Long-Term West Texas Export Special Study – Update

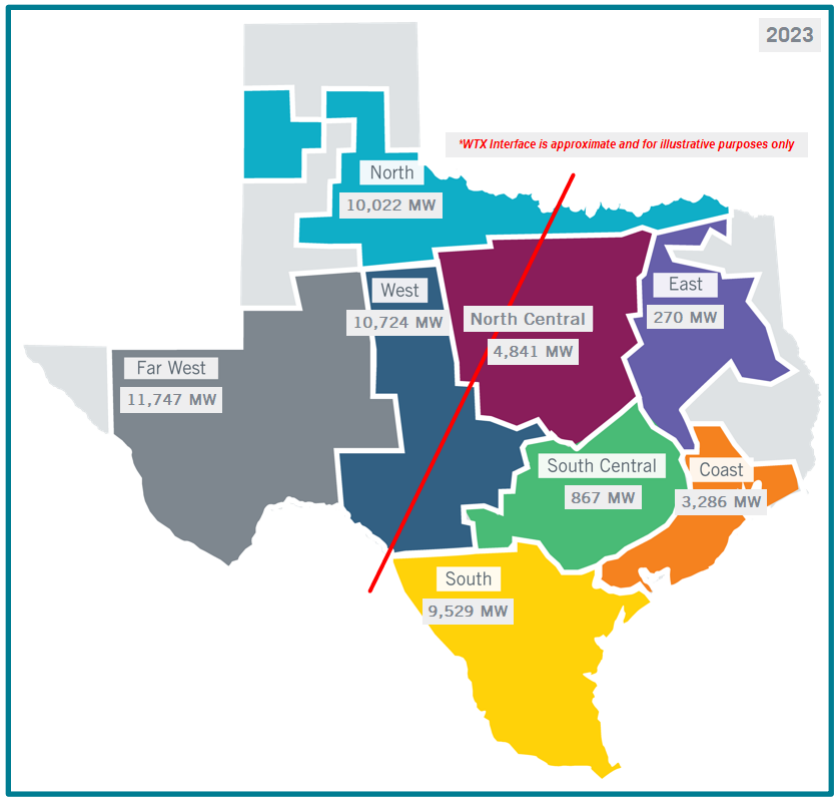
Jameson Haesler
ERCOT System Planning

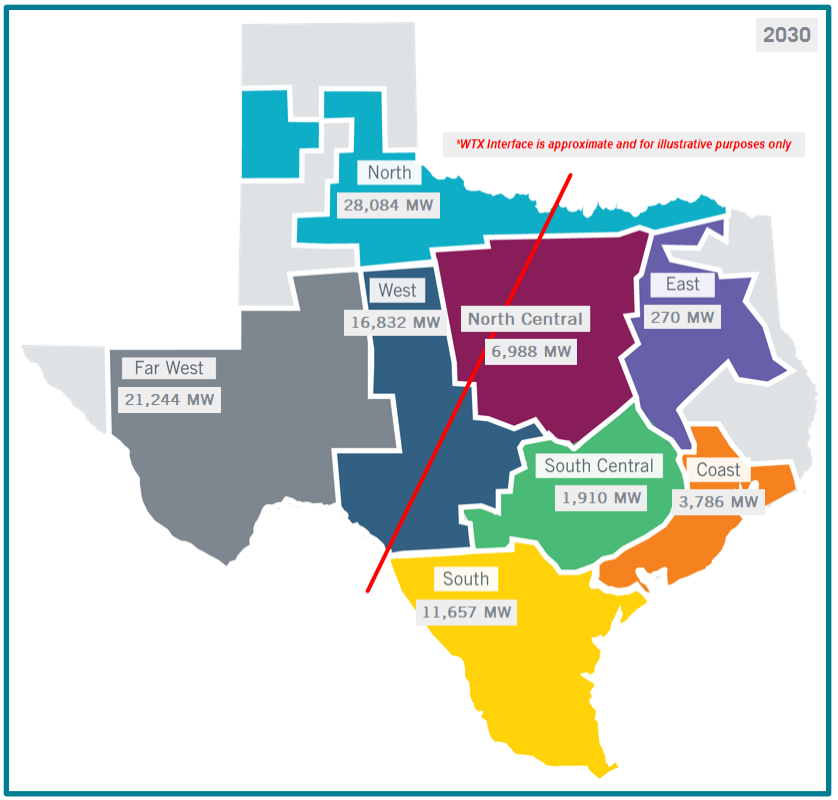
Regional Planning Group
September 15, 2021

