WestTEC REC Meeting

Update on 10-Year & 20-Year Studies
Presented by Energy Strategies

December 11th, 2025

ENERGY STRATEGIES

Agenda

- **10-Year Report**
  - Update on Delivery to Steering
- **20-Year Timeline**
  - 2026 Plan for 20-Year Study
- **20-Year Reference Case**
  - Preliminary Hypothesis Map
  - Preliminary Loads
  - Preliminary PCM Results
- **20-Year Scenarios**
  - Busbar Mapping Resources
- **Assessments**
  - Discussion on 20-Year Assessments (IDA, Benefits, Extreme Event)

Update on 10-Year Report & WATT Review Timeline

10-Year Report

- **Energy Strategies team has drafted the 10-year report. The report includes:**
  - A 6-page executive summary
  - A 20-page report
  - Technical appendices with supplemental data & methodology
- **Energy Strategies facilitated the following review period for the WestTEC 10-year report:**
  - **Energy Strategies Drafts Report:** Today – Wednesday, November 5th
  - **WATT and REC Review Period:** Thursday, November 6 - Thursday, November 20th
  - **Energy Strategies Edits Final Report:** Friday, November 21st – Monday, December 8th
  - ★ **Steering Committee Review Period:** Tuesday, December 9th – Tuesday, December 16th
- **Assuming Steering approval, report to be published in February 2026**

10-year Horizon Study Summary

Introduction

The West faces a growing list of challenges, including concerns over supply shortages, the need to quickly connect new resources and loads, a complex checker board of wholesale markets, and mounting pressures that comes with the fact that strong and stable economic growth is increasingly dependent on the affordability and availability of electricity. A common thread amongst these challenges is transmission – the mission-critical network of lines and equipment that enables the day-to-day operations of society. While Western transmission companies have processes for expanding *local* grids, there is no parallel for planning the sometimes large but always critical *interregional* transmission lines that connect our regions and states. These interregional lines are part of the solution and are of growing importance but are widely agreed to be in short supply.

Enter WestTEC – a new industry-led and uniquely Western enterprise focused on addressing this interregional planning gap with actionable transmission projects that enhance reliability while supporting economic efficiency and state goals. WestTEC, which is led by an unprecedented number of regional partners, including utilities, planning bodies, state and tribal governments, public interest organizations, and infrastructure companies, is:

- **Entirely voluntary** – not another compliance exercise
- **Informational** – complementary and not replacing other planning process
- **Integrated and consolidated** - avoiding siloed planning in favor of a system-wide view
- **Innovating Western planning** - offering actionable transmission projects that can be pursued by others

WestTEC will perform two studies for the benefit of industry: this ***10-year Horizon Study*** focused on near-term, actional transmission upgrades needed by 2035, and a subsequent

20-Year Study: Plan for 2026

WestTEC 20-Year Study Timeline Update

Case	Task	Q1 2026	Q2 2026	Q3 2026	Q4 2026	Q1 2027
Reference	Case & Methodology Development					
	Transmission Assessments/ Solutioning					
	Benefits/Extreme Event Assessments					
Scenarios (Flux & Core)	Busbar Mapping					
	Case & Methodology Development					
	Transmission Assessments/ Solutioning					
	Benefits/Extreme Event Assessments					
20-Year Portfolio	Portfolio Synthesis					
	Report Editing & Review					
	Stakeholder Engagement					

All-Committees Meeting Proposed Itinerary: January 21st 2026

Reference Case

- Present Reference Case Hypothesis Map
- Present Preliminary PCM and SRA Models with Reference Map Transmission
- Present Preliminary Hypothesis Map Refinements
- Present Busbar Mapped Point Loads for the Reference Case

Scenarios

- Present Busbar Mapped Resources for the Flux/Core Scenarios
- Present Preliminary Hypothesis Maps for the Flux/Core Scenarios

