



California ISO

ISO 2016-2017 Transmission
Planning Process

Interregional Transmission Project (ITP)
Evaluation and 50% RPS Out-of-State
Portfolio Assessment

January 4, 2018

Contents

1 Background1

2 Objectives2

3 Study components and methodology.....3

4 Assumptions and scenarios4

5 Key insights7

6 Recommendations and Next Steps.....10

1 Background

During the 2016-2017 planning cycle the ISO undertook a 50% RPS special study (2016-2017 50% RPS study) to focus on a broader investigation into the feasibility and implication of moving beyond 33% RPS from a transmission system perspective. The intent of the 2016-2017 50% RPS study was to build on the 50% studies performed as part of the ISO's 2015-2016 planning cycle to assess 50 percent California RPS portfolios under full capacity deliverability and energy only arrangements. The 2016-2017 50% RPS study expanded the scope of the initial study effort to acquire general information on system requirements within California that might be needed to import wind resources from Wyoming and New Mexico.

PREVIOUS INVESTIGATIONS OF IMPACTS OF MOVING BEYOND 33% RPS FOCUSED ON EVALUATING TRANSMISSION INFRASTRUCTURE WITHIN CALIFORNIA.

The 2016-2017 50% RPS special study accomplished the following objectives –

1. Investigated the impacts of moving beyond 33% RPS on California's transmission system
2. Tested the transmission capability estimates used in RPS calculator v6.2 and where appropriate, provided updates to these transmission capability estimates; and
3. Carried out a preliminary examination of transmission implications of meeting part of California's 50 percent RPS requirement by assuming California's procurement of 2000 MW of wind resources in Wyoming and 2000 MW of wind resources in New Mexico.

The results of that analysis are documented in Section 6.3 of the ISO 2016-2017 Transmission Plan¹.

Drivers behind this Interregional Transmission Projects (ITP) Evaluation and 50% RPS Out-of-state Assessment

1. Based on insights gained from 2016-2017 50% RPS special study and consequent stakeholder feedback regarding the out-of-state portfolio assessment, the ISO decided to embark on a supplemental effort this year to further assess the feasibility of delivering the 50% RPS out-of-state portfolio from Wyoming and New Mexico to corresponding injection points within the ISO Balancing Authority Area (BAA).

¹ http://www.caiso.com/Documents/Board-Approved_2016-2017TransmissionPlan.pdf

2. As part of the interregional coordination efforts, the ISO also embarked on an extensive outreach to the Western Planning Regions (WPRs) to refine assumptions that were crucial to evaluate the out-of-state renewable portfolio. This outreach pointed to significant transmission topology assumption refinements that were warranted for the system outside of California owing to the fact that each Western Planning Region (WPR) assesses the ‘firmness’ of planned transmission projects using different criteria.
3. The ISO decided to leverage this work being done on the out-of-state portfolio modeling to test the framework to compare effectiveness of ITPs that were submitted as part of the 2016 ITP request window.
4. The ISO also received feedback from stakeholders that production cost simulations and power flow analyses do not entirely capture the challenges with procuring adequate transmission service in order to be able to “count on” out-of-state renewable resources. This prompted an investigation into Available Transmission Capacity (ATC) along the representative paths from Wyoming to California and from New Mexico to California.

*DRIVERS BEHIND THIS ASSESSMENT
EMERGED FROM THE INSIGHTS OBTAINED
FROM THE PREVIOUS 50% RPS SPECIAL
STUDIES AND THE CONSEQUENT
STAKEHOLDER INPUT.*

This report provides the context and clarifications to accompany the more detailed study results presented on Day 2 of the September 21-22, 2017 stakeholder meeting². Appendix A of this report contains the detailed slides that dive deeper into methodology, assumptions, study scenarios, key findings and recommendations for the next steps.

2 Objectives

The overarching intent was to identify key insights about the transmission impact of out-of-state renewable resources identified by the CPUC as part of the 50% RPS out-of-state portfolio and to leverage this assessment to test-drive a framework to evaluate ITPs. The assessment was designed to meet the following four specific objectives:

1. Refine the out-of-state resource modeling and transmission topology modeling
2. Identify Available Transfer Capability that can be used by the wind resources in WY and NM in order to be delivered to CA
3. Identify transmission constraints outside of CA while trying to meet part of the 50% RPS obligation by relying on a large amount of wind resources in WY and NM

² https://www.caiso.com/Documents/Day2_ISO-Presentation_2017-2018TransmissionPlanningProcess_PreliminaryReliabilityResults.pdf

4. Test effectiveness of ITPs in mitigating observed transmission issues outside of CA and test a framework for comparing ITPs

The assessment is strictly for informational purposes. The results should not be construed as reflecting the direction of future inter-regional transmission, renewable generation development or policy direction in California and outside of California nor will this study be a basis for procurement/build decisions in 2016-2017 TPP cycle or 2017-2018 TPP cycle.

While the above objectives were communicated openly, this initiative also sparked inevitable stakeholder interest in the observations the ISO could draw from the analysis regarding comparisons between the challenges in accessing resources in potentially alternative out of state regions. This also translates into interest in comparisons between alternative interregional transmission projects as potential policy-driven transmission should future state policy direction lead to the need for greater access into the study areas. The ISO's observations in this regard are set out in section 5 of this report.

3 Study components and methodology

The assessment methodology comprised of three main components – (i) Production cost model (PCM) simulations, (ii) Power flow assessment and (iii) Available Transfer Capacity (ATC) assessment. Slides 13 through 20 of Appendix A lay out the assumptions and methodology showing sequential study components.

PCM simulations

The PCM simulations were intended to provide insight into:

- Extent of curtailment of out-of-state renewables
- Identification of transmission constraints outside of California that may results in significant amount of congestion when delivering wind resources from WY and NM to CAISO BAA
- Stressed snapshot identification for the purpose of power flow studies
- Impact of ITPs on PCM results

A THREE-PRONGED ASSESSMENT INVOLVED PRODUCTION COST MODELING SIMULATIONS, POWER FLOW ASSESSMENT AND ATC ASSESSMENT.

Power flow assessment

The intent of the power flow assessment was to –

- Identify additional transmission limitations that may not be captured by PCM studies
- To confirm the transmission system limitations identified by PCM simulation
- Capture the reliability impact of ITPs

The 8,760 hours of power system simulation created during the PCM analysis were used to identify high transmission system usage patterns to be tested using the power flow models for the reliability assessment. A contingency assessment was performed with a focus on the system outside of California.

