes the detailed results for the evaluation of the selected transmission project improvement.

4.1. West Texas Export

The following transmission improvement options that were previously proposed in the Long-Term West Texas Export Special Study were evaluated to relieve the congestion observed on the WTX Export interface:

- WTX Export Option 1: Build new 345-kV AC double circuits from Bakersfield to Howard, Brown to Bell, Clear Crossing to Watermill, and Tesla to Royse
- WTX Export Option 2: Build new 345-kV AC double circuits from Bakersfield to Howard, Brown to Bell, Clear Crossing to Watermill, and a new High Voltage Direct Current (HVDC) line from Tesla to King

Given the potential lead time for the construction of transmission projects at this magnitude, only the 2027 study year was used to evaluate these two options. The economic analysis results are included in Table 4. While both options can result in reductions in the production cost of $47.4 million and $66.2 million, generator revenue *increases* were observed for both options. Generator revenue increases in comparison to the base case would occur mainly in renewable-rich areas where the nodal prices increase as the renewable generation curtailment is reduced. By contrast, GRR was also observed in demand centers where nodal prices will have dropped due to the increased energy deliverable to those areas from lower-cost resources after the studied transmission lines are in service.[6]

Table 4: Economic Analysis Results for WTX Interface Transmission Improvement Options (Base Case -Case with Project)[7]

Option	Adj. PCS in 2027 ($M)	Break-even Capital Cost in 2027 Dollars ($M) - PCS	Adj. GRR in 2027 (M$)	Break-even Capital Cost in 2027 Dollars ($M) - GRR[8]
1	47.4	359.0	-267.7	N/A
2	66.2	501.3	-303.1	N/A

4.2. STP – WAP Circuit 39 Line Upgrade

Congestion was observed on the South Texas Project to WA Parish 345-kV line. The most severe contingency causing this congestion is the loss of two 345-kV lines from

[6] For more information regarding revenue increase after WTX Export projects, see the June 2023 RPG presentation at https://www.ercot.com/files/docs/2023/06/12/2022%20RTP%20Economic%20Study%20Update_June2023_RPG.pdf

[7] Positive “Adj. PCS” means a decrease in production cost for the case with the transmission project. Negative “Adj. GRR” means an increase in generator revenue after the transmission project is built.

[8] Break-even Capital Cost is not calculated if a project does not produce a positive Adj. PCS or a positive Adj. GRR.

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Bailey to Hillje and from Wolf to Hillje. Table 5 shows the details of this observed congestion.

Table 5: South Texas Project to WA Parish Congestion Details

Congested Element	South Texas Project to WA Parish 345-kV line			
Most Severe Contingency	Loss of Bailey to Hillje and Wolf to Hillje 345-kV lines			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	1,347	2024	6.1	20.0
		2027	7.6	40.7

The upgrade of the 345-kV line from South Texas Project to WA Parish was evaluated in both the 2024 and 2027 study years, and the economic analysis results are included in Table 6. This project did not meet the economic planning criteria as it increased both the production cost and the generator revenue. ERCOT plans to re-evaluate the project in the 2023 RTP economic study if the South Texas Project to WA Parish 345-kV line is still significantly congested.

Table 6: Economic Analysis Results for South Texas Project to WA Parish 345-kV Line Upgrade

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
-3.9	0.2	-1.8	N/A	-17.6	-29.1	-22.0	N/A

4.3. Lewisville - Dunham Line Upgrade

Congestion was observed on the Lewisville Switch to Dunham 345-kV line. The most severe contingency causing this congestion is the loss of the second parallel 345-kV line. Table 7 shows the details on the investigated congestion.

Table 7: Lewisville – Dunham 345-kV Line Congestion Details

Congested Element	Lewisville Switch to Dunham 345-kV line			
Most Severe Contingency	Loss of the second circuit in parallel			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	1,568	2024	13.9	63.9
		2027	12.5	73.4

The upgrade of the line was evaluated in both the 2024 and 2027 study years, and the economic analysis results are included in Table 8. The Lewisville - Dunham 345-kV line

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upgrade project lowered the production cost but increased the generator revenue for both the 2024 and 2027 study years.