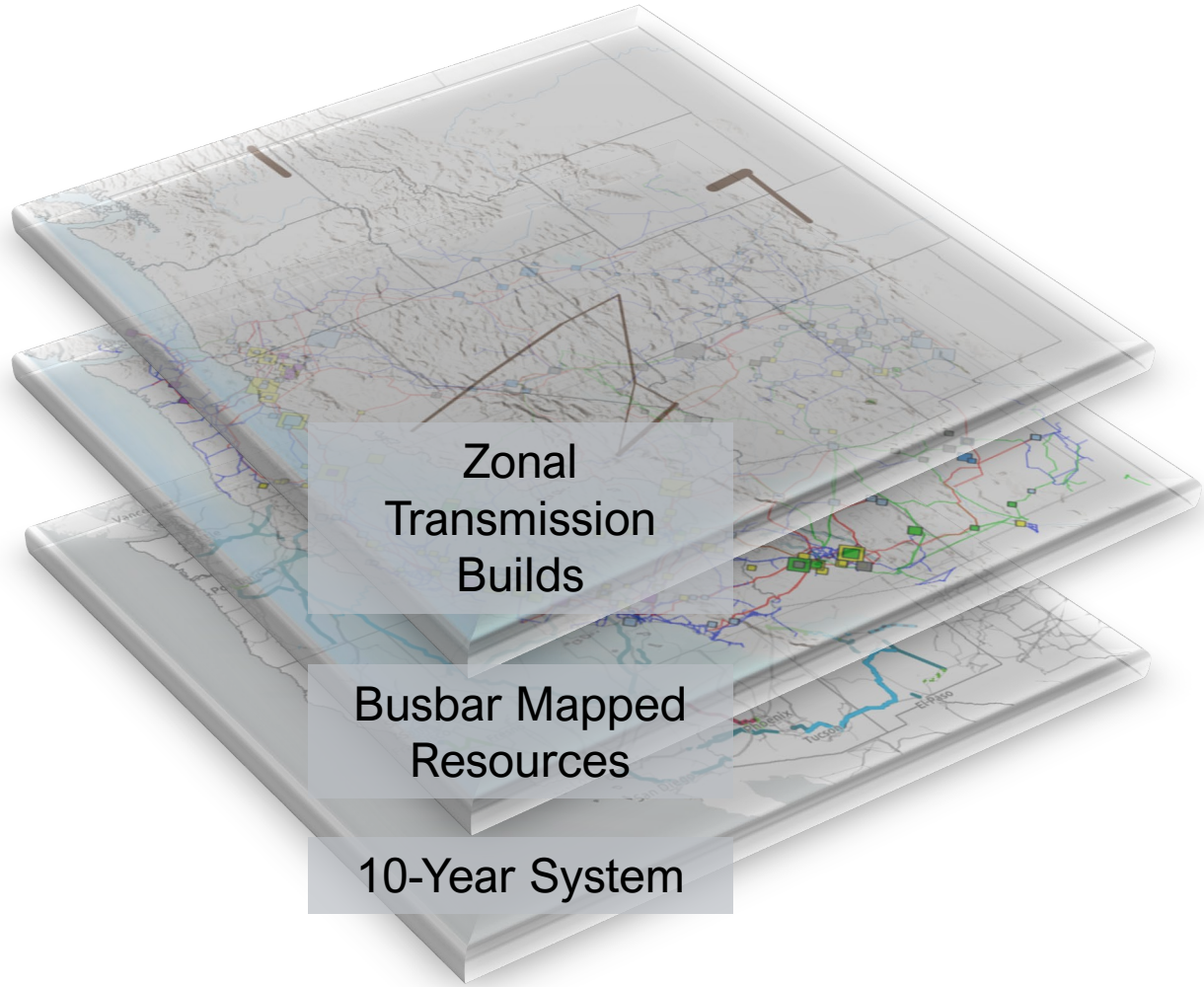
Assessments

- Propose a Preliminary Framework for 20-Year Interarea Deliverability Assessment (IDA)
- Propose a Preliminary Framework for Assessing Transmission Benefits
- Propose a Preliminary Extreme Event Assessment Methodology