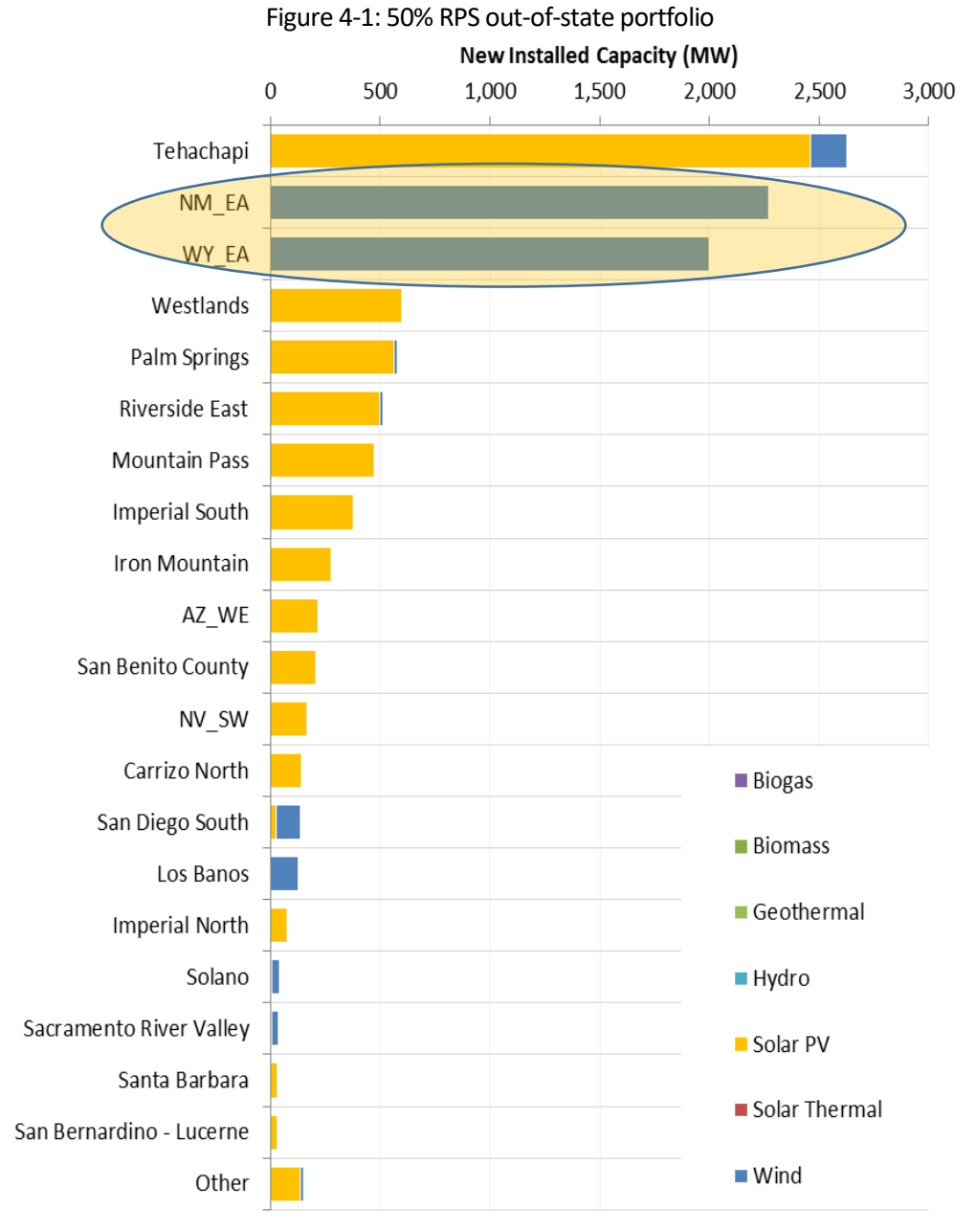
ATC assessment

As part of the ATC assessment the ISO tested if adequate ATC exists for delivering the renewable resources from Wyoming and New Mexico to the ISO BAA. At a conceptual level, this exercise can also provide us with an insight into the ‘deliverability’ of these out-of-state resources. However, the ISO believes that it is reasonable to assume that large out-of-state resource installations serving California load would not be viable without long-term firm transmission service from the point of receipt to the CAISO BAA boundary.

4 Assumptions and scenarios

The portfolio

The out-of-state 50% RPS portfolio provided by the CPUC as part of the 2016-2017 TPP was utilized as part of this Assessment. Figure 4-1 shows the top 20 zones and corresponding renewable resource capacities modeled in this portfolio. “WY_EA” and “NM_EA” zones stand for Wyoming and New Mexico wind resources that are part of this portfolio.



Primary data sources for modeling assumptions

Key assumptions impacting the assessment can be divided into two categories – (i) resource assumptions and (ii) transmission assumptions. The ISO relied on the following sources as primary data references for these assumptions –

- Models used by the ISO in 2016-2017 50% RPS study
- Information prepared by the WPRs for the development of WECC’s Anchor Data Set seed case as of Q3 of 2017
- NTTG’s biennial study plan version 3.5³ (draft as of May 29, 2017)
- WestConnect’s regional study plan for 2016-2017 planning cycle⁴

ITPs

During the first quarter of the interregional coordination cycle an “open window” was provided for project sponsors to submit ITP proposals to the planning regions for considering in their 2016-2017 regional planning cycles. On March 31, 2016 the “open window” was closed and four ITP proposals had been submitted to the ISO, NTTG, and WestConnect. A common theme among all projects was their focus on providing California long-term firm transmission access to out-of-state renewable generation in Wyoming and New Mexico to support California’s 50 percent RPS goal. Table 4-1 provides a brief description of each ITP.

Table 4-1: ITP submittals and descriptions

Proposed Project	Description
TransWest Express Transmission Project	The TransWest Express Transmission Project (TWE Project) is a proposed 730-mile, phased 1,500/3,000 MW, ±600 kV, bi-directional, two-terminal, high voltage direct current (HVDC) transmission system with terminals in south-central Wyoming and southeastern Nevada. The Relevant Planning Regions are the ISO, NTTG, and WestConnect.
Southwest Intertie Project North	The Southwest Intertie Project (SWIP) is a proposed 275 mile 500kV single circuit AC line that connects the Midpoint 500 kV substation to the Robinson Summit 500 kV substation. The SWIP is expected to have a bi-directional WECC-approved path rating of approximately 2000 MW. The Relevant Planning Regions are NTTG and WestConnect. (Note that this project was also submitted into the ISO’s regional planning process as a potential regional – e.g. ISO – economic driven project.)

³ https://www.nttg.biz/site/index.php?option=com_docman&view=document&layout=default&alias=2825-2016-17-nttg-biennial-study-plan-quarter-6-revisions-redlined-05-08-2017&category_slug=planning-committee-meeting-material-05-10-2017&Itemid=31

⁴ <https://doc.westconnect.com/Documents.aspx?NID=17180>

Cross-Tie Project	The Cross-Tie Transmission Line (Cross-Tie) project is a 213 mile 500 kV HVAC transmission project that will be constructed between central Utah and east-central Nevada. The Cross-Tie Project is expected to have a rating of approximately 1500 MW. The Relevant Planning Regions are NTTG and WestConnect.
REX HVDC	The AC to DC Conversion Project proposes to convert a portion of the 500 kV Southwest Powerlink (SWPL) to a multi-terminal, multi-polar HVDC system with terminals at North Gila (500 kV), Imperial Valley (500 kV), and Miguel Substations (230 kV). The Relevant Planning Regions are the ISO and WestConnect.

Base line scenarios

Two baseline scenarios as shown in Table 4-2 were selected to capture the range of plausible assumptions pertaining to planned transmission and planned resources.

Table 4-2: Assumption and Scenario Matrix

	Resource Assumptions	Transmission Assumptions
Case A	CPUC’s out-of-state 50% portfolios - ~2,000 MW in Wyoming - ~2,000 MW in New Mexico	Only the committed segments of Gateway Energy Project
Case B	CPUC’s out-of-state 50% portfolios - ~2,000 MW in Wyoming - ~2,000 MW in New Mexico ~1,100 MW incremental wind in Wyoming as included in PacifiCorp’s 2017 IRP	Committed segments of Gateway Energy Project and Aeolus – Anticline 500 kV line ⁵

These baseline scenarios and the study methodology mentioned in section 3 were used to capture the impact of 50% RPS out-of-state portfolio with and without the four ITPs.

5 Key insights

The assessment involving production cost simulation, power flow studies and Available Transmission Capacity (ATC) assessment culminated in six key insights. Supporting results and data pertaining to

⁵ PacifiCorp has requested the “acknowledgment” of the Aeolus to Bridger/Anticline transmission segment in its 2017 IRP - https://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/2017_IRP_Volume1_IRP_Final.pdf

renewable curtailment, thermal overload performance and ATC assessment are presented in Appendix A (slide #21 through #40).

The key insights are as follows –

1. **Impact of transmission development outside of California:** Assumptions about transmission development outside of California (e.g. Gateway Energy Project) have a significant impact on system performance while delivering renewable resources in Wyoming and New Mexico to California. Different planning regions having different criteria for judging “firmness” of planned transmission creates challenges in formulation of unified study assumptions.
2. **Primary driver behind renewable curtailment:** Production cost simulations indicate that transmission constraints are not the primary drivers behind renewable curtailment observed in Wyoming and New Mexico. This conclusion can be drawn from the fact that the total ISO renewable curtailment (including the Wyoming and New Mexico renewables) was almost entirely eliminated when the Net ISO Export limit was relaxed.
3. **Impact of ITPs on renewable curtailment:** ITPs are effective at reducing the renewable curtailment in Wyoming and New Mexico that is observed when the Net ISO Export Limit of 2,000 MW is enforced in production cost simulations. Under this scenario the curtailment of Wyoming and New Mexico renewables is 7% to 8% of the total potential. The two ITPs that are based on building AC lines resulted in lower renewable curtailment than the curtailment observed in scenarios that model Trans West Express HVDC (TWE).
4. **Transmission constraints that must be mitigated:** The southwestern Wyoming system showed severe overloads on the 230 kV local network. These constraints will have to be mitigated in order for any ITP to realize its full potential benefits.
5. **Reliability benefit comparison of ITPs;** The reliability impact based on thermal relief provided by each of the three ITPs aiming to deliver Wyoming wind to California i.e. TWE, Southwest Intertie Project – North (SWIP-N) with Gateway West and Cross-Tie with Gateway South is comparable. REX HVDC project does not greatly impact reliability performance based on thermal relief for delivering resources from New Mexico to California.
 - *INADEQUATE ATC IS THE BIGGEST HURDLE THAT COULD BE ELIMINATED BY DEVELOPMENT OF ITPS.*
 - *RENEWABLE CURTAILMENT IS PRIMARILY DRIVEN BY FACTORS OTHER THAN TRANSMISSION LIMITATIONS.*
 - *ALL THE ITPS PROVIDE SIMILAR THERMAL LOADING RELIEF FOR THE BULK TRANSMISSION SYSTEM OUTSIDE OF CALIFORNIA.*
6. **Severe lack of ATC:** ATC assessment revealed a severe shortage of available contractual transmission capacity to deliver new Wyoming and New Mexico renewables to California. TWE would provide ~1,500 MW of ATC, and is the only ITP that would provide ATC from southwestern Wyoming to southern CA without having to rely on other transmission facilities not owned by the project sponsor. All the other ITPs would

have to rely on other existing or planned transmission facilities not owned by the project sponsor in order to provide this level of incremental ATC from Wyoming to California and from New Mexico to California.

