NORTHERN TIER
TRANSMISSION GROUP

NTTG Annual Interregional Information

Annual Interregional Coordination Meeting

Folsom, CA

February 22, 2018

NORTHERN TIER
TRANSMISSION GROUP

NTTG Organization and Planning Process Overview

Presented by
Sharon Helms, NTTG Program Manager

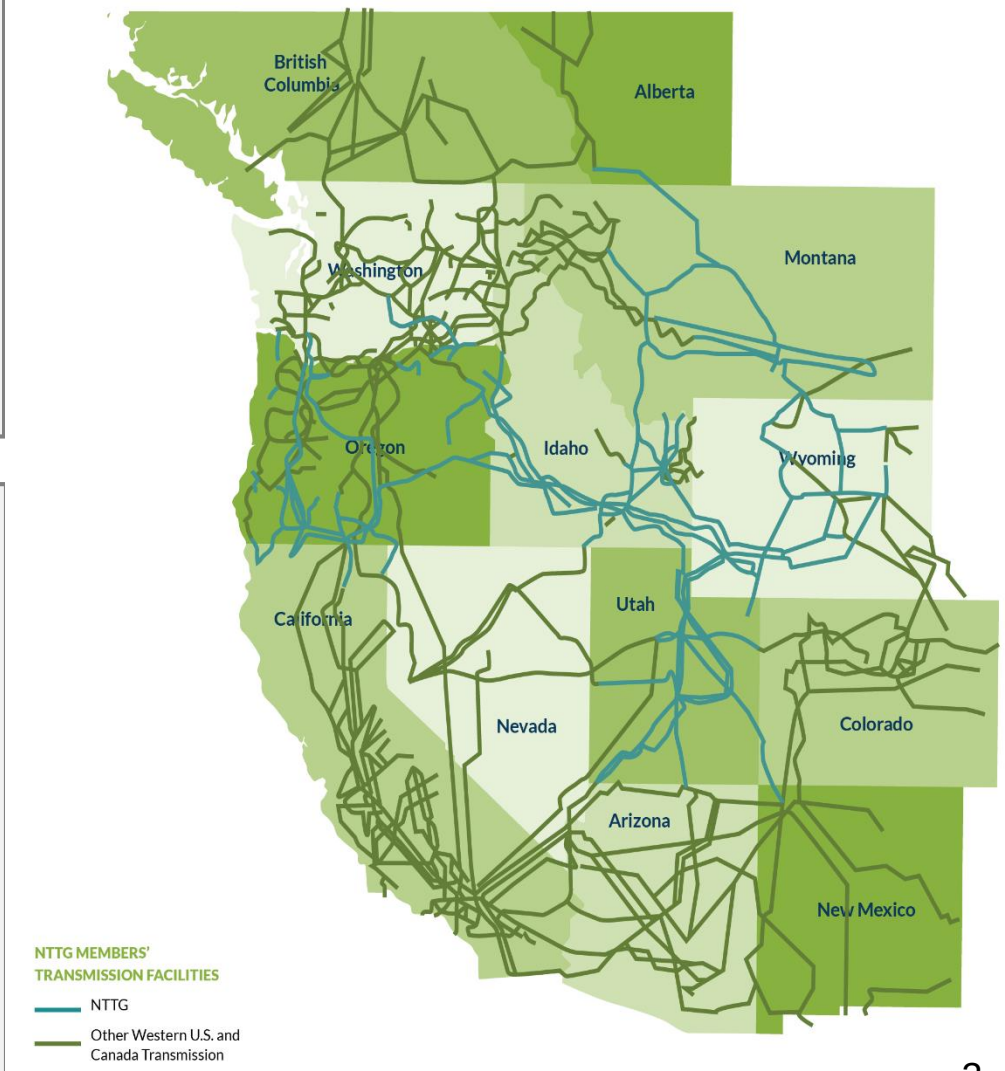
Northern Tier Transmission Group

Participating Utilities

Deseret Power Electric Cooperative
Idaho Power
MATL LLP
NorthWestern Energy
PacifiCorp
Portland General Electric
Utah Associated Municipal Power Systems

Participating State Representatives

Idaho Public Utilities Commission
Montana Consumer Counsel
Montana Public Service Commission
Oregon Public Utility Commission
Utah Office of Consumer Services
Utah Public Service Commission
Wyoming Office of Consumer Advocates
Wyoming Public Service Commission



Planning Process Flow Map

INITIAL REGIONAL PLAN (IRP)
NON-COMMITTED PROJECTS

- Boardman to Hemingway (B2H)
- Energy Gateway South (Gateway S)
- Energy Gateway West (Gateway W)
- Antelope Projects