20-Year Reference Case

20-Year Reference Case Development: Overview

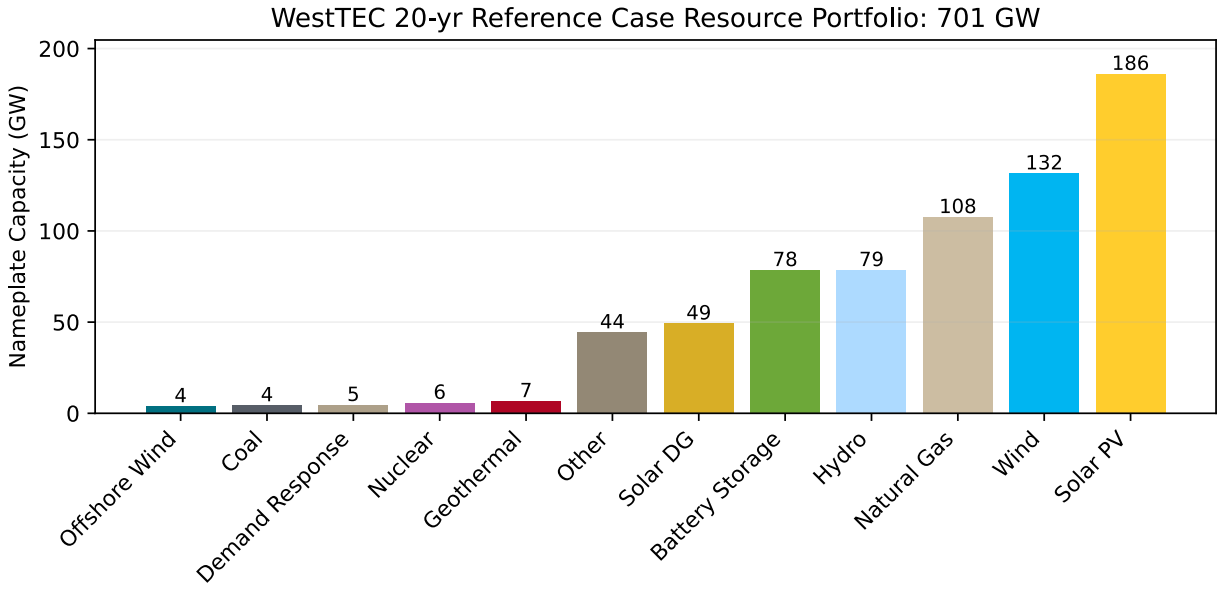
- **Kickoff:** Energy Strategies has kicked off development of 20-year reference case nodal models & hypothesis map
  - Team is developing production cost model and system reliability assessment (SRA) power flow models in parallel using 10-year final cases as a starting point
- **Loads:** E3 will be providing Energy Strategies the incremental load growth levels assumed in capacity expansion models for the 2045 reference case
  - Energy Strategies will develop area-level load profiles for the 20-year reference case, but **will likely seek WATT feedback to "busbar map" large point loads and data centers.**
  - Using this feedback, we will create an updated load distribution table
- **Resources:** Team has completed a 20-year Resource Table and is actively importing these into a PCM
- **Transmission:** Energy Strategies is developing a hypothesis Map for the 20-year reference case using:
  - Location of Busbar Mapped Resources
  - Overlay of E3 Zonal Transmission Upgrades
  - Other Data & Information from 10-Year Study as Needed
- **Contingencies:** Energy Strategies is currently brainstorming methods to developing contingency alternatives for WECC path ratings in 20-year models