Table 5-1: Summary of directional insights about ITPs

	SWIP-N with Gateway West*	Cross-Tie with Gateway South*	TransWest Express	REX HVDC with SunZia
Total ISO renewables including WY and NM wind	ISO renewable curtailment**	—	—	—
Impact on only WY and NM wind curtailment	WY wind curtailment**	↓↓↓	↓	—
	NM wind curtailment**	—	—	↓↓
<div style="border: 1px dashed gray; padding: 5px;"> Reduction in curtailment or overload No impact relative to baseline </div>	Curtailment (No ISO Export Limit)	—	—	—
	Thermal Overload Performance	↓↓	↓↓	↓↓
	Planning Level Cost***	\$2B - \$3.9B	\$1.5B - \$2.1B	\$2.4B - 3.2B

* SWIP-N and Cross-Tie without certain segments of Gateway were studied and were found to be decisively inadequate for the purpose of delivering Wyoming resources to California

** Curtailment under 2,000 MW Net ISO Export Limit

*** Based on (i) the request window submittals and (ii) cost information specified in RETI 2.0 Western Outreach Project Report – http://docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN214339_20161102T083330_RETI_20_Western_Outreach_Project_Report.pdf

ATC Assessment
<ul style="list-style-type: none"> The ISO's examination of yearly, firm, point-to-point ATC data from the Western OASIS points to a severe lack of scheduling capability to deliver Wyoming and New Mexico wind to California None of the ITPs except TWE will create sufficient long-term, firm ATC from the renewable resource area all the way to the ISO without relying on other transmission not owned by the project sponsor. Note the proponent of the SWIP North project cites having pre-existing arrangements to secure transmission rights on the One Nevada Transmission Line (ON Line), addressing one of two transmission paths needing ATC on other transmission.

Observations informative for next steps

As noted earlier, this initiative also sparked inevitable stakeholder interest in the observations the ISO could draw from the analysis regarding comparisons between the challenges in accessing resources in potentially alternative out of state regions. This also translates into interest in comparisons between alternative interregional transmission projects as potential policy-driven transmission should future state policy direction lead to the need for greater access into the study areas.

A review of the data collected to prepare the analysis as well as the study results themselves do not provide a clear and unequivocal conclusion as to which out of state resource zone is superior, and which interregional transmission project is superior in providing access to out of state resources. A number of attributes that were identified through stakeholder discussion as requiring further consideration given the differing nature of the projects and dependencies:

- How would procurement take place – interregional project, regional project, or as a component of generation procurement – and how would that influence a selection process?

- How will the plans of the ISO out of state neighbors work to support or create challenges for the different alternatives?
- What arrangements with other non-ISO transmission owners for capacity and for development of non-ISO transmission need to be considered and how would those arrangements be developed?
- How will successful project sponsors be selected, and how will cost responsibility be assigned?
- How will staging and sequencing of transmission and generation resources be managed to ensure effective use of resources and periods of underutilization of capacity?

As well, stakeholders commented on the potential for ATC possibly available in the future through the retirement of existing out of state coal-fired generation. While coal fired generation retirements are expected into the future, with the pace driven by economic if not policy reasons, the use for which that capacity will be available will depend on a number of issues, especially the resource plans of the neighboring planning regions.

These issues suggest that further transmission planning analysis alone will not be determinative; that broader consideration through resource policy and resource procurement processes may be necessary before further transmission analysis will be useful. It is very challenging for a transmission planning process to unilaterally land on a preference for the source of out of state renewable resources, or the transmission to access those resources, given the attributes that need to be considered in such a selection. These views were taken into account in developing the recommendations and next steps set out below.

6 Recommendations and Next Steps

The exploratory nature of this effort leads to the following recommendations pertaining to next steps that will inform the ongoing IRP proceeding and will refine the ITP evaluation framework in preparation of future planning cycles:

1. Provide the insights obtained from this assessment into CPUC's ongoing IRP proceeding for creation of future RPS portfolios. This will supplement the information already provided by the ISO as part of 2016-2017 TPP 50% special study and RETI 2.0.
2. Continue with preparatory and foundational steps to ensure that the ISO is positioned to support the anticipated policy and procurement activities that in turn will inform future transmission planning activities. These include:
 - Create a framework for accounting for interdependencies of ITPs and other non-ITP infrastructure projects while evaluating ITPs.

- Incorporate ATC assessment as part of the ITP evaluation framework for future ITP request window submittals. Create a repeatable process to coordinate with the respective Transmission Providers (TPs) to retrieve the most accurate ATC data on the requested paths in a timely manner.
3. Continue to explore the other attributes that would be taken into account in selecting a “preferred” project to access out of state wind resources. These would include attributes such as how transmission would be procured, arrangements with non-ISO transmission owners for capacity, staging and sequencing of transmission and generation resources.

Appendix A – September 21-22, 2017 Stakeholder presentation slides



Interregional Transmission Project (ITP) Evaluation and 50% RPS Out-of-State Portfolio Assessment

*An information-only study performed as a continuation of 2016-
2017 Transmission Planning Process*

Sushant Barave

Ebrahim Rahimi

Charles Cheung

Vera Hart

Yi Zhang

Mudita Suri

Luba Kravchuk

Gary DeShazo

Regional Transmission

September 22, 2017



Agenda

Context and drivers behind the assessment

1. Executive Summary
2. Methodology to assess the impact of OOS portfolio and effectiveness of ITPs
3. Assumptions –
 - i. Resource assumptions and modeling
 - ii. Topology assumptions and modeling
4. Study scenarios
5. Key findings
 - i. Power flow assessment
 - ii. Production cost simulation assessment
 - iii. ATC assessment
6. Recommendations and next steps



Context

Continuation of the information-only 50% RPS special study (2016-2017 TPP)

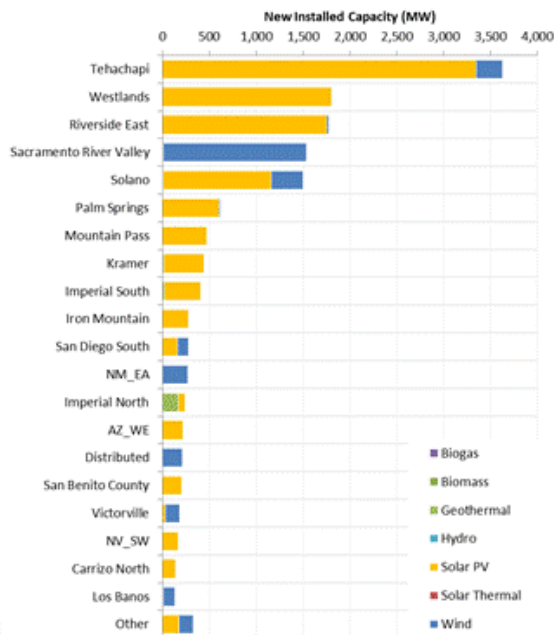
The 2016-2017 50% RPS study focused on

- Investigating the transmission impacts of moving beyond 33 percent RPS requirements in California;
- Testing the transmission capability estimates used in RPS calculator v6.2 and where appropriate, updating these transmission capability estimates; and
- Investigating transmission implications on in-state facilities of meeting part of California's 50 percent RPS requirement by assuming California's procurement of 2000 MW of wind resources in Wyoming and 2000 MW of wind resources in New Mexico.