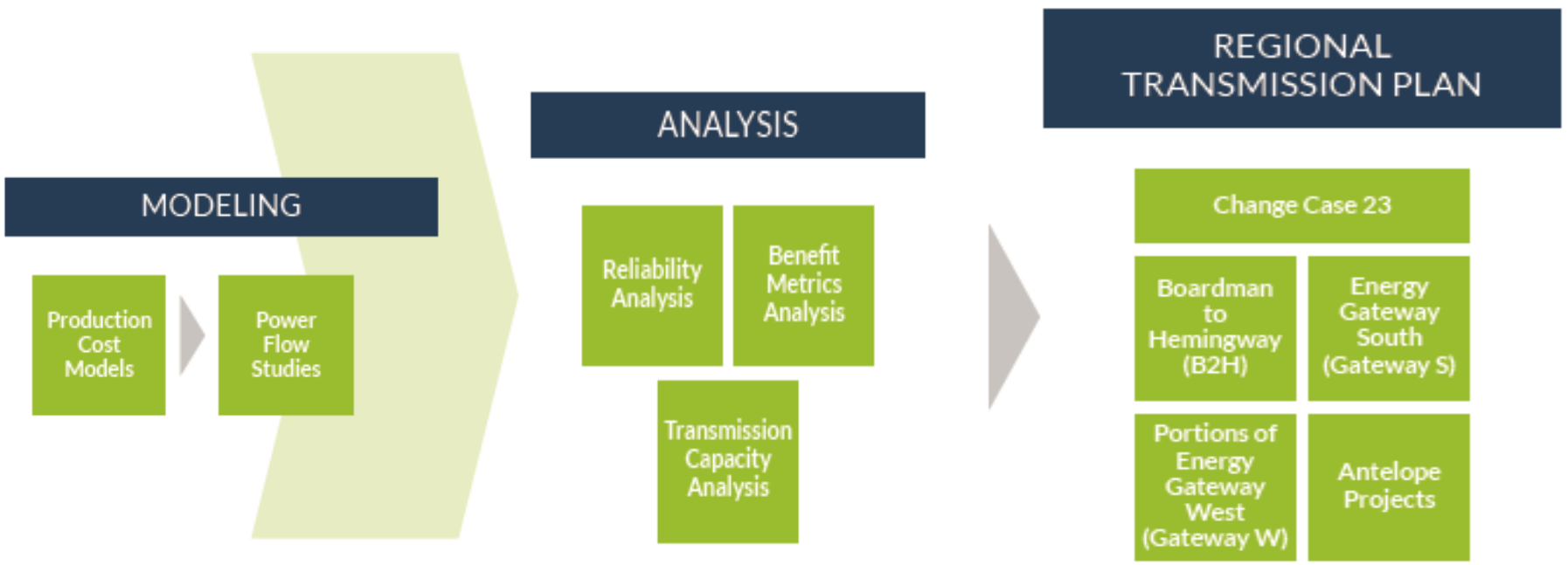
INTERREGIONAL TRANSMISSION PROJECTS

- SWIP North (SWIPN)
- Cross Tie
- TransWest Express (TWE)

CHANGE CASES CONSIDERED

CASE	B2H	GATEWAY S*	GATEWAY W*	ANTELOPE PROJECTS	SWIP N	CROSS-TIE	TWE
null							
pRTP	X	X	d				
iRTP	X	X	X	X			
CC1	X						
CC2		X		X			
CC3		X	X				
CC4	X		X	X			
CC5							X
CC6						X	
CC7					X		
CC8							X
CC9		X					X
CC20		X	X				X
CC10						X	
CC11		X				X	
CC18		X	X			X	
CC12					X		
CC13			X		X		
CC19		X	X		X		
CC14		X	X		X	X	
CC15			X		X		X
CC16		X				X	X
CC17		X	X		X	X	X
CC21	X	X	a	X			
CC22	X	X	b	X			
CC23	X	X	c	X			

Planning Process Flow Map



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NTTG 2016-2017 Regional Plan Overview