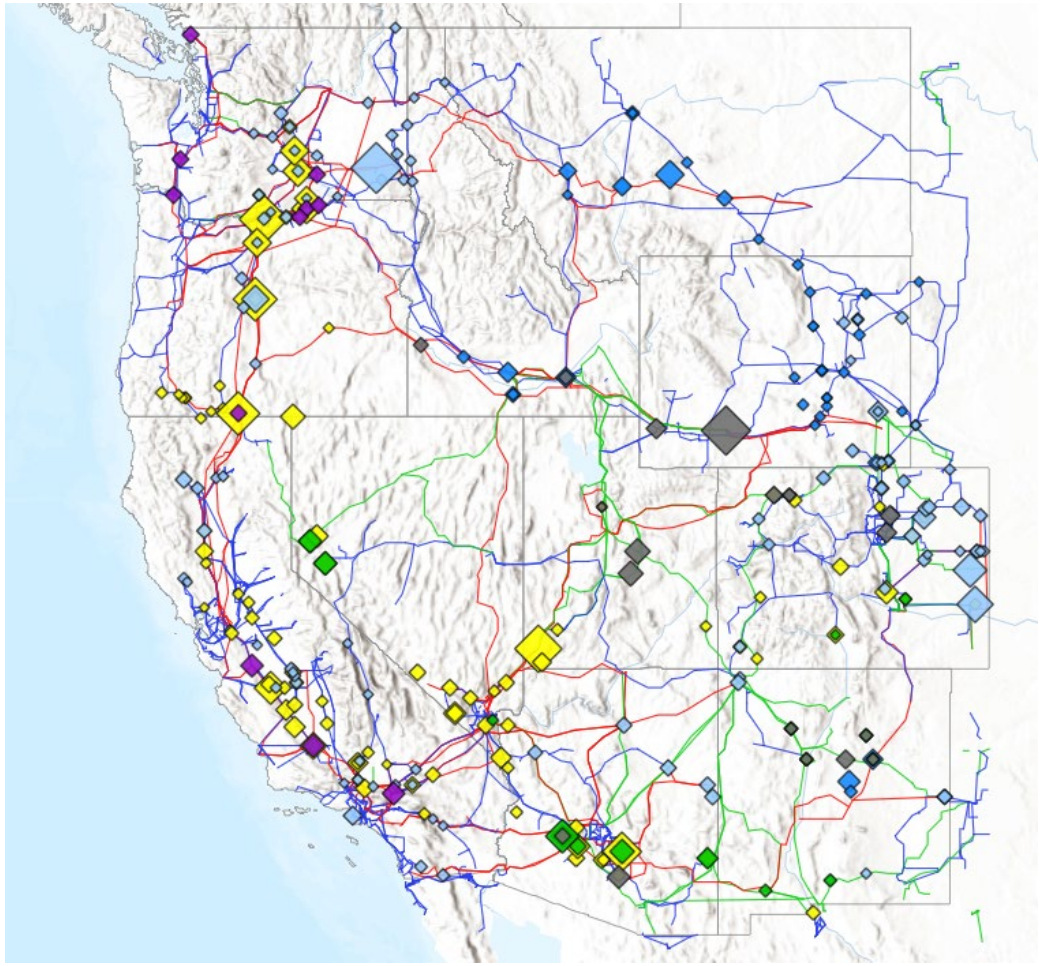


20-Year Resources

- Starting Point
  - 10-Year WestTEC resource buildout
    - Planned retirements were allowed to retire naturally
  - 2024-25 CAISO TPP resources from 2034 to 2039 case