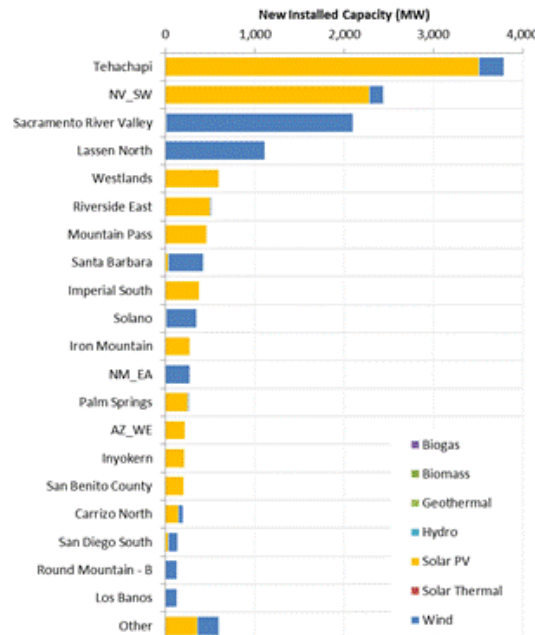
Portfolios provided by the CPUC; the Out-of-state portfolio shows a shift to higher WY and NM wind

Portfolio	In-state FCDS	In-state EODS	OOS EODS/FCDS
MW Capacity	14,842	14,814	11,093

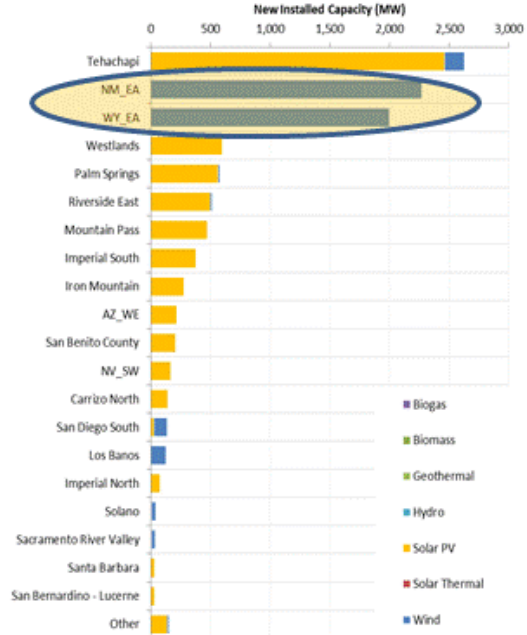
In-state FCDS



In-state EODS



Out-of-state FCDS/EODS



Note - RPS calculator v6.2 was used to generate the portfolios

Findings from 2016-2017 out-of-state portfolio assessment helped us identify three action items

Assessment	Key findings pertaining to OOS portfolio (2016-2017 50% special study)
Production Cost Simulation	<ul style="list-style-type: none"> • Curtailment: OOS portfolio showed the lowest curtailment • Transmission congestion: OOS portfolio showed the least amount of intra-CA congestion • <u>Further coordination is expected on stressed scenario identification and reviewing study results</u>
Reliability Assessment	<ul style="list-style-type: none"> • OOS portfolio was the least severe one • No major issues in the Northern CA system due to lower amount of resource selection • One potential issue in Southern CA observed in all portfolios • <u>The snapshots identified with CA transmission in mind were not the most stressed ones for the system outside of CA</u>
Deliverability	<ul style="list-style-type: none"> • Evaluated the need for MIC expansion and found that adequate import capacity exists to deliver OOS resources (NM and WY) from injection point into CAISO BA to CAISO loads



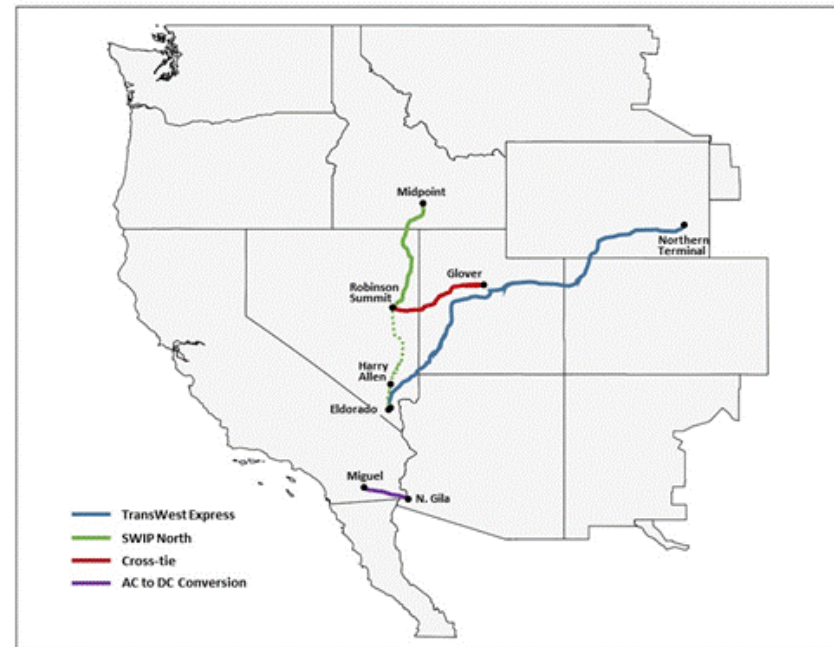
Three action items identified based on ISO's analysis and stakeholder feedback –

1. Refining the assumptions and models
2. Using the out-of-state portfolio to test ITP evaluation framework in preparation for the next planning cycles; and
3. Exploring a way to capture the Available Transmission Capacity (ATC) for out-of-state RPS resources

Four ITPs were submitted to the California ISO, NTTG, and WestConnect

- | | |
|--|---|
| <ul style="list-style-type: none"> ❑ TransWest Express (TWE) <ul style="list-style-type: none"> - California ISO - NTTG - WestConnect | <ul style="list-style-type: none"> ❑ Cross-tie Transmission Line <ul style="list-style-type: none"> - California ISO - NTTG - WestConnect |
| <ul style="list-style-type: none"> ❑ SWIP North (SWIP-N) <ul style="list-style-type: none"> - California ISO - NTTG - WestConnect | <ul style="list-style-type: none"> ❑ Renewable Energy Express HVDC Conversion (REX HVDC Project)* <ul style="list-style-type: none"> - California ISO - WestConnect |

Relevant Planning Region



A common theme among all projects is the focus on providing California transmission access to out-of-state renewable generation in Wyoming and New Mexico to support California's 50 percent RPS goal.

* This project was previously named Desert Tortoise Expressway.

Regional coordination efforts resulted in model refinement and contingency list creation

- Received input from WestConnect and NTTG about the location and size of wind resources in NM and WY respectively
- WPRs provided input regarding transmission topology enhancements in alignment with the ongoing WECC Anchor Data Set work
- Shared power flow models with WPRs and received feedback
- Shared contingency files with ColumbiaGrid, WestConnect and NTTG; the WPRs provided crucial information regarding additional contingencies to be tested
- APS and NV Energy provided specific input regarding contingencies to be tested



Objectives

Test the system outside of CA using OOS portfolio and leverage the findings to gain insights about ITPs

Refine the out-of-state resource and topology modeling

Identify Available Transfer Capability that can be used by the wind resources in WY and NM in order to deliver to CA

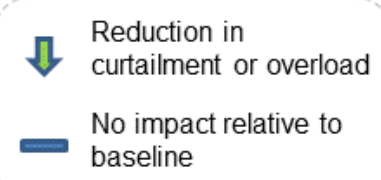
Identify transmission constraints outside of CA while trying to meet part of the 50% RPS obligation by relying on wind resources in WY and NM

Test effectiveness of ITPs in mitigating observed transmission issues outside of CA and test a framework for comparing ITPs



Executive Summary

Summary of directional insights about ITPs

	SWIP-N with Gateway West*	Cross-Tie with Gateway South*	TransWest Express	REX HVDC with SunZia
Total ISO renewables including WY and NM wind	ISO renewable curtailment **	—	—	—
Impact on only WY and NM wind curtailment	WY wind curtailment **	↓ ↓ ↓	↓	—
	NM wind curtailment **	—	—	↓ ↓
	Curtailment (No ISO Export Limit)	—	—	—
	Thermal Overload Performance	↓ ↓	↓ ↓	—
	Planning Level Cost***	\$2B - \$3.9B	\$1.5B - \$2.1B	\$2.4B - 3.2B

* SWIP-N and Cross-Tie without certain segments of Gateway were studied and were found to be decisively inadequate for the purpose of delivering Wyoming resources to California
 ** Curtailment under 2,000 MW Net ISO Export Limit
 *** Based on (i) the request window submittals and (ii) cost information specified in RETI 2.0 Western Outreach Project Report – (http://docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN214339_20161102T083330_RETI_20_Western_Outreach_Project_Report.pdf)