Outline

- Recap
- Preliminary Y2030 Assessment and System Improvement Options
- Next Steps

Overview of IBR Capacity in the Study Cases

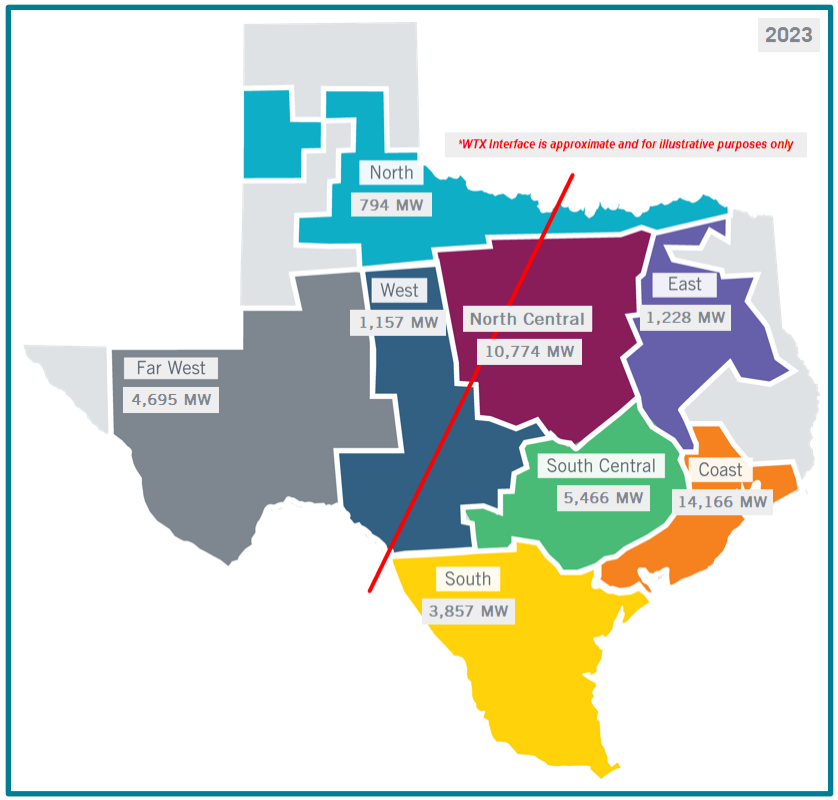


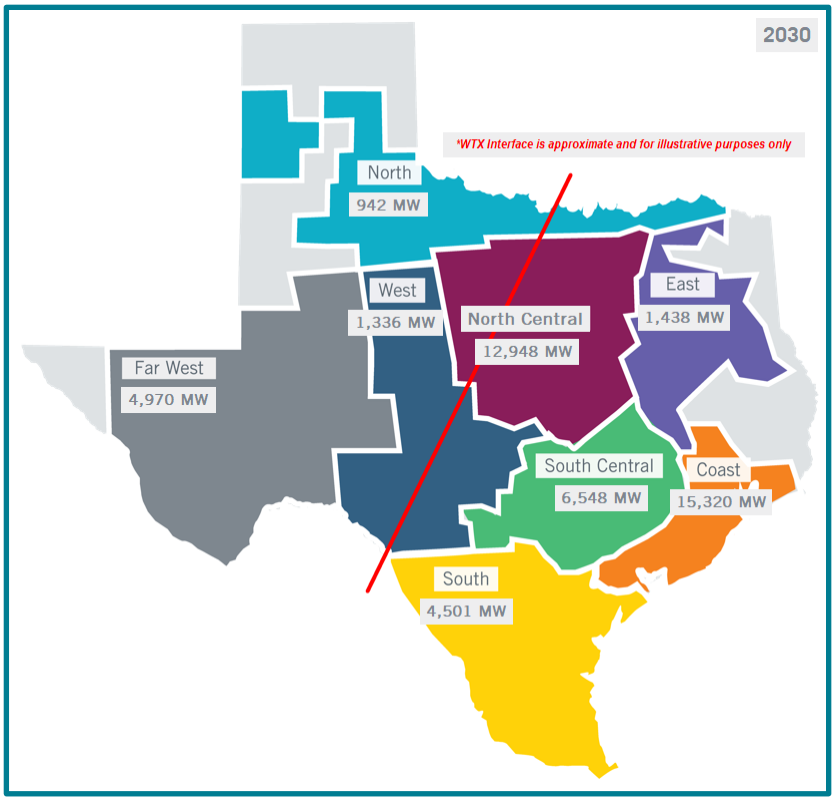


Scenarios	IBR Capacity(1)
2023	~ 53.3 GW
2030	~ 92.8 GW

(1). IBR capacities do not include batteries.

Overview of Load in the Reliability Cases



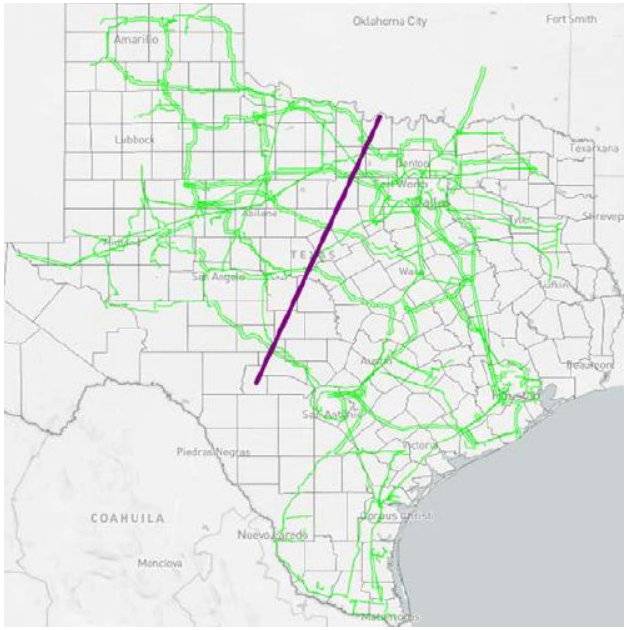


Scenarios	System Load(1) in the Reliability Cases
2023	~42 GW
2030	~48 GW

(1). Economic cases use 8760 hourly load profiles

Assumptions

- West Texas (WTX) export flow in the base case is measured as the sum of the flow on the existing 16 345-kV circuits
  - Riley – Krum West Switch 345-kV DCKT
  - Jacksboro Switching – Willow Creek Switch and Jacksboro Switching – Henderson Ranch Switch 345-kV DCKT
  - Graham SES – Parker Switch 345-kV DCKT
  - Clear Crossing – Willow Creek Switch 345-kV DCKT
  - West Shackelford Station – Sam Switch and West Shackelford Station – Navarro 345-kV DCKT
  - Brown Switch – Killeen Switch 345-kV DCKT
  - Big Hill – Kendall 345-kV DCKT
  - Jacksboro Switching – Krum West Switch 345-kV SCKT
  - Comanche Switch – Comanche Peak SES 345-kV SCKT



For illustrative purposes

Assumptions (continued)

- Reliability Assessment
  - Energy Storage Resources (ESRs) are dispatched at 0 MW with voltage support capability
  - Synchronous generators in West Texas are assumed offline under high West Texas export transfer condition

- Economic Assessment
  - 90% of the calculated stability limit is applied in the economic assessment, which is consistent with the Transmission and Security Operating Procedure