Table 8: Lewisville - Dunham 345-kV Line Upgrade Economic Analysis Results

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
4.4	0.7	2.5	18.9	-43.7	-47.9	-43.4	N/A

4.4. Comanche Switch (Oncor) – Comanche Tap Area Upgrade

The Comanche Switch (Oncor) to Comanche Tap 138-kV line was congested under the contingency loss of the 138-kV line from Comanche Switch (Oncor) to Comanche Peak SES. Table 9 includes details of the congestion experienced in the Comanche Switch area. As more renewable resources are commissioned in this region, it is anticipated that this line will become more congested so the Comanche Area 138-kV upgrade is included in the study.

Table 9: Comanche Switch (Oncor) to Comanche Tap 138-kV Line Congestion Details

Congested Element	Comanche Switch (Oncor) to Comanche Tap 138-kV line			
Most Severe Contingency	Comanche Switch (Oncor) to Comanche Peak SES			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	212	2024	0.9	0.4
		2027	6.6	2.6

The loss of the 138-kV line between Comanche Switch and Comanche Peak SES also increased the power flow over the 138-kV lines downstream as the power was re-distributed post-contingency. This caused congestion on the 138-kV line sections continuing north to Shiloh, Hasse and Dublin.[9] Upgrading the 138-kV lines from Comanche Switch (Oncor) to Comanche Tap and Shiloh and Hasse to Dublin, totaling approximately 24 miles, was evaluated to alleviate the congestion observed in the Comanche Switch area. Economic analysis results are included in Table 10. The project reduced the generator revenue by $9.8 million while increasing the production cost by $2.8 million.

Table 10: Economic Analysis Results Details for Comanche Area 138-kV Upgrades

Adj. PCS in 2024 ($M)	Adj. PCS in	Levelized PCS in 2024	Break-even Capital Cost in	Adj. GRR in	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024

[9] When studying different upgrade options, it was determined that the congestion will be pushed further downstream until the Hasse – Dublin line section is upgraded.

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	2027 ($M)	Dollars ($M)	2024 Dollars ($M) - PCS	2024 (M$)			Dollars ($M) - GRR
-1.2	-4.9	-2.8	N/A	6.2	14.9	9.8	76.3

4.5. Bergheim Area Upgrade

Both study years 2024 and 2027 showed congestion on the Bergheim 345/138-kV transformer. The transformer was congested under the contingency loss of the 345-kV double circuit lines from Zorn to Hayes Energy. Table 11 includes details of the congestion seen on this transformer.

Table 11: Bergheim 345/138-kV Transformer Congestion Details

Congested Element	Bergheim 345/138-kV transformer			
Most Severe Contingency	Loss of Zorn to Hayes Energy 345-kV double-circuit lines			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	370	2024	6.0	1.1
		2027	13.2	5.7

The upgrade of the Bergheim 345/138-kV transformer increased the amount of power flowing through the 138-kV path downstream and caused congestion on this 138-kV path. Upgrading approximately 26 miles of 138-kV lines from Bergheim through Antler to Highway 46 and from Bergheim through Fair Oaks to Fair Oaks Ranch was able to relieve the congestion observed in the area. This project reduced the annual generator revenue by $4.1 million but increased the production cost by $1.1 million. ERCOT plans to re-evaluate this project in the 2023 RTP economic study. The economic analysis results are included in Table 12.

Table 12: Economic Analysis Details for Bergheim Area Upgrades

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
-0.8	-1.6	-1.1	N/A	7.6	0.8	4.1	31.6

4.6. WA Parish – Bellaire Area Upgrade

The analysis showed limited congestion on the 345-kV line from WA Parish to Bellaire, with an annual congestion cost of $0.03 million and $0.1 million, respectively, for 2024 and 2027. The line was congested under the contingency loss of the 345-kV double-circuit line from WA Parish to Jeanetta. Table 13 includes details of the congestion. However, this area has been historically congested in operations. Per TSP's recommendation,

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upgrade of the WA Parish to Bellaire circuit 50 and Smithers to Bellaire circuit 98 345-kV double-circuit lines was selected for evaluation. The economic analysis results are included in Table 14. This project decreased the annual generator revenue by $9.0 million, with a break-even capital cost of $69.7 million.