Presented by
Chelsea Loomis, NTTG Planning Committee Chair

Timeline

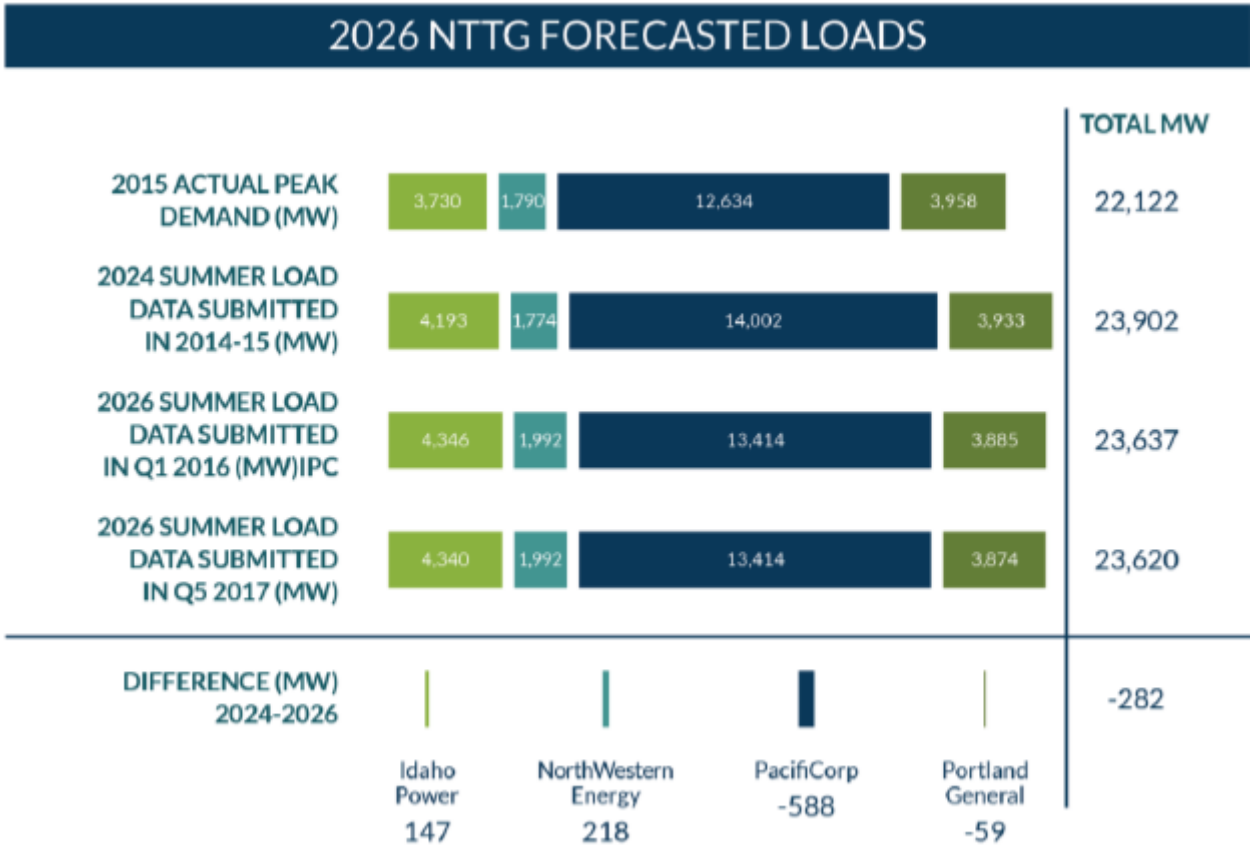

Q1-Q4
2016
Q1
Regional Transmission Plan Data Gathering and Economic Study Request Window
Q2
Study Plan Development and Approval
Q3-Q4
Run Studies
Q4
Draft Regional Transmission Plan and Economic Study Results
Q5-Q8
2017
Q5
Stakeholder Review, Data Updates and Economic Study Request Window
Q6
Cost Allocation, Draft Final Regional Transmission Plan (DFRTP)
Q7
DFRTP Review
Q8
Project Sponsor Pre-qualification for Next Cycle
Regional Transmission Plan Approval and Economic Study Results

Quarter 1 and Quarter 2

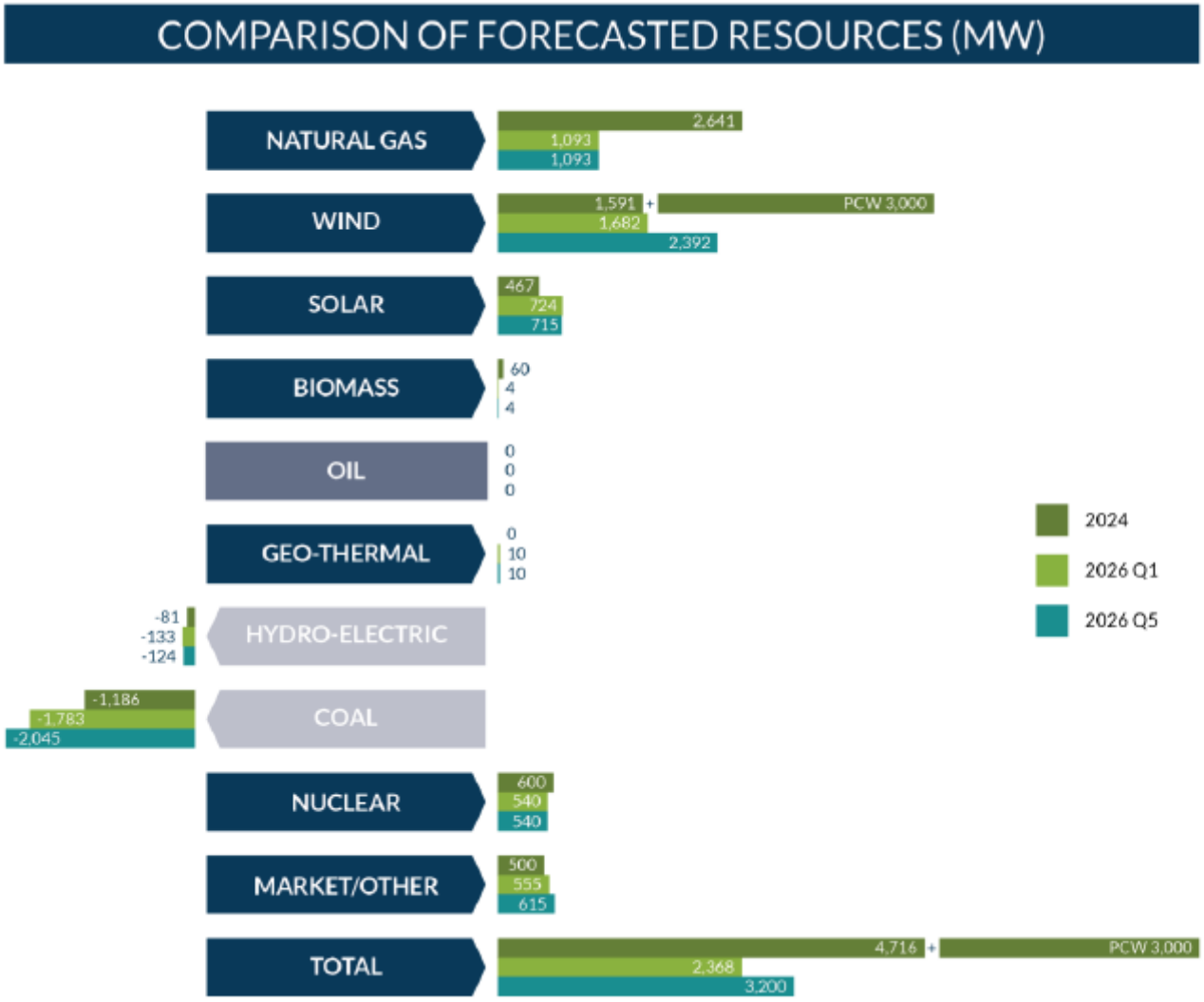
- Q1: Data Submittals
  - Load, resource, firm service, interregional projects, PPR/PPC, capital/reserves/losses
- Q2: Develop Study Plan
  - 10 year look at the system
  - Technical Work Group, composed of members of the Planning Committee
  - Approval of Study Plan from Steering Committee