Preliminary Observations – 2030 Scenario

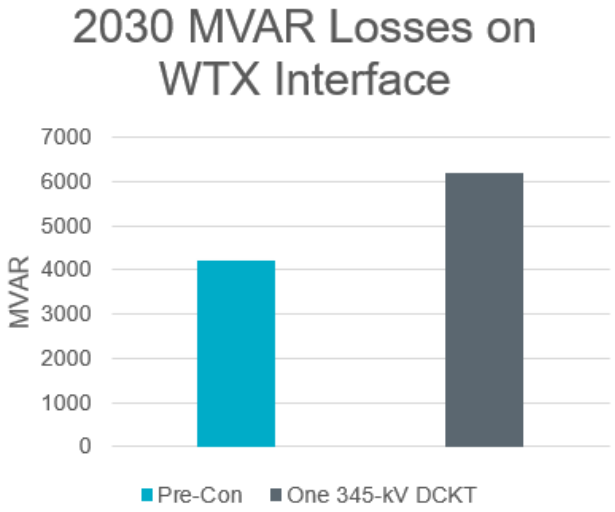
- Estimated Transfer Capability Improvement

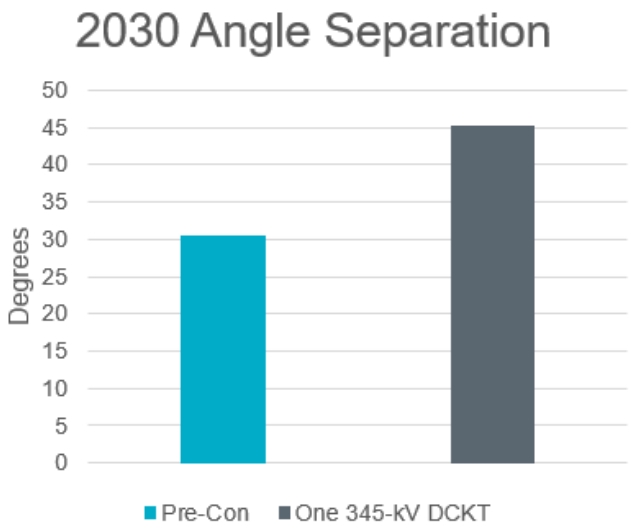
Options	Estimated Power Transfer Improvement (1)	Estimated Cost	Notes
A typical 345-kV double circuit (DCKT)	< 1 GW	√√	• Not effective for long distance transfer • Complex Subsynchronous Resonance (SSR) issues need to be addressed if adding series capacitors
A low impedance 345-kV DCKT	1~1.2 GW	√√	• Not widely implemented
A typical 500-kV DCKT	1.3~1.6 GW	√√√	• Additional transformers are needed to connect to the existing grid • ~4 transformers per circuit
VSC-HVDC	1.5~2 GW	√√√	• Suitable for long distance power transfer • Need further discussion on the system operation and market operation
Reactive Devices	2~4 MVAr/MW	√	• Additional reactive devices alone could increase the operational risk to have voltage instability occur near nominal voltage

(1). Based on steady state voltage stability limit. An approximation based on the tested options. Could vary depending on the location and type of stability constraints.