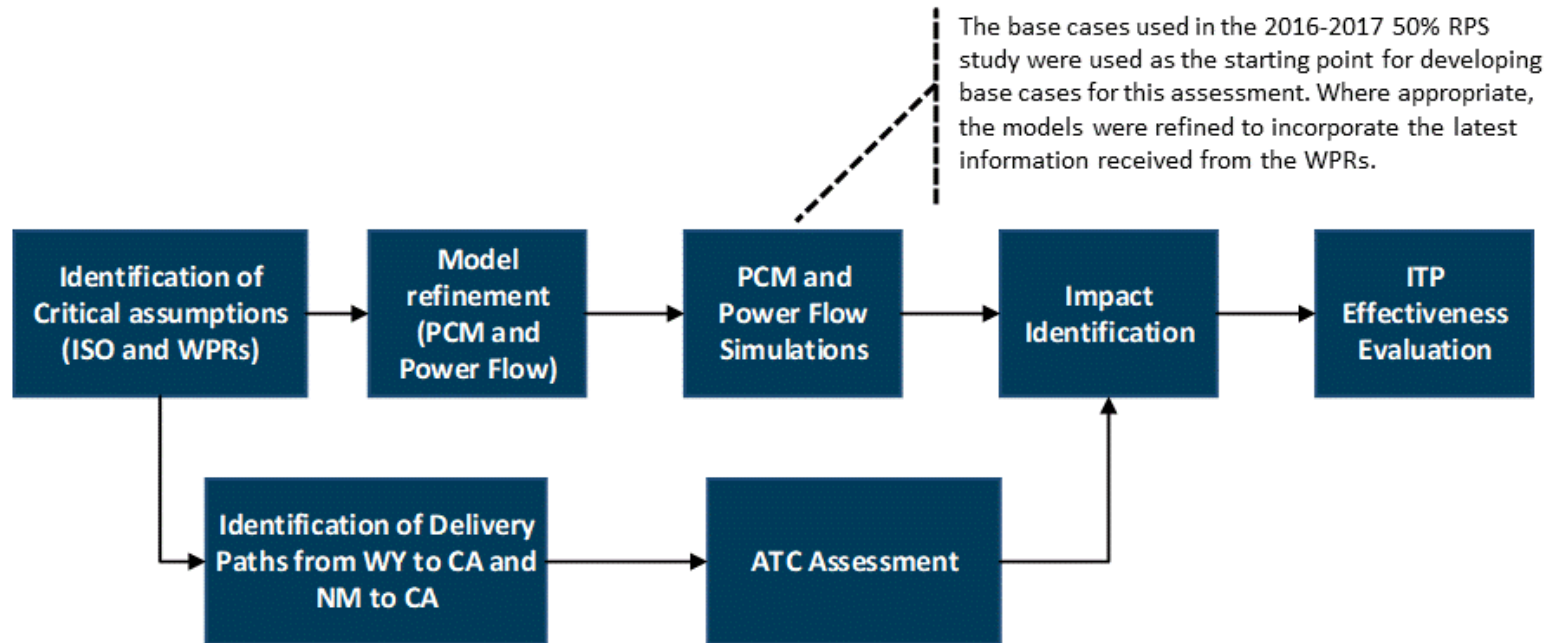
ATC Assessment

- The ISO’s examination of yearly, firm, point-to-point ATC data from the Western OASIS points to a severe lack of scheduling capability to deliver Wyoming and New Mexico wind to California
- None of the ITPs except TWE will create sufficient long-term, firm ATC from the renewable resource area all the way to the ISO without relying on other transmission not owned by the project sponsor. Note the proponent of the SWIP North project cites having pre-existing arrangements to secure transmission rights on the One Nevada Transmission Line (ON Line), addressing one of two transmission paths needing ATC on other transmission.



Methodology and Assumptions

Study methodology and sequence



The base cases used in the 2016-2017 50% RPS study were used as the starting point for developing base cases for this assessment. Where appropriate, the models were refined to incorporate the latest information received from the WPRs.

The ATC assessment was performed to determine the availability, if any, of existing transmission to import wind resources from Wyoming and New Mexico into California (OATI's Western OASIS was relied upon for this purpose)

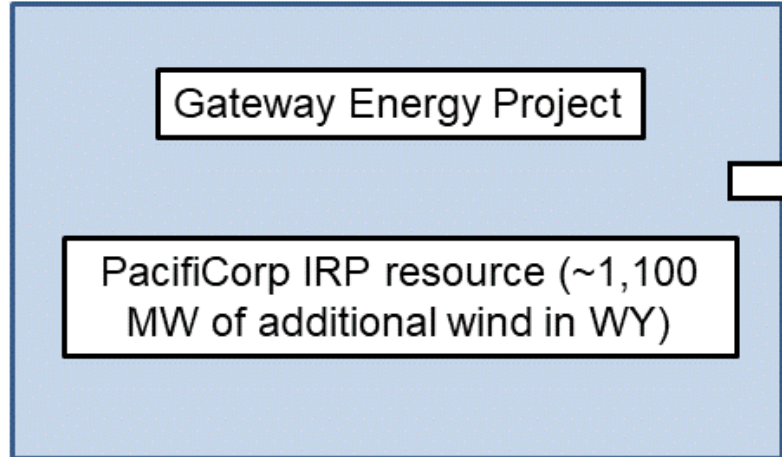
Primary data sources for modeling refinements

- Models used by the ISO in 2016-2017 50% RPS study
- Information currently being prepared by the WPRs for the development of WECC's Anchor Data Set
- NTTG's biennial study plan version 3.5¹ (draft as on May 29, 2017)
- WestConnect's² regional study plan for 2016-2017 planning cycle

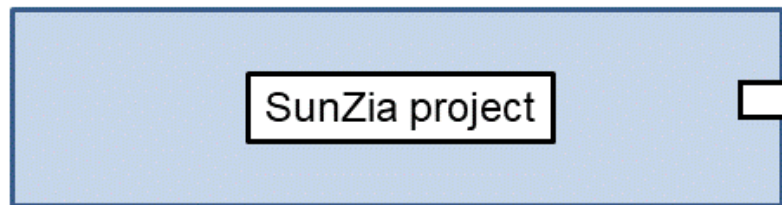
¹ https://www.nttg.biz/site/index.php?option=com_docman&view=document&layout=default&alias=2825-2016-17-nttg-biennial-study-plan-quarter-6-revisions-redlined-05-08-2017&category_slug=planning-committee-meeting-material-05-10-2017&Itemid=31

² <https://doc.westconnect.com/Documents.aspx?NID=17180>

Uncertainties about key assumptions with potential impact on the ITP assessment



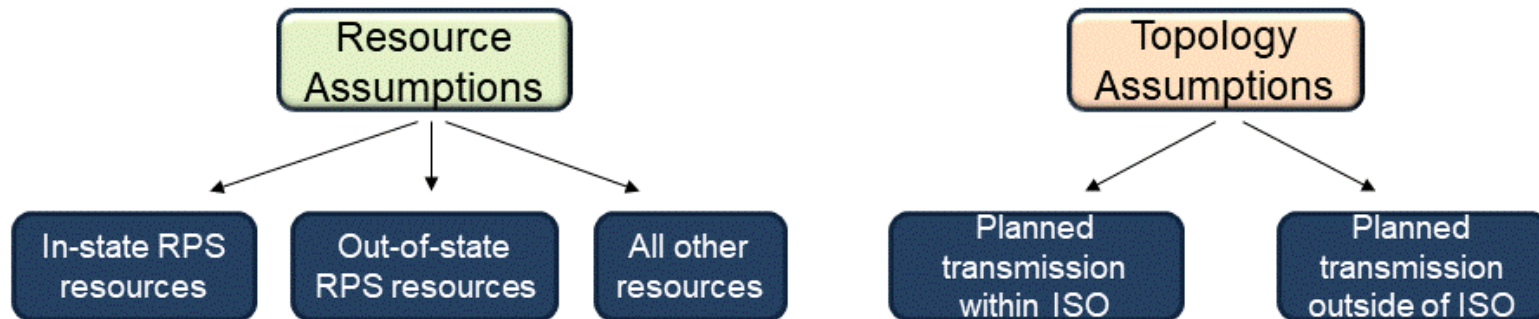
Assumptions regarding Gateway Energy Project and incremental Wyoming wind specified in PAC IRP were expected to be critical for Wyoming wind scenario



Assumptions regarding SunZia Project were expected to be critical for New Mexico wind scenario

Key modeling enhancements and topology/resource assumptions

Starting study model: 2016-2017 TPP 50% RPS out-of-state portfolio case



- No change to in-state RPS
- WY and NM RPS resources identified in the out-of-state portfolio
- Additional wind resources identified in WY as part of PacifiCorp's IRP (~1,100 MW)
- Minor generation adjustments per the latest WPR ADS seed case (as of May 2017)

- Modeled projects approved in the 2016-2017 TPP
- Relied on the information received from the Anchor Data Set work being performed by WPRs
- Gateway Energy Project
- SunZia Project

Baseline assumptions

	Resource Assumptions	Transmission Assumptions
Case A	CPUC's out-of-state 50% portfolios <ul style="list-style-type: none"> - ~2,000 MW in Wyoming - ~2,000 MW in New Mexico 	Only the committed segments of Gateway Energy Project
Case B	CPUC's out-of-state 50% portfolios <ul style="list-style-type: none"> - ~2,000 MW in Wyoming - ~2,000 MW in New Mexico + ~1,100 MW incremental wind in Wyoming as included in PacifiCorp's 2017 IRP	Committed segments of Gateway Energy Project + Aeolus – Anticline 500 kV line*