SPONSOR	FROM	TO	VOLTAGE	CIRCUIT	TYPE	REGIONALLY SIGNIFICANT [6]	COMMITTED	PROJECTS
DESERET G&T	Bonanza	Upalco	138 kV	2	LTP	No	No	New Line
IDAHO POWER	Longhorn	Hemingway	500 kV	1	LTP & pRTP[7]	Yes	No	Boardman to Hemingway (B2H) Project
	Hemingway	Bowmont	230 kV	2	LTP	Yes	No	New Line (associated with Boardman to Hemingway)
	Bowmont	Hubbard	230 kV	1	LTP	Yes	No	New Line (associated with Boardman to Hemingway)
	Cedar Hill	Hemingway	500 kV	1	LTP	Yes	No	Gateway West Segment #9 (joint with PacifiCorp East)
	Cedar Hill	Midpoint	500 kV	1	LTP	Yes	No	Gateway West Segment #10
	Midpoint	Borah	500 kV	1	LTP	Yes	No	(convert existing from 345 kV operation)
	King	Wood River	138 kV	1	LTP	No	No	Line Reconductor
	Willis	Star	138 kV	1	LTP	No	No	New Line
MATL	SE Alberta		DC	1	LTP	Yes	No	MATL 600 MW Back to Back DC Converter
PACIFICORP EAST	Aeolus	Clover	500 kV	1	LTP & pRTP	Yes	No	Gateway South Project – Segment #2
	Aeolus	Anticline	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segments 2&3
	Anticline	Jim Bridger	500 kV	1	LTP & pRTP	Yes	No	345/500 kV Tie
	Anticline	Populus	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #4
	Populus	Borah	500 kV	1	LTP	Yes	No	Gateway West Segment #5
	Populus	Cedar Hill	500 kV	1	LTP	Yes	No	Gateway West Segment #7
	Antelope	Goshen	345 kV	1	LTP	Yes	No	Nuclear Resource Integration
	Antelope	Borah	345 kV	1	LTP	Yes	No	Nuclear Resource Integration
	Windstar	Aeolus	230 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #1W
	Oquirrh	Terminal	345 kV	2	LTP	Yes	Yes	Gateway Central
	Cedar Hill	Hemingway	500 kV	1	LTP	Yes	No	Gateway West Segment #9 (joint with Idaho Power)
PACIFICORP WEST	Wallula	McNary	230 kV	1	LTP	Yes	Yes	Gateway West Segment A
PORTLAND GENERAL	Blue Lake	Gresham	230 kV	1	LTP	No	No	New Line
	Blue Lake	Troutdale	230 kV	1	LTP	No	No	Rebuild
	Blue Lake	Troutdale	230 kV	2	LTP	No	No	New Line
	Horizon	Springville Jct	230 kV	1	LTP	No	No	New Line (Trojan-St Marys-Horizon)
	Horizon	Harborton	230 kV	1	LTP	No	No	New Line (re-terminates Horizon Line)
	Trojan	Harborton	230 kV	1	LTP	No	No	Re-termination to Harborton
	St Marys	Harborton	230 kV	1	LTP	No	No	Re-termination to Harborton
	Rivergate	Harborton	230 kV	1	LTP	No	No	Re-termination to Harborton
	Trojan	Harborton	230 kV	2	LTP	No	No	Re-termination to Harborton

Q1: Forecasted Loads



Q1: Forecasted Resources



Q1: Firm Service

Q1: Public Policy Consideration

- NTTG received one combined request from Renewable Northwest and the Northwest Renewable Energy Coalition
- Accelerated phase out of Colstrip Unit 3 (CS units 1 and 2 already assumed offline)
- Analysis was performed in Q5

Interregional Projects

- Cross-Tie: 500 kV AC, 213 miles, 1500 MW
- SWIP: 500 kV AC, 275 miles, 2000 MW
- Transwest Express: ±600 kV, 730 miles, phased 1500/3000 MW

Q2: Development of Study Plan

- Methodology
- Assumptions
- Software to be used
  - Production Cost Modeling: GridView
  - Power flow: PowerWorld
- Criteria
- Public Policy Requirements/Considerations