Y2030 Reliability Assessment – Base Case

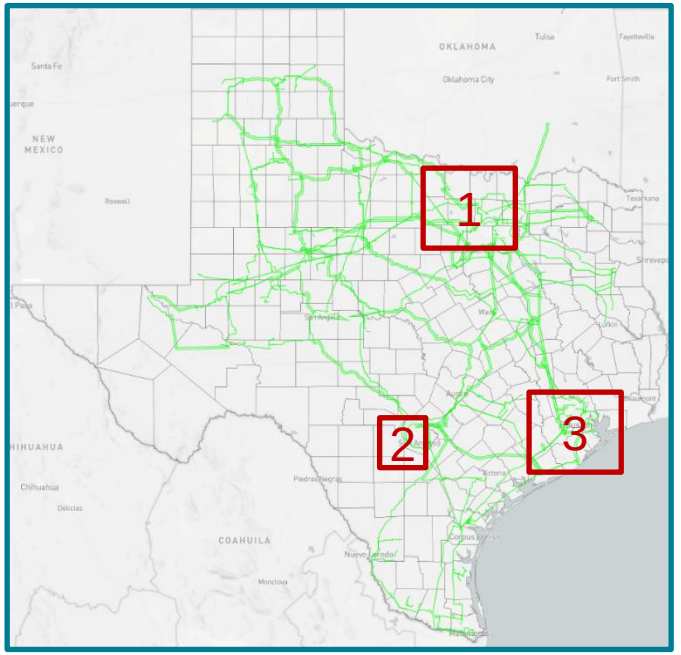
- Expect West Texas export limit to be constrained by dynamic stability limit
- Dynamic analysis is in progress but preliminary results show it to be less than current VSAT limit of 13.75 GW
- Long distance power transfer led to
  - Significant increase of reactive power consumption under normal and outage conditions
  - Significant angle separation on major transfer corridors under normal and outage conditions
  - Both stressed conditions would lead to dynamic instability prior to reaching thermal overload





Y2030 Economic Assessment – Base Case

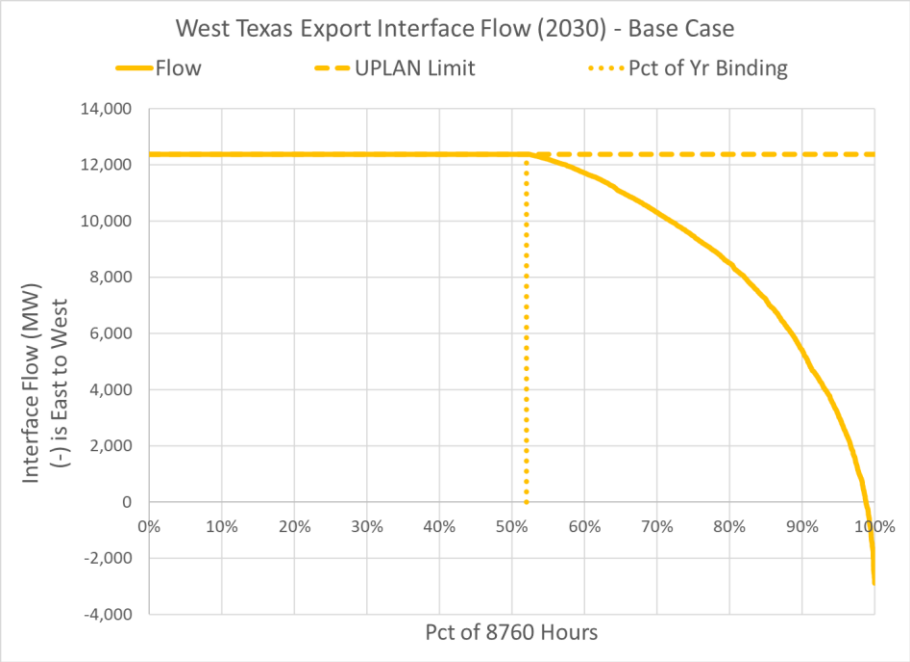
- Significant congestion is observed in the following areas in the Y2030 base case:
  1. Northwest DFW area
  2. Western San Antonio
  3. Houston Import