- 20-year CapEx reference builds





20-Year Loads

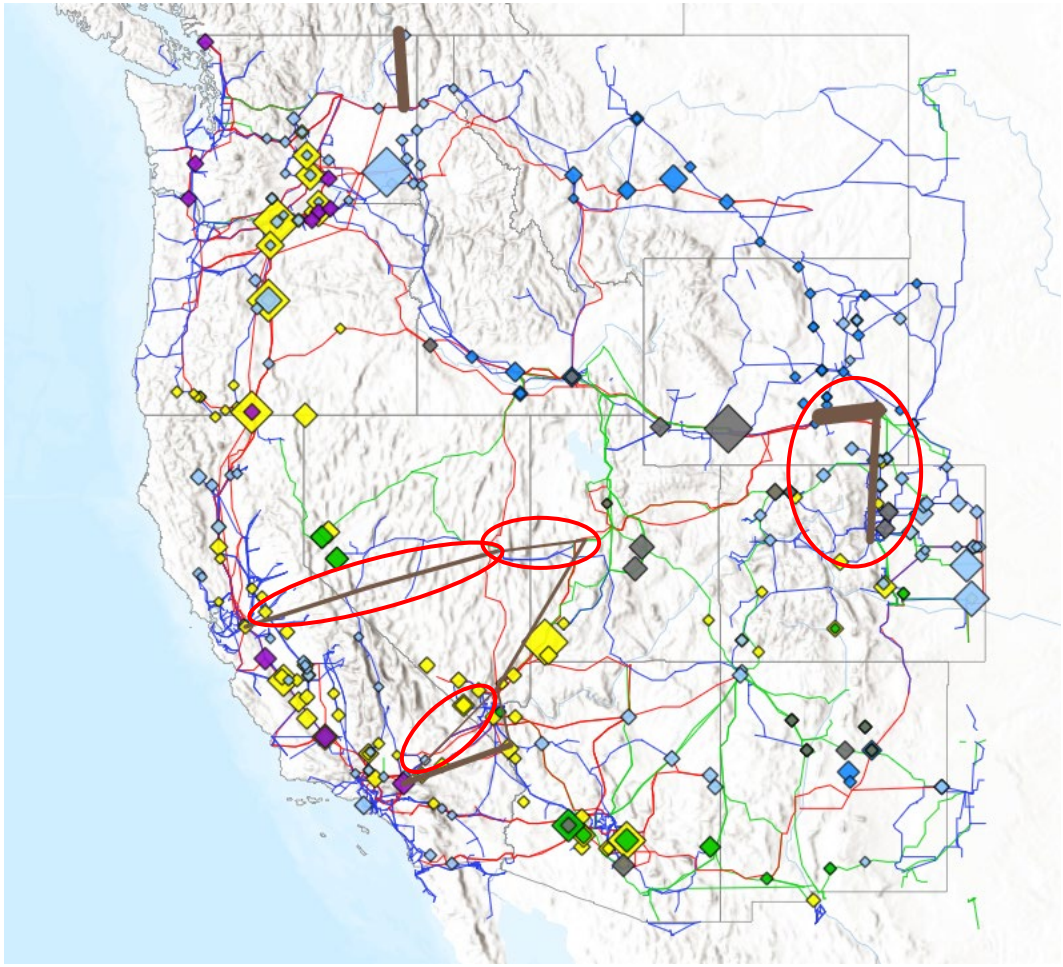
- E3 provided Energy Strategies a workbook containing BA-level loads assumed in the 2045 reference case
  - Energy Strategies translated these to the GridView Area topology, which is slightly different than E3's PLEXOS model
  - Used E3's GV Area to PLEXOS area mapping to create **preliminary** 2045 PCM loads
- Assumed the same "distribution" of loads across nodes in a load area as in the 2035 Reference Case for now
  - However, we would like to work with WATT to site data center loads – will do this concurrently with siting resources for the two scenarios
  - Using this feedback, we will create an updated load distribution table

US Western Interconnection	Peak (MW)	Avg MW	Annual Energy (GWh)
2035	192,955	120,273	1,053,593
2045	225,616	142,910	1,251,889
Increase	**32,661**	**22,636**	**198,296**
Percent Increase	**16.9%**	**18.8%**	**18.8%**

20-Year Hypothesis Map Development

- Energy Strategies is developing a hypothesis map for the 20-year reference case using:
  - Location of busbar mapped resources
  - Overlay of E3 zonal transmission upgrades
  - Other data & information from 10-Year Study as needed
- Preliminary hypothesis map included additional capacity between:
  - PSCO, WACM, and PacifiCorp WY
  - PacifiCorp Utah and Nevada
  - Northern Nevada to Northern California
  - Southern Nevada to Southern California
- Each of these upgrades represent additional inter-BA transfer capability that was required for economic transfers in the capacity expansion model
- This represents a starting point that we will use a combination of production cost modeling and Powerflow modeling to iterate and refine

Zonal Hypothesis Map



Preliminary 20-Year PCM High Level Results

Supply and demand:

		2035 v3.4	2045 v0.1
Generation	***Generation (MWh)***	1,379,496,252	1,622,834,571
Generation	***Pumping (MWh)***	-143,898,820	-201,205,296
Load	***Served_Load (MWh)***	1,235,597,349	1,421,629,244
Transmission	***Import/Losses (MWh)***	-6	-4

Curtailment:

Generation	***Dumped_Energy (MWh)***	19,851,923	126,830,506
Load	***Unserved_Load (MWh)***	0	2,022

20-Year Flux & Core Scenarios

Resources & Busbar Mapping Update

Busbar Mapping Principles

- Resource Busbar Mapping follows same approach as Reference Case
  - Initial mapping suggestions by ES
  - WATT Review & Edits
  - Regional Review
  - Implementation into Nodal Model
- Scenarios can and should have different siting strategies, so appreciate critical thinking from this group about how to accomplish that given data and timeframe
  - ES may place things in similar locations as the Reference case, but should think about how these futures may impact siting decisions
- **ES proposes to facilitate a WATT review process for Flux and Core Busbar Mapping from December 22nd - January 19th**
  - Will post data for review by WATT onto sharepoint over the holidays
  - Will likely hold region-specific calls to review busbar mapping and “fill in gaps” in early January