Study Plan Considerations

- NTTG assumed firm service for new projects
  - A note has been added to the data submittal form to clarify if new generation has associated firm transmission
- Goal: Find the “more efficient or cost effective” combination of projects

Development of Base Cases

- “Round Trip” process
- Started with WECC 25hs1a (PF) and WECC TEPPC CC1.3 (PCM)
- Ran PCM which resulted in 8760 hours
- Selected 7 Stress cases from the 8760 hours
- Converted those PCM cases back to transient-stability ready PF cases

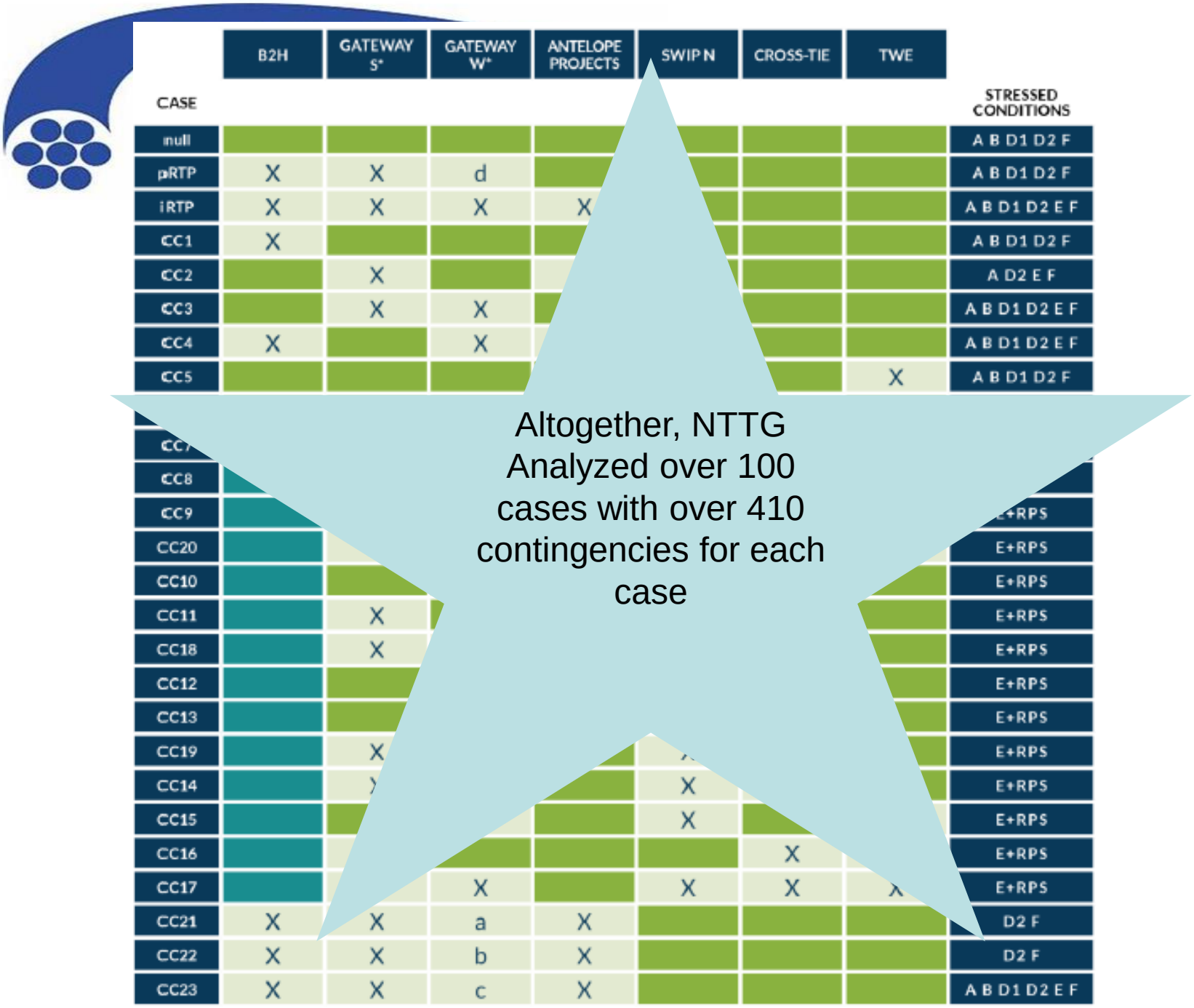
The 7 Power Flow Base Cases

STRESSED CONDITION	DATE	HOUR	TWG LABEL
Max. NTTG Summer Peak	July 22, 2026	16:00	A
Max. NTTG Winter Peak	December 8, 2026	19:00	B
Max. MT to NW	September 10, 2026	Midnight	C
High Southern Idaho Import	June 11,2026	14:00	D1
High Southern Idaho Export	September 17, 2026	2:00	D2
High Tot2 Flows	November 11, 2026	17:00	E
High Wyoming Wind	September 17, 2026	2:00	F