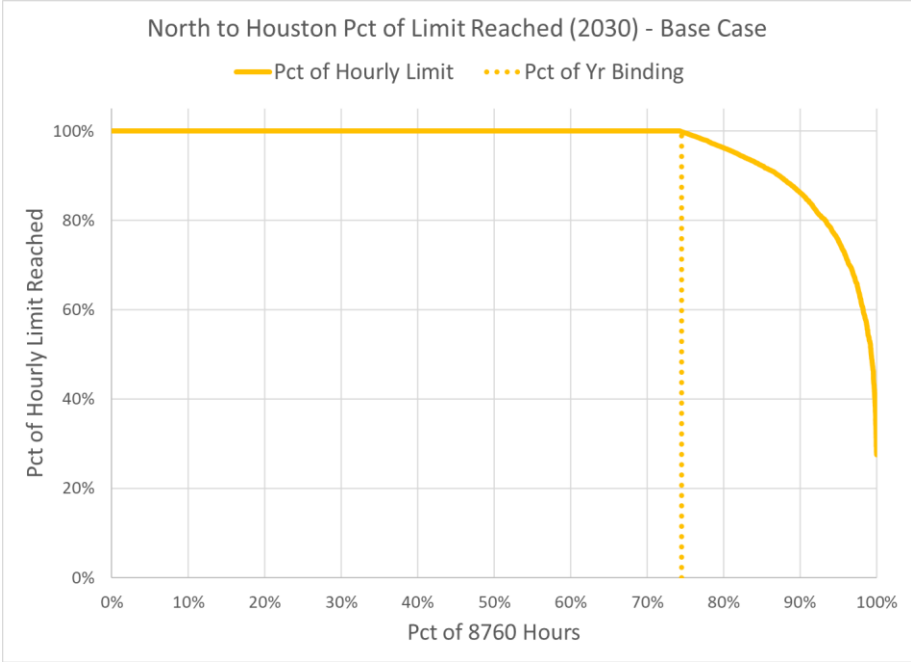


- Overview of annual wind and solar curtailment in the base case
  - 88% of total system IBR curtailment is behind the WTX interface
  - 27% of the potential IBR generation output behind(1) the WTX interface is curtailed

(1). Far West, West, North, North Central weather zones

Y2030 Economic Assessment – Base Case





(1). 90% of the estimated VSAT limit for WTX transfer is used in the economic tests
(2). North-to-Houston import limits are consistent with 21RTP hourly profile limits

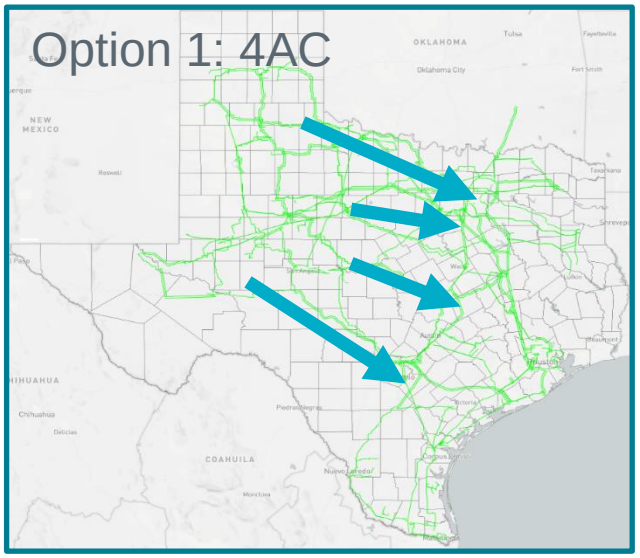
Considerations in Identifying System Improvements

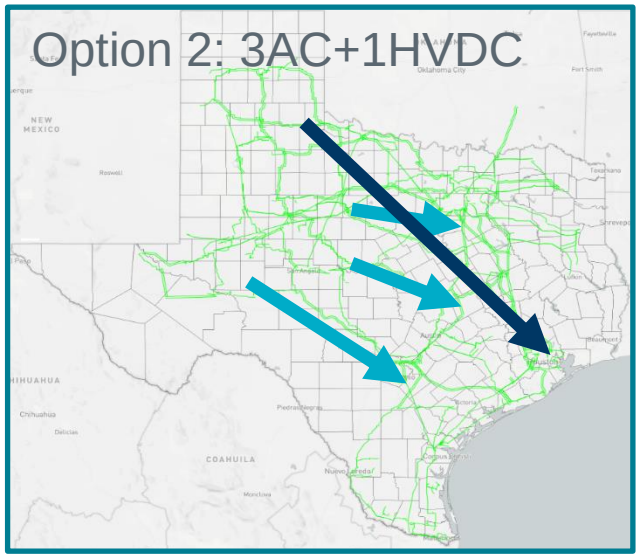
- Stability issues and needs
- Thermal constraints and congestion