Table 13: WA Parish to Bellaire 345-kV Line Congestion Details

Congested Element	WA Parish to Bellaire 345-kV line			
Most Severe Contingency	Loss of WA Parish to Jeanetta 345-kV double-circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	1,314	2024	0.1	0.03
		2027	0.2	0.1

Table 14: Economic Analysis Details for WA Parish to Bellaire and Smithers to Bellaire 345-kV Double Circuit Line Upgrade

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
-0.3	-0.3	-0.2	N/A	10.5	8.4	9.0	69.7

4.7. WA Parish – Obrien Area Upgrade

Congestion was observed on the 345-kV line from WA Parish to Obrien. The line was congested under the contingency loss of the parallel 345-kV line from WA Parish to Obrien. Table 15 includes details of the congestion seen on this line.

Table 15: WA Parish to Obrien 345-kV Line Congestion Details

Congested Element	WA Parish to Obrien 345-kV line circuit 98			
Most Severe Contingency	Loss of WA Parish to Obrien 345-kV line circuit 99			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	1,450	2024	1.1	3.1
		2027	1.0	1.8

The upgrade of WA Parish to Obrien 345-kV double-circuit line was evaluated in both the 2024 and 2027 economic cases, and the economic analysis results are included in Table 16. As the result of the WA Parish to Obrien upgrade, the annual generator revenue was reduced by $12.7 million, leading to a break-even capital cost of $98.5 million.

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Table 16: Economic Analysis Results for WA Parish to Obrien 345-kV Double Circuit Line Upgrade

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
0.5	-4.3	-1.7	N/A	2.5	25.0	12.7	98.5

4.8. Barton Chapel Wind Farm – Oran Sub 138 kV Line Upgrade

Congestion was observed on the 138-kV line from Barton Chapel Wind Farm to Oran Sub. The line was congested under the contingency loss of the 345-kV double circuit line from Graham to Parker. Table 17 includes details of the congestion seen on this line.

Table 17: Barton Chapel Wind Farm to Oran Sub 138-kV Line Congestion Details

Congested Element	Barton Chapel Wind Farm to Oran Sub 138-kV line			
Most Severe Contingency	Loss of Graham to Parker 345-kV double circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	212	2024	13.1	6.7
		2027	9.5	4.8

The upgrade of the line was evaluated in both the 2024 and 2027 economic cases, and the economic analysis results are included in Table 18. The project resulted in a reduction for the annual generator revenue at $3.5 million.

Table 18: Economic Analysis Results for Barton Chapel Wind Farm to Oran Sub 138-kV Line Upgrade

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
0.2	-1.1	-0.4	N/A	6.2	1.0	3.5	27.0

4.9. North Laredo Switch to Piloncillo 138 kV Rebuild

Congestion was observed on the 138-kV line from North Laredo Switch to Piloncillo. The line was mainly congested under the contingency loss of the 345-kV double-circuit line from Fowlerton to Lobo. Table 19 includes details of the congestion experienced in the Laredo area.

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Table 19: North Laredo Switch to Piloncillo 138-kV Line Congestion Details

Congested Element	North Laredo Switch to Piloncillo 138-kV line			
Most Severe Contingency	Loss of Fowlerton to Lobo 345-kV double circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	122	2024	54.1	2.7
		2027	40.8	0.6

The rebuild of the line was evaluated in both the 2024 and 2027 economic cases, and the economic analysis results are included in Table 20. The upgrade caused a decrease in the annual generator revenue and the break-even capital cost is approximately $70.8 million. The congestion in the Laredo area has been observed in the past and multiple project options were studied to address the issue in previous RTP studies. ERCOT will examine the impact of the recent RPG-approved Asherton - Uvalde 138-kV Conversion Project (23RPG007) on the congestion pattern in the area in the 2023 RTP.