Change Cases

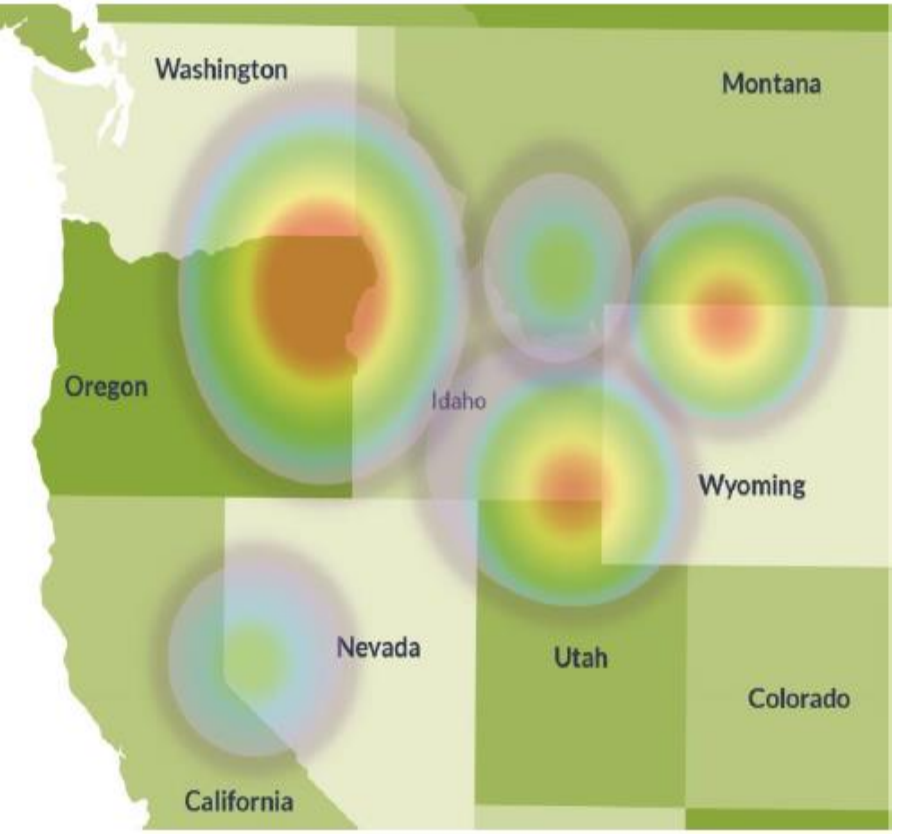
- Null Case: Today's topology with forecasted changes
- Start with the Initial Regional Transmission Plan
  - Rollup of projects identified in the local plans AND those from the prior Regional Plan
- Scenarios where one or more of the Alternative Projects is added to or replaces one or more Non-Committed project in the Initial Regional Transmission Plan

CASE	B2H	GATEWAY S*	GATEWAY W*	ANTELOPE PROJECTS	SWIP N	CROSS-TIE	TWE	STRESSED CONDITIONS
null								A B D1 D2 F
pRTP	X	X	d					A B D1 D2 F
iRTP	X	X	X	X				A B D1 D2 E F
CC1	X							A B D1 D2 F
CC2		X		X				A D2 E F
CC3		X	X					A B D1 D2 E F
CC4	X		X	X				A B D1 D2 E F
CC5							X	A B D1 D2 F
CC6						X		A B D1 D2 F
CC7					X			A B D1 D2 F
CC8							X	E+RPS
CC9		X					X	E+RPS
CC20		X	X				X	E+RPS
CC10						X		E+RPS
CC11		X				X		E+RPS
CC18		X	X			X		E+RPS
CC12					X			E+RPS
CC13			X		X			E+RPS
CC19		X	X		X			E+RPS
CC14		X	X		X	X		E+RPS
CC15			X		X		X	E+RPS
CC16		X				X	X	E+RPS
CC17		X	X		X	X	X	E+RPS
CC21	X	X	a	X				D2 F
CC22	X	X	b	X				D2 F
CC23	X	X	c	X				A B D1 D2 E F


B2H
GATEWAY S*
GATEWAY W*
ANTELOPE PROJECTS
SWIP N
CROSS-TIE
TWE
CASE
STRESSED CONDITIONS
null A B D1 D2 F
pRTP X X d A B D1 D2 F
iRTP X X X X A B D1 D2 E F
CC1 X A B D1 D2 F
CC2 X A D2 E F
CC3 X X A B D1 D2 E F
CC4 X X A B D1 D2 E F
CC5 X A B D1 D2 F
CC8
CC9
CC20 E+RPS
CC10 E+RPS
CC11 X E+RPS
CC18 X E+RPS
CC12 E+RPS
CC13 E+RPS
CC19 X E+RPS
CC14 X E+RPS
CC15 X E+RPS
CC16 X E+RPS
CC17 X X X E+RPS
CC21 X X a X D2 F
CC22 X X b X D2 F
CC23 X X c X A B D1 D2 E F
Altogether, NTTG Analyzed over 100 cases with over 410 contingencies for each case