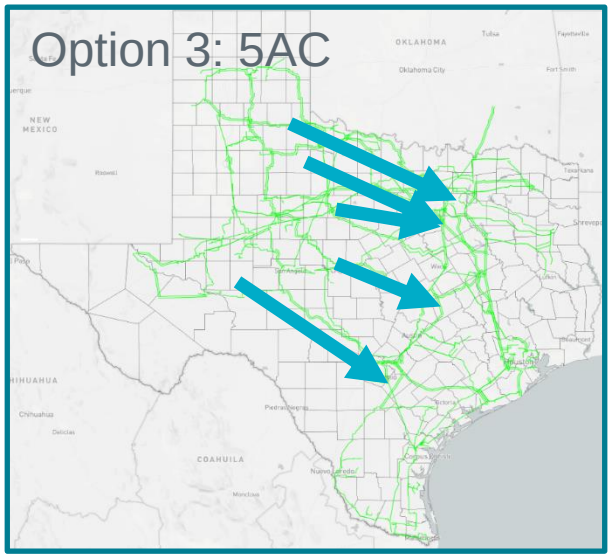
- Generally, the options to address stability may not be the best ones for thermal related congestion since the cause of stability and thermal issues are not always the same.
  - Stability: more relevant to impedance and controls
  - Thermal: more relevant to thermal rating

- Both AC only and HVDC+AC hybrid options have been tested for Y2030 improvements