Core Scenario Busbar Mapping

- **No busbar mapping of solar or wind (each region has less solar & wind than it did in the reference case)**
  - Plan to scale down wind and solar directly and then can work with WATT on re-mapping
- **Battery: Scale up region-by-region and then work with WATT to re-map**
- **Hydrogen: There is no hydrogen**
- **Nuclear: Need to map 7.1 GW of Nuclear in the PNW (PNW_NE)**
  - Working w NW Stakeholders to site
- **Natural Gas: 3 regions with more gas; 1 with less; All regions already have a busbar mapped gas gen so plan to just scale up or down as a starting point**
  - Need a good plan for EPE as we're going from 48 to 1,400 MW

Core – Reference E3 Buildout Deltas

Region	Natural Gas	Nuclear	Hydrogen	Solar	Wind	Battery Storage	Total
AZPS	0	0	0	0	-1,149	2,833	1,683
CA_NP15	0	0	-3,726	-588	-2,203	0	-6,516
CA_SP15	0	0	0	0	-1,580	0	-1,580
CA_ZP26	0	0	0	-3,596	-1,474	8,054	2,984
EPE	1,401	0	0	-3,841	-1,277	-2,421	-6,138
IPCO	0	0	0	0	-1,756	0	-1,756
NEVP	0	0	0	0	-1,485	397	-1,088
NWMT	0	0	0	0	-1,779	0	-1,779
PACE	315	0	0	-5,503	-1,085	0	-6,273
PNM	-479	0	0	-1,657	-960	3,149	53
PNW_NE	0	7,176	0	-11,058	-10,903	0	-14,786
PNW_NW	0	0	0	0	0	0	0
PNW_SE	0	0	0	-4,824	-2,516	0	-7,340
PNW_SW	0	0	-5,472	-1,004	0	0	-6,476
PSCO	0	0	0	-1,132	-5,222	1,171	-5,184
SRP	0	0	0	0	0	662	662
TEPC	0	0	0	-9,592	0	-5,674	-15,265
WACM	487	0	0	-2,712	-5,810	1,412	-6,624
WALC	0	0	0	0	0	610	610
WAUW	0	0	0	0	0	9	9
Total	1,723	7,176	-9,197	-45,506	-39,200	10,201	-74,803

Flux Scenario Busbar Mapping

- **61 GW of additional Solar and 39 GWs of additional wind**
  - Start by scaling up existing locations & work with WATT to re-map
- **Battery: 45 GW more than reference case; scale up region-by-region and then work with WATT to re-map**
- **Hydrogen: 21 GWs of Hydrogen**
  - Need locations for additional large firm resources in CA, IPCO, PACE, PNW_SW, and WACM
  - Can also distribute these out amongst other zones within the region
- **Nuclear: There is no nuclear in the Flux scenario**
- **Natural Gas: No incremental gas in the Flux Case… can likely use some of these locations to site hydrogen.**

Flux – Reference E3 Buildout Deltas

Region	Natural Gas	Nuclear	Hydrogen	Solar	Wind	Battery Storage	Total
AZPS	0	0	0	9,909	8,981	6,732	**25,621**
CA_NP15	0	0	6,019	0	2,614	3,229	**11,862**
CA_SP15	0	0	3,707	0	0	0	**3,707**
CA_ZP26	0	0	0	0	0	13,099	**13,099**
EPE	-48	0	42	1,687	402	1,797	**3,878**
IPCO	0	0	2,820	3,761	3,276	0	**9,858**
NEVP	0	0	0	0	54	1,365	**1,419**
NWMT	0	0	0	0	1,553	0	**1,553**
PACE	-4,000	0	2,798	6,253	4,522	0	**9,574**
PNM	-3,770	0	42	7,783	1,135	4,321	**9,512**
PNW_NE	0	0	0	5,148	3,854	0	**9,002**
PNW_NW	0	0	0	0	0	0	**0**
PNW_SE	0	0	0	3,183	3,744	534	**7,461**
PNW_SW	0	0	4,044	4,221	0	0	**8,265**
PSCO	0	0	0	2,450	2,686	2,371	**7,506**
SRP	0	0	0	3,971	0	861	**4,832**
TEPC	0	0	0	1,299	0	3,222	**4,521**
WACM	-1,312	0	2,155	832	4,375	1,317	**7,367**
WALC	0	0	0	10,988	2,228	6,762	**19,978**
WAUW	0	0	0	0	0	0	**0**
Total	**-9,130**	**0**	**21,627**	**61,484**	**39,423**	**45,609**	**159,015**