Results: Heat Map Example

D2: Null Case, demonstrates violations

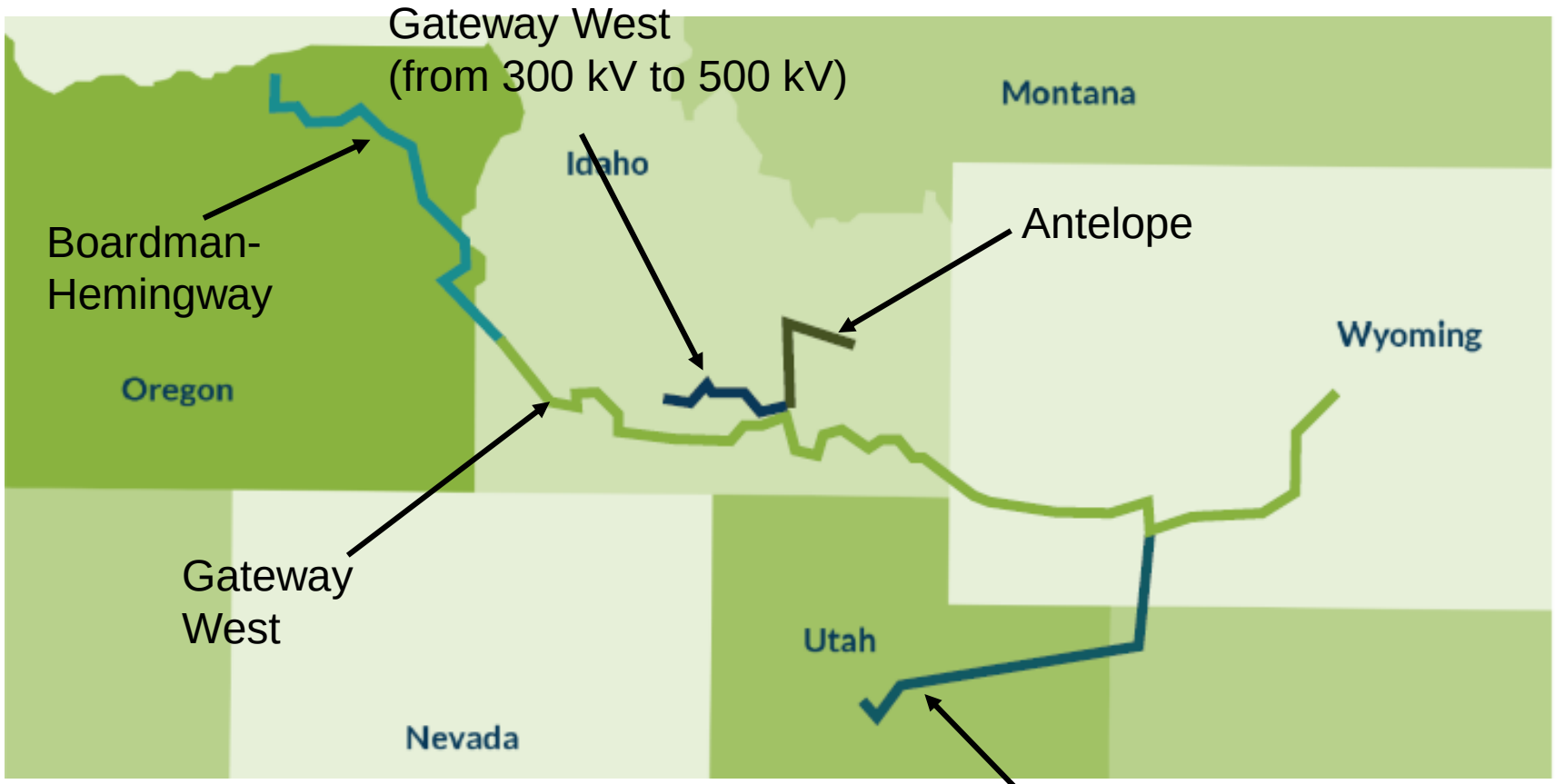


D2: Initial Regional Plan, demonstrates improvement from Null Case analysis

Results (cont.)

- Initial RTP, change case 21 and change case 23 satisfy reliability criteria
- Further evaluation after the Q5 data submittal indicated that change case 23 is the configuration that meets the needs of the NTTG footprint as well as being the most cost effective