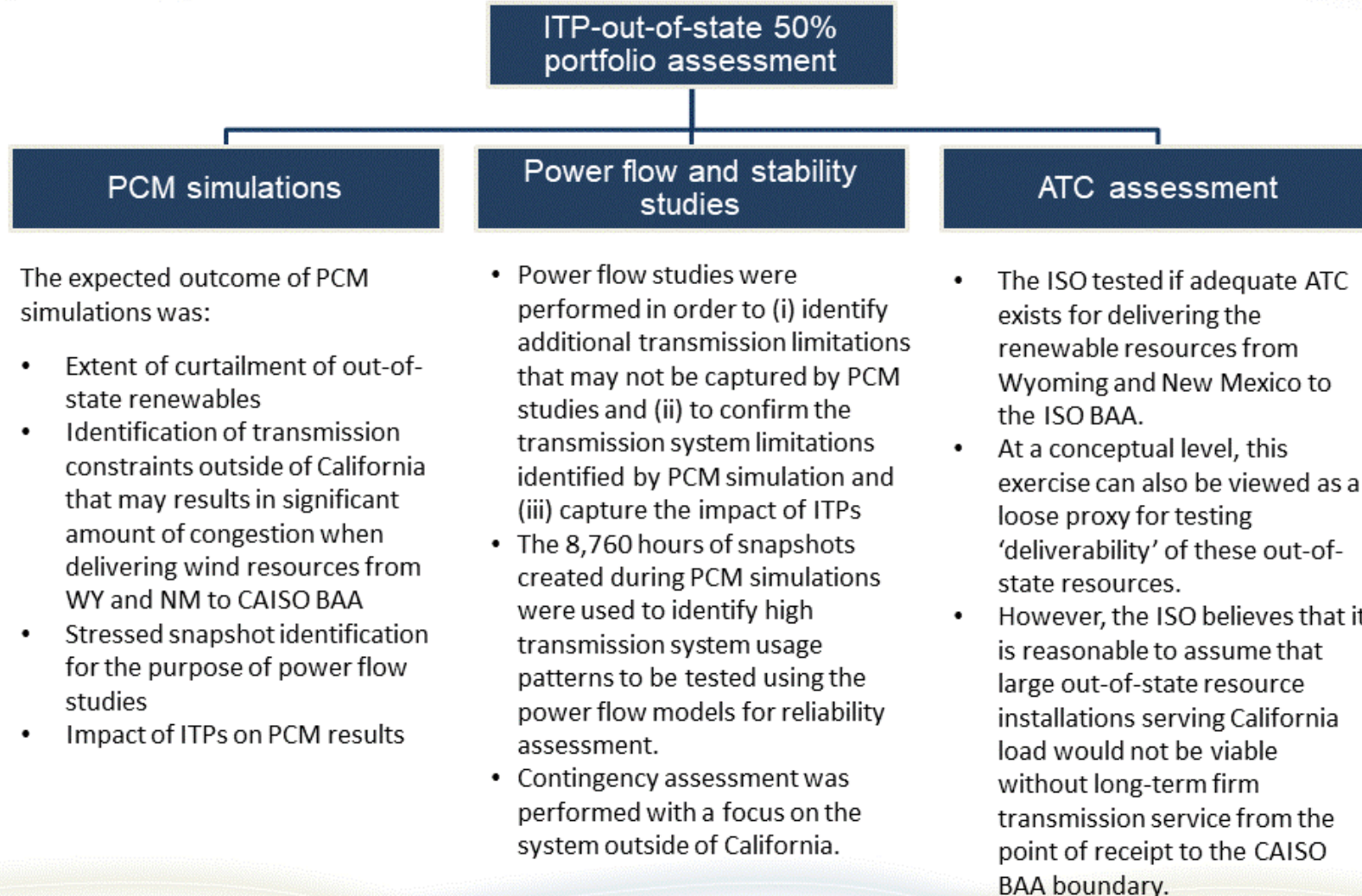
* PacifiCorp has requested the "acknowledgment" of the Aeolus to Bridger/Anticline transmission segment in its 2017 IRP - https://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/2017_IRP_Volume1_IRP_Final.pdf

Due to interdependencies with other major transmission projects and resource assumptions several scenarios were studied

	TWE	Cross-Tie	Cross-Tie with Gateway South	SWIP-N	SWIP-N with Gateway West	REX HVDC	REX HVDC With SunZia
Case A	✓	✓	✓	✓	✓	✓	✓
Case B	✓	✓	✓	✓	✓	✗	✗

- For SWIP-N and Cross-tie it was quickly evident that studying these projects without certain segments of Gateway was not going to add much value to PCM and power flow assessment
- AC-DC Conversion Project was not studied with baseline B because baseline B was specific to the WY wind scenario