Tested System Improvements for WTX Transfer



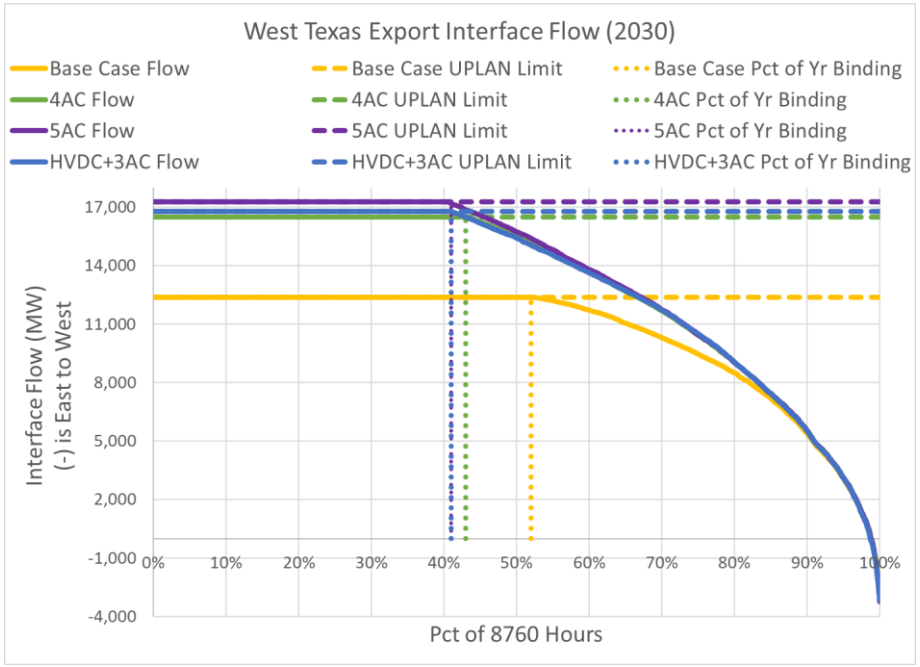


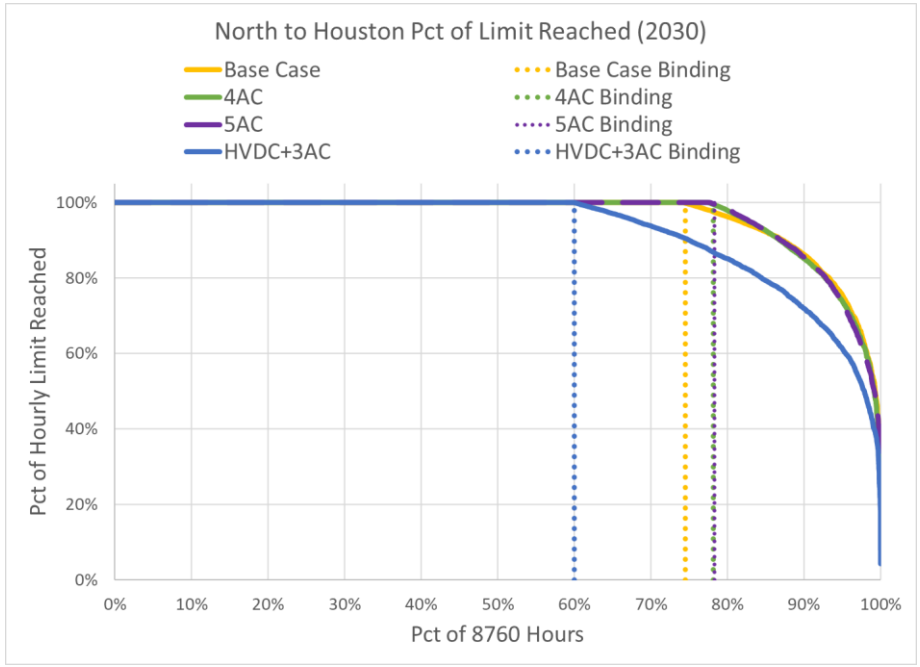


Option[1]	Description	Estimated Circuit Miles[4]	Estimated WTX Transfer Capability in VSAT (GW)
	Base Case		13.8
1	4AC[2]	~1,027	18.3
2	3AC and 1HVDC[3]	~721 (AC) and ~545 (HVDC)	18.6
3	5AC	~1,292	19.2

(1). Arrows represent general locations; specific locations are still under review
(2). A low impedance 345-kV double circuit line is assumed in this assessment
(3). A ~1.5GW HVDC is assumed in this assessment
(4). Miles represent DCKT AC and HVDC lines

Y2030 Economic Assessment with Improvement Options





- All three tested options improve the WTX transfer capability and Option 2 (1HVDC+3AC) also improves North to Houston Import capability

Preliminary Observations for the Y2030 Condition

Zones	Wind/Solar Curtailment (%)			
	Base Case	Option 1 (4 AC)	Option 2 (1HVDC+3AC)	Option 3 (5AC)
WTX (FW, W, N, NC) Zones	26.8	18.4	17.9	17.2
Estimated Production Cost Savings ($M)	--	670	808	774

- All three tested options reduce IBR curtailment in WTX and result in significant Production Cost Savings
- Option 2 has more IBR curtailment but higher Production Cost Savings compared to Option 3

Preliminary Results with System Improvements for the Y2030 Condition

Comparison	Option 1 (4 AC)	Option 2 (1HVDC+3AC)	Option 3 (5AC)
Estimated WTX Transfer Capability in VSAT (GW)	18.3	18.6	19.2
Estimated Production Cost Savings ($M)	670	808	774
Congestion in DFW	Decreased	Decreased	Decreased
Congestion in Western S.A.	Resolved	Resolved	Resolved
Congestion on Houston Import	Increased	Decreased	Increased
Congestion behind WTX interface(1)	Increased	Increased	Increased

(1). Local thermal constraints within WTX

- Based on the Y2030 results, WTX export is expected to remain a significant constraint even with system improvements
- Further improvement of WTX transfer capability may be limited by thermal constraints inside and outside WTX

Next Steps

- Identify potential short-term improvements if applicable
- Work with TSPs on the details of the tested system improvements, e.g., physical feasibility, cost estimates, etc.
- Comments can be provided to Shun Hsien (Fred) Huang shuang@ercot.com