Projects Selected into NTTG's Regional Transmission Plan



Questions

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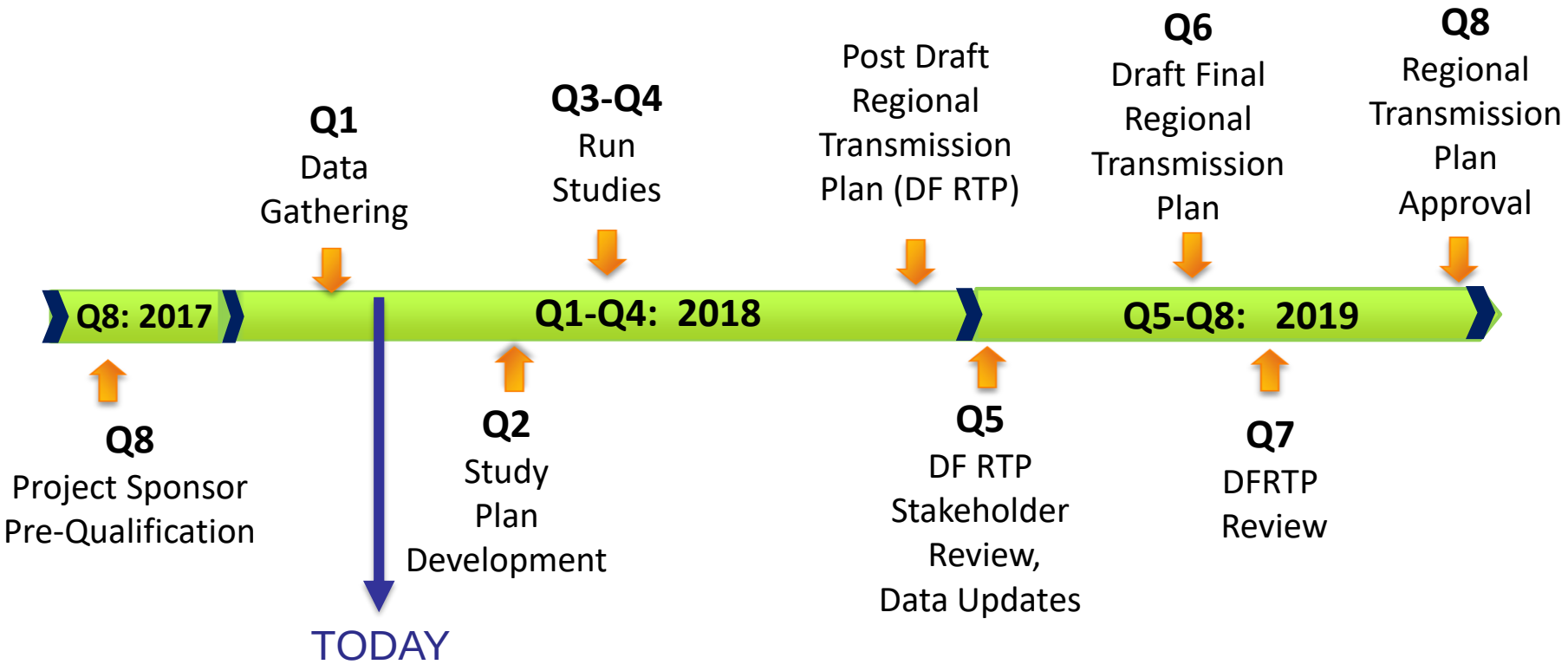
NTTG 2018-2019 Planning Activities

Presented by
Sharon Helms, NTTG Program Manager

2018-2019 Process Timeline



Key 2018 Planning Milestones

Milestone	Key Dates
Q1 Data Submittal Window Closes • Projects, NTA's and ITP's • Local TP Plans/Needs • Public Policy Consideration Studies • Economic Congestion Studies • Stakeholder Meeting – Portland, Oregon	**March 31, 2018** April 26, 2018
2018-19 Study Plan Posted for Stakeholder Comment • Stakeholder Meeting – Boise, Idaho	May, 2018 June 21, 2018
2018-19 Study Plan Approval	**July 10, 2018**
Q3-Q4 Reliability and Economic Analysis • Stakeholder Meeting – Bozeman, Montana • Stakeholder Meeting – SLC, Utah	 September 27, 2018 December 13, 2018
2018-19 Draft Regional Transmission Plan Posted	**December 31, 2018**

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NTTG Use of ADS in 2018-2019 Biennial Cycle

Presented by
Ron Schellberg, NTTG TWG Project Manager

NTTG Use of 2028 ADS in Studies

- The ADS forms the basis for its studies, subject to:
  - A consistency check with the Prior Regional Transmission Plan (pRTP) and Quarter 1 data submittals (due March 31st)
  - There are known differences between the 28hs1a Powerflow case which is the basis of the 2028 ADS and the pRTP
    - Mostly missing resources, but there may be also bulk transmission addition difference as well.
- Change files will be developed in layers to track recommended changes to draft ADS (delivered in March 2018) that should be incorporated into the Final 2028 ADS (delivered in June 2018), for example:
  - Layer 1 – Missing resources and transmission missing from draft ADS based upon pRTP
  - Layer 2 – Changes necessary to reflect Q1 Data submittals

NTTG Use of 2028 ADS in Studies

- Studies are performed and managed by the Technical Workgroup, comprised of NTTG members with study expertise. The Technical Workgroup reports to the NTTG Planning Committee.
- NTTG will review and validate modified ADS prior to performing studies
- Typically, NTTG will select 6+ conditions for study, which may include:
  - Heavy Summer Peak NTTG loads
  - Heavy Winter Peak NTTG Loads
  - Selected stressed path conditions:
    - Colstrip System
    - Tot 2 with North-to-South flows
    - Low/High renewable production (no change in installed capacity)

NTTG Use of 2028 ADS in Studies

- NTTG will use the ADS to extract study seed conditions for its studies
  - These seed conditions may need to be adjusted to meet the study objectives. Examples:
    - Heavy Summer and Winter NTTG co-incident loads will be scaled from 1 in 2 to 1 in 5 and/or 1 in 10 probability
    - Adjust interchange/resource dispatch to meet path flow targets.
- NTTG will study a subset of these conditions using today's network topology (Null Case)

NTTG Use of 2028 ADS in Studies

- NTTG typically analyzes each condition with over 400 single and credible double contingencies.
- NTTG depending on contingency results, additional dynamic simulations may be performed.
- Results will be tabulated or displayed in heat-map form in a manor that does not expose CEII
- Studies will begin in July and a draft study report will be drafted and available by the end of the year.