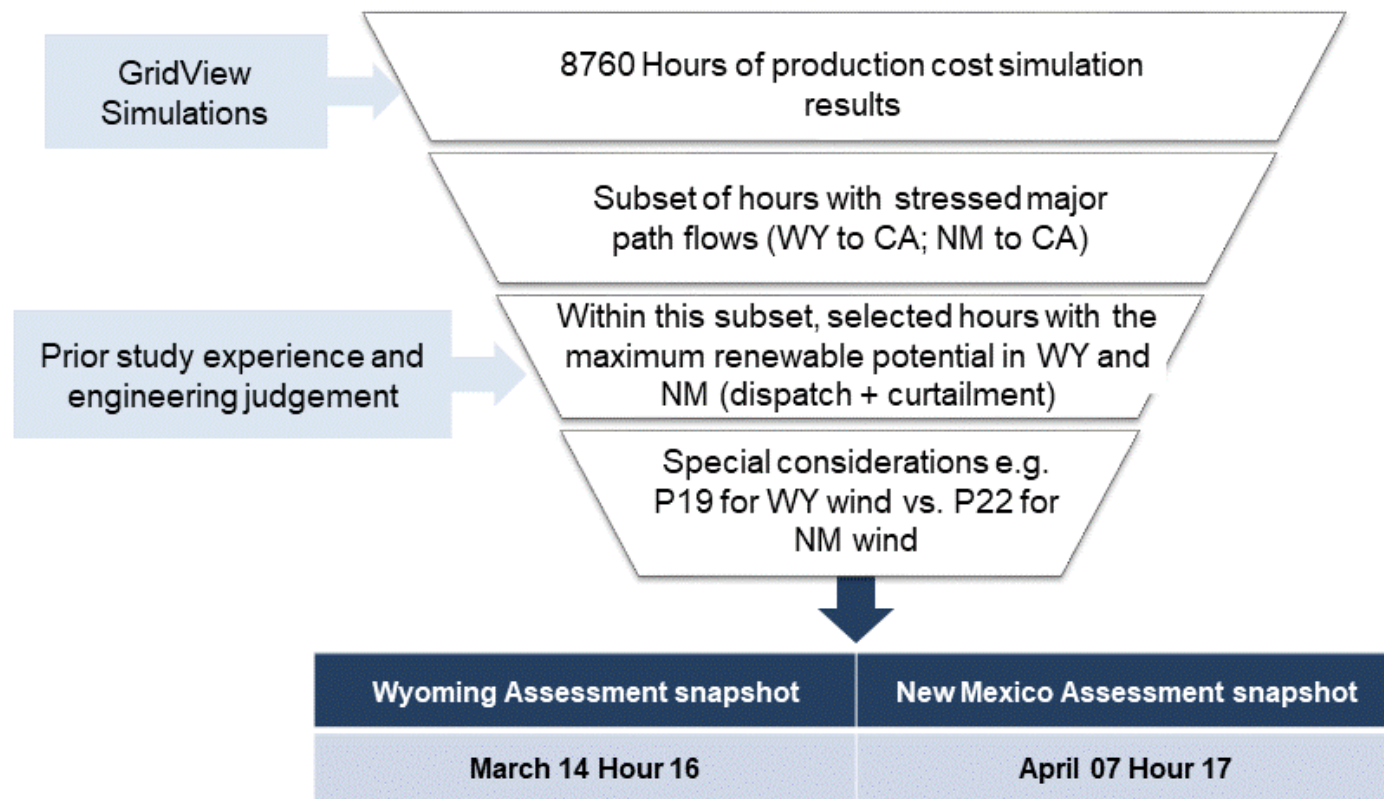
Study Components





Power Flow Assessment

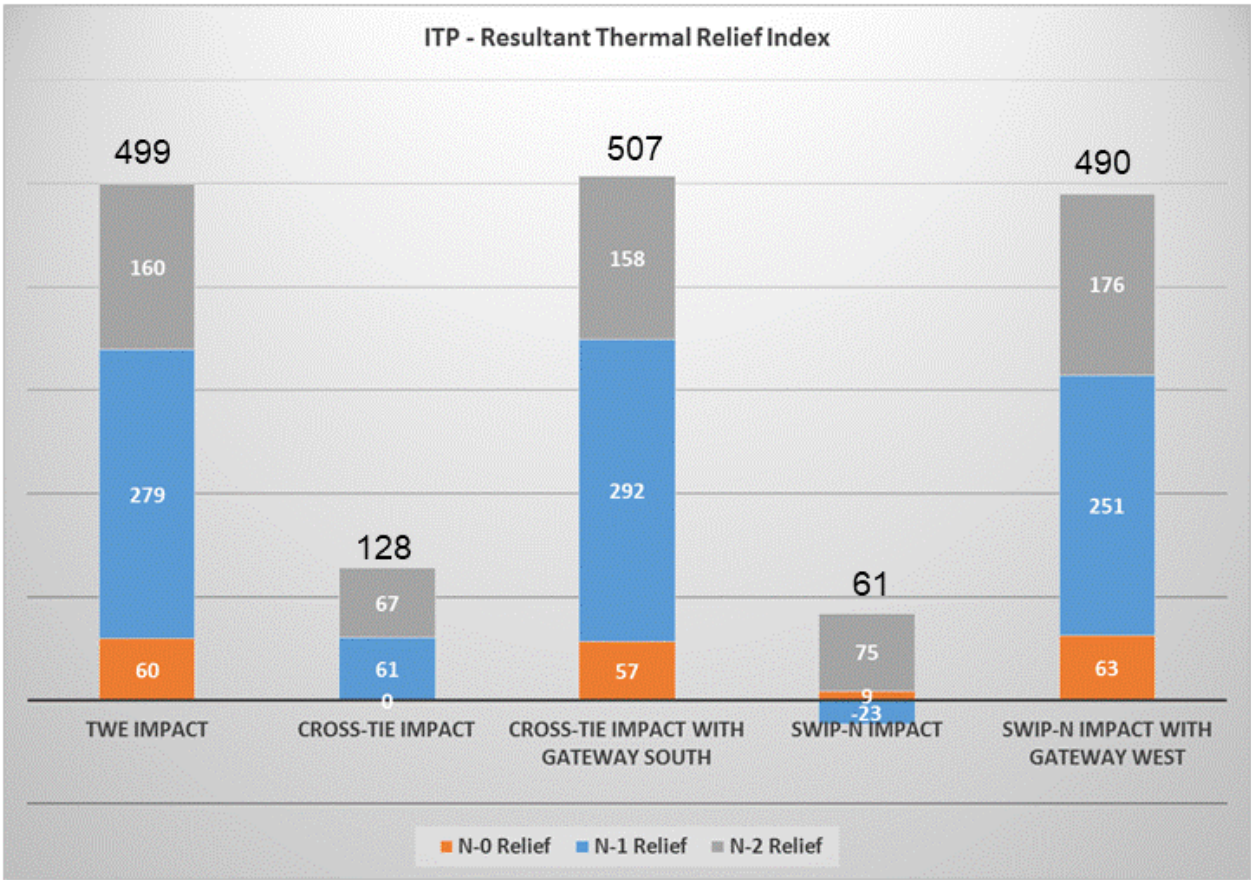
Power flow snapshots were selected based on stressed conditions from an out-of-state system perspective



Key findings for the WY snapshot

- N-0:
 - 230 kV system in Southwestern WY was heavily constrained with and without ITPs
 - In case B, we had to add more than 1,000 MVAR to dispatch ~3,000 MW of wind in Wyoming
- N-1:
 - Contingencies of 230 kV elements result in case divergences indicating a need for a gen-drop scheme or additional reactive support
 - Local issues could also be mitigated by transmission upgrades
 - Contingencies on P19 and West of Borah
- P19 (Bridger West) was allowed to exceed its existing path rating in Case B in order to expose downstream bulk system issues
- Thermal relief index was computed to account for a holistic overload relief provided by each ITP as well as adverse impacts

TRI comparison for ITPs delivering WY wind to CA



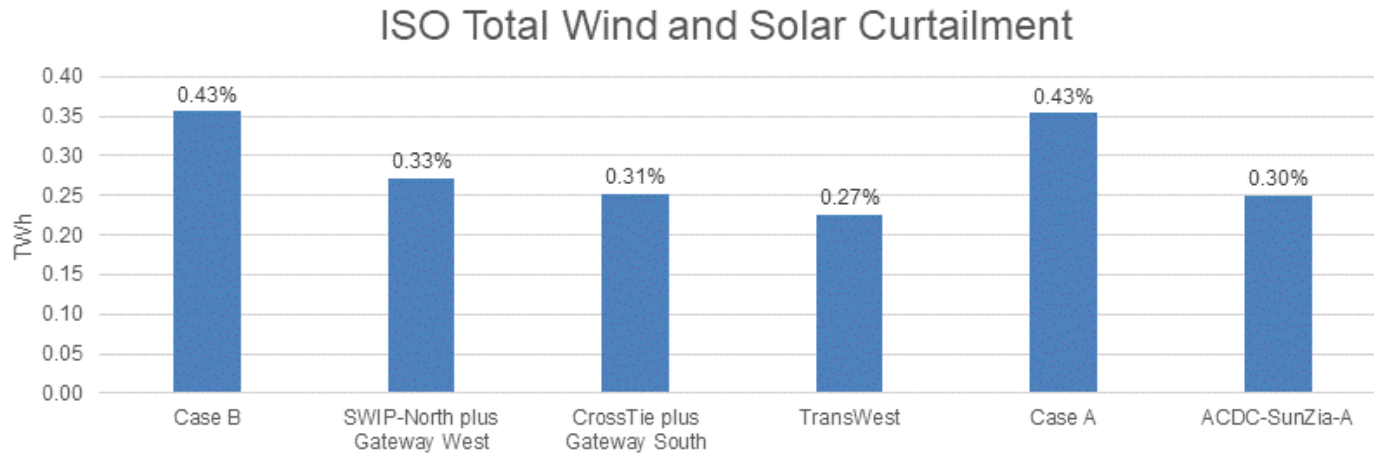


Production Cost Simulation Assessment

Overview of Production Cost Model for ITP studies

- Started from the PCM for OOS 50% portfolio in 2016/17 planning cycle
- Updated ISO's network model to reflect the changes identified in 2017/2018 planning cycle reliability assessment
- Updated WPR (NTTG, WestConnect, and ColumbiaGrid) system models based on recommendations of the corresponding planning regions
- Load forecast and NG/CO2 prices remained the same as in the last planning cycle
- WY local 230 kV line limits were not enforced

ISO Wind and Solar curtailment – No Export Limit scenario



WY and NM wind generation was not curtailed in the No Export Limit scenario

Major congestion related to NM OOS wind – Case A

Transmission congestion is also related to overall generation dispatch including Gas and Coal generation

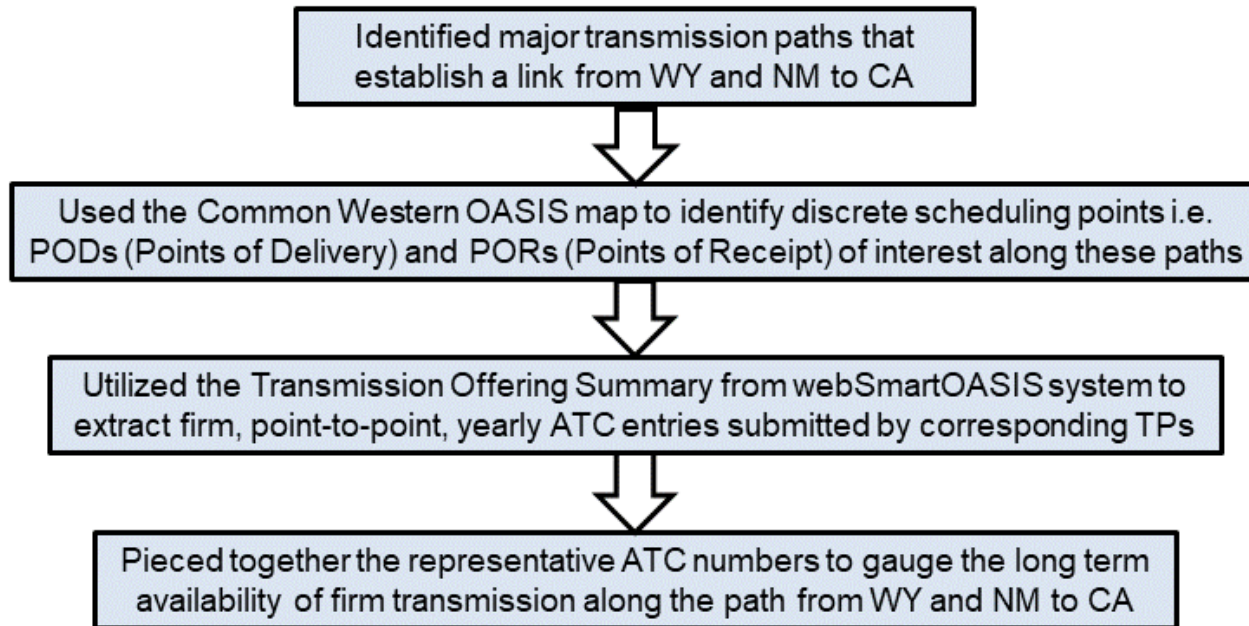
Constraints Name	Case A		REX HVDC plus SunZia	
	Costs T (K\$)	Duration_T (Hrs)	Costs T (K\$)	Duration_T (Hrs)
2000 MW ISO Net Export limit				
P22 Southwest of Four Corners	6,038	477	41	6
P33 Bonanza West	5,086	583	4,692	521
P30 TOT 1A	4,877	539	3,252	427
FOURCORN 500/100 kV transformer #1	3,049	220	487	55
P29 Intermountain-Gonder 230 kV	2,071	562	1,512	507
BONANZA-MONA 345 kV line #1	1,609	223	1,131	163