Table 20: Economic Analysis Details for North Laredo Switch to Piloncillo 138-kV Line Rebuild

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
-0.9	-1.6	-1.2	N/A	6.9	12.5	9.1	70.8

4.10. Loyola Sub 138/69-kV transformer Area Upgrade

Analysis showed congestion on the Loyola Sub 138/69-kV transformer in both study years 2024 and 2027. The transformer was congested under the contingency loss of the 138-kV line from Loyola Sub to Kleberg. Table 21 includes details of the congestion seen on this transformer.

Table 21: Loyola Sub 138/69-kV Transformer Congestion Details

Congested Element	Loyola Sub 138/69-kV transformer			
Most Severe Contingency	Loss of Loyola Sub to Kleberg 138-kV line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	40	2024	12.7	8.6
		2027	17.9	26.1

Upgrading the Loyola Sub transformer resulted in more power flowing down the 69-kV path and caused congestion on the 69-kV path. Upgrading approximately 8 miles of 69-kV lines from Loyola Sub through Riviera Sub to Ricardo Sub alleviated the congestion

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in the area. There was no PCS and the project reduced the annual generator revenue by $11.1 million. The economic analysis results are included in Table 22.

Table 22: Economic Analysis Details for Loyola Sub 138/69-kV Transformer Area Upgrades

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
0.4	-2.4	-0.9	N/A	9.5	13.9	11.1	85.7

4.11. Benbrook Switch to Decordova 345-kV Line Upgrade

The study showed congestion on the 345-kV line from Benbrook Switch to Decordova in both study years 2024 and 2027. The line was congested under the contingency loss of the 345-kV double-circuit line from Parker to Comanche Peak SES. Table 23 includes details of the congestion on this line.

Table 23: Benbrook Switch to Decordova 345-kV line Congestion Details

Congested Element	Benbrook Switch to Decordova 345-kV line			
Most Severe Contingency	Loss of Parker to Comanche Peak SES 345-kV double circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	1,031	2024	3.3	15.2
		2027	4.3	26.1

The upgrade of the line was evaluated in both the 2024 and 2027 economic cases, and the economic analysis results are included in Table 24. This project decreased the production cost by $0.5 million annually while resulting in $10.3 million of increase in the generator revenue.

Table 24: Economic Analysis Details for Benbrook Switch to Decordova 345-kV Line Upgrade

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
1.7	-0.7	0.5	4.1	-9.9	-11.9	-10.3	N/A

4.12. Temple Switch to Tin Roof POD 138-kV Line Upgrade

Temple Switch to Tin Roof POD 138-kV line was one of the top congested constraints in both 2024 and 2027 study years. The line was congested under the contingency loss of the 345-kV double-circuit line from Bell County East Switch to Sandow Switch.

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Congestion on this line may be attributed to addition of Large Flexible Loads (LFLs) in the area. Table 25 includes details of the congestion on this line.

Table 25: Temple Switch to Tin Roof POD 138-kV Line Congestion Details

Congested Element	Temple Switch to Tin Roof POD 138-kV Line			
Most Severe Contingency	Loss of Bell County East Switch to Sandow Switch 345-kV double circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	486	2024	9.2	22.9
		2027	9.4	24.9

A placeholder project is currently included in the 2022 RTP reliability cases for the study years of 2024 through 2028. Therefore, this project was evaluated in the economic planning study for 2024 and 2027. The placeholder project includes the following transmission improvements:

- Expand Tin Roof POD substation (loops in the 345-kV double circuit line from Temple SS to Bell County East Switch) and add two 345/138-kV transformers
- Upgrade the Temple Switch to Temple Southeast 138-kV line
- Upgrade the Temple Switch to Tin Roof POD 138-kV line
- Upgrade the Temple Switch to Temple 138-kV line
- Upgrade the Scott and White POI to Temple Southeast 138-kV line
- Upgrade the Scott and White POI to Temple South 138-kV line
- Upgrade the Temple North (13608) to Temple Elm Creek (13662) 138-kV line
- Upgrade the Temple North (3608) to Temple Elm Creek (13662) 138-kV line

The addition of the placeholder project resulted in increased congestion on the Temple Switch to Tin Roof POD 138-kV line. To mitigate this congestion, a new second 138-kV circuit from Temple Switch to Tin Roof POD was added to the original placeholder project. Table 26 shows the economic analysis results for this project. The simulation results for the project showed a decrease in the annual generator revenue ($16.5 million).