20-Year Supplemental Assessments

Preliminary Brainstorming for the IDA, Benefits, and Extreme Events Assessments

Benefits Assessment

- A large part of making the 20-Year study “actionable” is quantifying transmission benefits
- WestTEC study plan proposed 7 benefits (summarized on this slide), but we recognize best practices on this topic are evolving.
  - We seek guidance from WestTEC members to inform us of best-practices on benefits assessments.
  - Will likely use ESIG 1920 Benefits Working Group to help inform
- Plan is to propose a preliminary benefits methodology at the January All-Committees meeting
  - Final benefits methodology can be finalized in Q2 2026
- Comments thus far in WATT:
  - Sensitivity around emissions benefits & how to handle state discrepancies
  - What about benefits that are difficult to quantify?
  - Will WestTEC break benefits down to sub-regional level?

Benefits Outlined in WestTEC Study Plan

Benefit	Description (Similar to WestTEC Study Plan)
Operational & Congestion Efficiencies	Change in annual adjusted production cost (APC), capturing reductions in short-run generation production costs to serve load due to reduced congestion and/or curtailment (including reduced transmission energy losses; can be enhanced to reflect outage-related impacts if modeled).
Improved Resource Adequacy (reduced loss of load probability)	Load diversity savings from greater inter-area transfer capability, enabling balancing areas to share resources that could otherwise be constrained and potentially avoid construction of capacity resources.
Capacity Savings from Reduced Peak Energy Losses	Savings in capacity costs from reduced peak energy losses, lowering the total generation capacity required to meet peak demand.
Extreme Event Mitigation (resilience benefits)	Change in cost of unserved load and/or production under tail-event stressed conditions (high loads, generation unavailability, transmission outages, weather and other factors); valued using VOLL for avoided load curtailments.
Increased Resource Access	Savings from accessing higher-value resources due to transmission expansion; estimated via counterfactual scenarios and reflected as reductions in capital costs of the resource portfolio.
Avoided Emissions	GHG emission reductions due to transmission expansion and enabled resources, quantified using carbon cost and discount rate analysis.
Avoided or Deferred Reliability Upgrades	Avoided cost of reliability upgrades that would otherwise be needed; identified via powerflow results comparing facility loading (near/over thermal limits) with and without the transmission portfolio and estimating upgrade/replacement costs.

Extreme Event Assessment

- From Study Plan: WestTEC has received interest in the modeling of extreme events. This scenario will be a **Powerflow study** designed to test the performance of the transmission portfolio under extreme weather events and/or a limited set of contingencies representing outages consistent with high impact low probability events (such as transmission outages due to wildfires).
- Examples of such events include a heat dome, polar vortex, or similar condition that reflects high/low temperatures and impact on demand, changes in hydroelectric output, low wind or solar production, restrictions on imports, transmission outages, and impacts to generation availability through unplanned outages.
- WestTEC will develop a detailed scope for this assessment during the scenario development process that will initiate upon completion of this study plan.
  - Intended to be a post-hoc test of how a transmission portfolio enables system operations during an extreme weather event
  - Likely used to identify an extreme event benefit
  - ESIG working group for FERC 1920 coalescing around using **PCM**, assigning a value to lost load, and then weighting results probabilistically
- **We also welcome feedback from this group via email, or in a short-form presentation next WATT meeting, as to best practices or things you'd like this assessment to include.**

20-Year Interarea Deliverability Assessment

- Energy Strategies worked with WATT to identify a robust IDA assessment for the 10-year study
- We would like to work with WATT to identify the conditions, flowgates, and IDA transmission mitigations that are important in the 20-year timeframe

Thank you. Questions?