Table 26: Temple Switch to Tin Roof POD 138-kV Upgrades Economic Analysis Results

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
0.4	-1.1	-0.3	N/A	9.2	26.1	16.5	127.8

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4.13. Killeen Switch to Harker Heights South 138-kV Line Upgrade

The 138-kV line from Killeen Switch to Harker Heights South was congested mainly under the contingency loss of the 345-kV double-circuit line from Killeen Switch to Salado Switch. It was one of the top congested constraints for both 2024 and 2027 study years. Table 27 shows the details of the congestion on this line.

Table 27: Killeen Switch to Harker Heights South 138-kV Line Congestion Details

Congested Element	Killeen Switch to Harker Heights South 138-kV Line			
Most Severe Contingency	Loss of Killeen Switch to Salado Switch 345-kV double circuit line			
	Capacity (MVA)	**Study Year**	**% of Time Congested**	**Congestion Rent ($M)**
	326	2024	4.0	8.7
		2027	7.0	16.8

Upgrading the line from Killeen Switch to Harker Heights South addressed the congestion observed. However, the upgrade resulted in congestion moving to the 138-kV line from Harker Heights South to Belton Southwest. The scope of the project was updated to include approximately 16 miles of 138-kV line upgrades from Killeen Switch through Harker Heights South to Belton Southwest. The project was evaluated in both the 2024 and 2027 economic cases, and the economic analysis results are included in Table 28. Simulation results for the project demonstrated annual GRR of $ 5.5 million and the break-even capital cost is $42.3 million.

Table 28: Killeen Switch to Harker Heights South to Belton Southwest 138-kV Line Upgrades Economic Analysis Results

Adj. PCS in 2024 ($M)	Adj. PCS in 2027 ($M)	Levelized PCS in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - PCS	Adj. GRR in 2024 (M$)	Adj. GRR in 2027 (M$)	Levelized GRR in 2024 Dollars ($M)	Break-even Capital Cost in 2024 Dollars ($M) - GRR
0.7	-1.0	-0.1	N/A	-0.7	12.6	5.5	42.3

5. Conclusions

Using the updated 2022 RTP economic cases (both 2024 and 2027 study year cases), ERCOT performed an economic benefit-cost analysis for 14 transmission enhancements chosen based on a review of the initial congestion patterns and feedback from TSPs. For all transmission upgrades, both the PCS test and the GRR test were performed and a break-even capital cost, if appliable, was provided.

ERCOT evaluated, for informational purposes, the benefit/cost ratio for both the PCS and GRR tests using a generic cost estimate. A transmission system upgrade is economically

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viable if 1) it meets the PCS test or 2) it meets the GRR test requirement without adversely impacting the overall societal benefit.

If a generic cost estimate is utilized, the "Lewisville Switch – Dunham 345-kV line upgrade (Project 4)", "Upgrade of WAP – Bellaire CKT 50 while Smithers – Bellaire CKT 98, 345-kV double circuits (Project 7)", "Temple Switch to Tin Roof POD 138-kV line + Second circuit (Project 13)", and "Killeen Switch to Harker Heights South 138-kV line + Downstream Upgrade (Project 14)" are considered to be economically viable. The benefit-to-cost ratio based on generic cost estimates for those four projects are summarized in Table 29. This is for information only and to determine whether these projects meet the economic planning criteria the capital cost estimate provided by the TSPs should be used.

Table 29: Benefit-Cost Ratio Based on Generic Cost Estimate

Index	Description	Levelized PCS/Cost Ratio (%)	Levelized GRR/Cost Ratio (%)
Project 4	Lewisville Switch – Dunham 345-kV line upgrade	14.1	-
Project 7	Upgrade of WAP – Bellaire CKT 50 and Smithers – Bellaire CKT 98, 345-kV double circuits	-	17.7
Project 13	Temple Switch to Tin Roof POD 138-kV line + Second circuit	-	40.6
Project 14	Killeen Switch to Harker Heights South 138-kV line + Downstream Upgrades	-	21.9

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