Constraints Name	Case A		REX HVDC plus SunZia	
	Costs T (K\$)	Duration_T (Hrs)	Costs T (K\$)	Duration_T (Hrs)
No ISO Net Export limit				
P22 Southwest of Four Corners	2,599	238	0	0
P33 Bonanza West	280	62	129	55
P30 TOT 1A	768	139	350	71
FOURCORN 500/100 kV transformer #1	1,069	114	304	4
P29 Intermountain-Gonder 230 kV	175	22	9	11
BONANZA-MONA 345 kV line #1	0	0	0	0



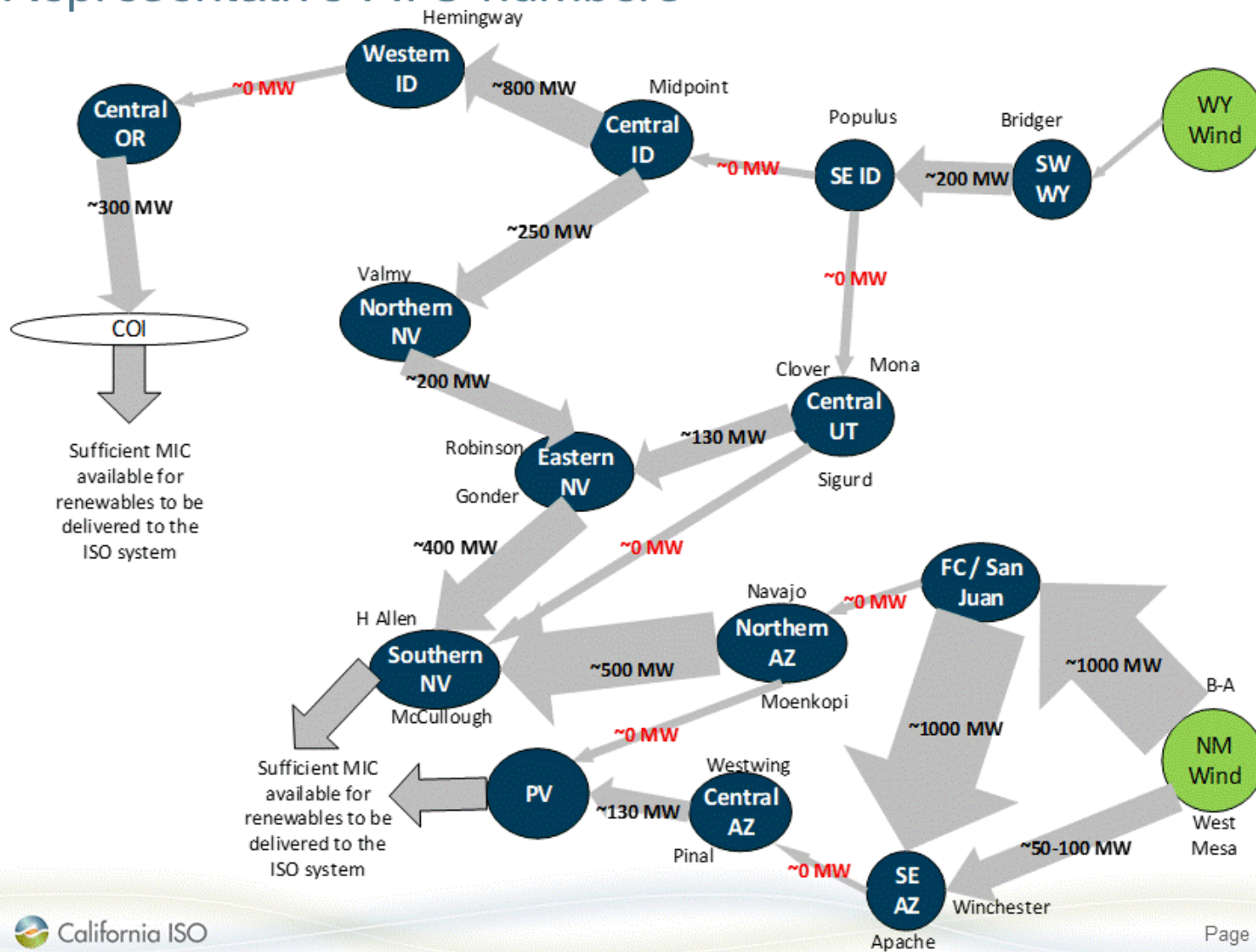
ATC Assessment

Stakeholders raised a question about the availability of ATC outside of California

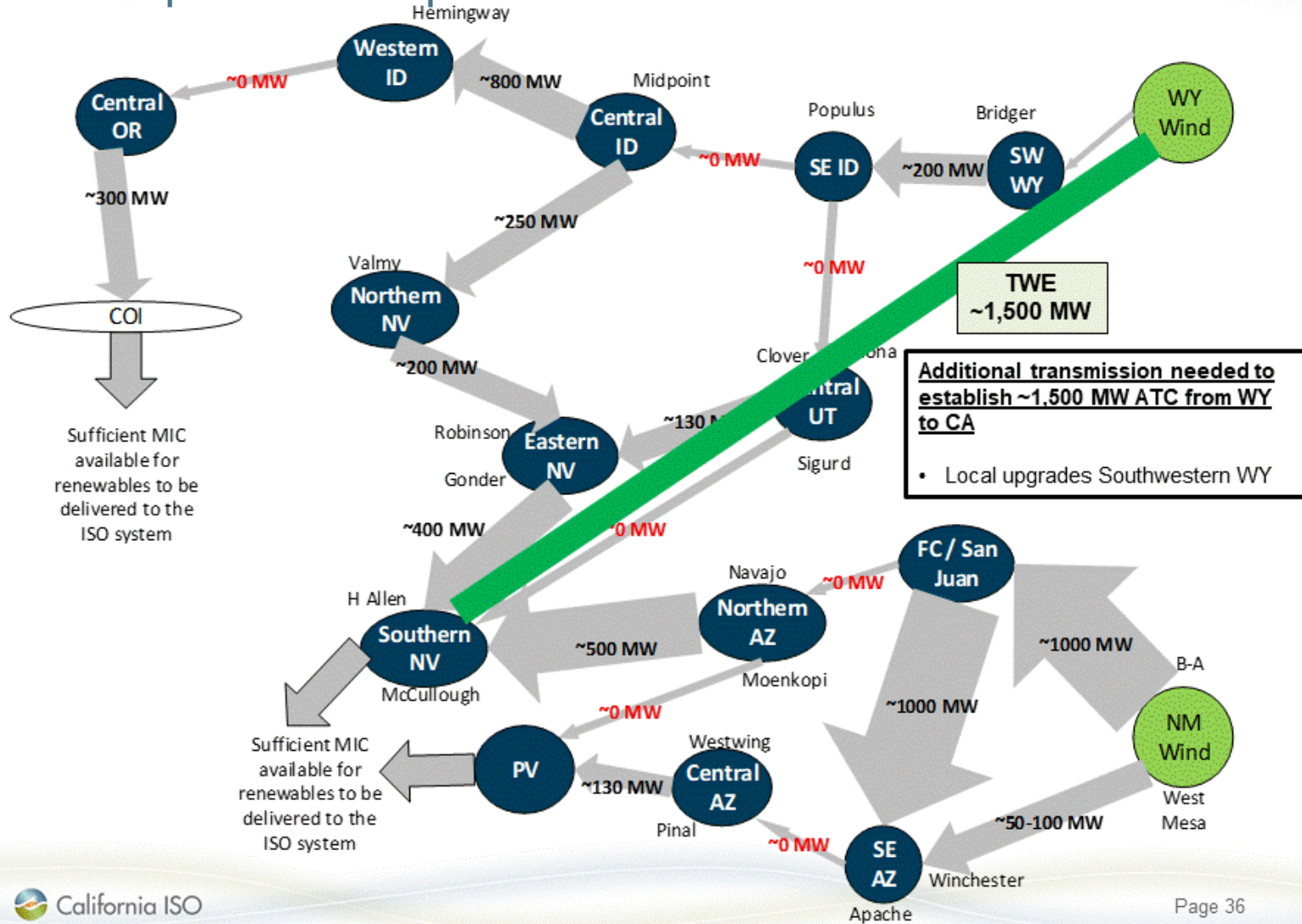


- OATI's webSmartOASIS system was utilized to extract ATC data
- Transmission Offering Summary in OASIS was utilized; this is what each Transmission Provider(TP) has submitted as available on a facility over a particular timeframe
- We looked for the active offerings in the first month of 2027 as a proxy for long-term availability

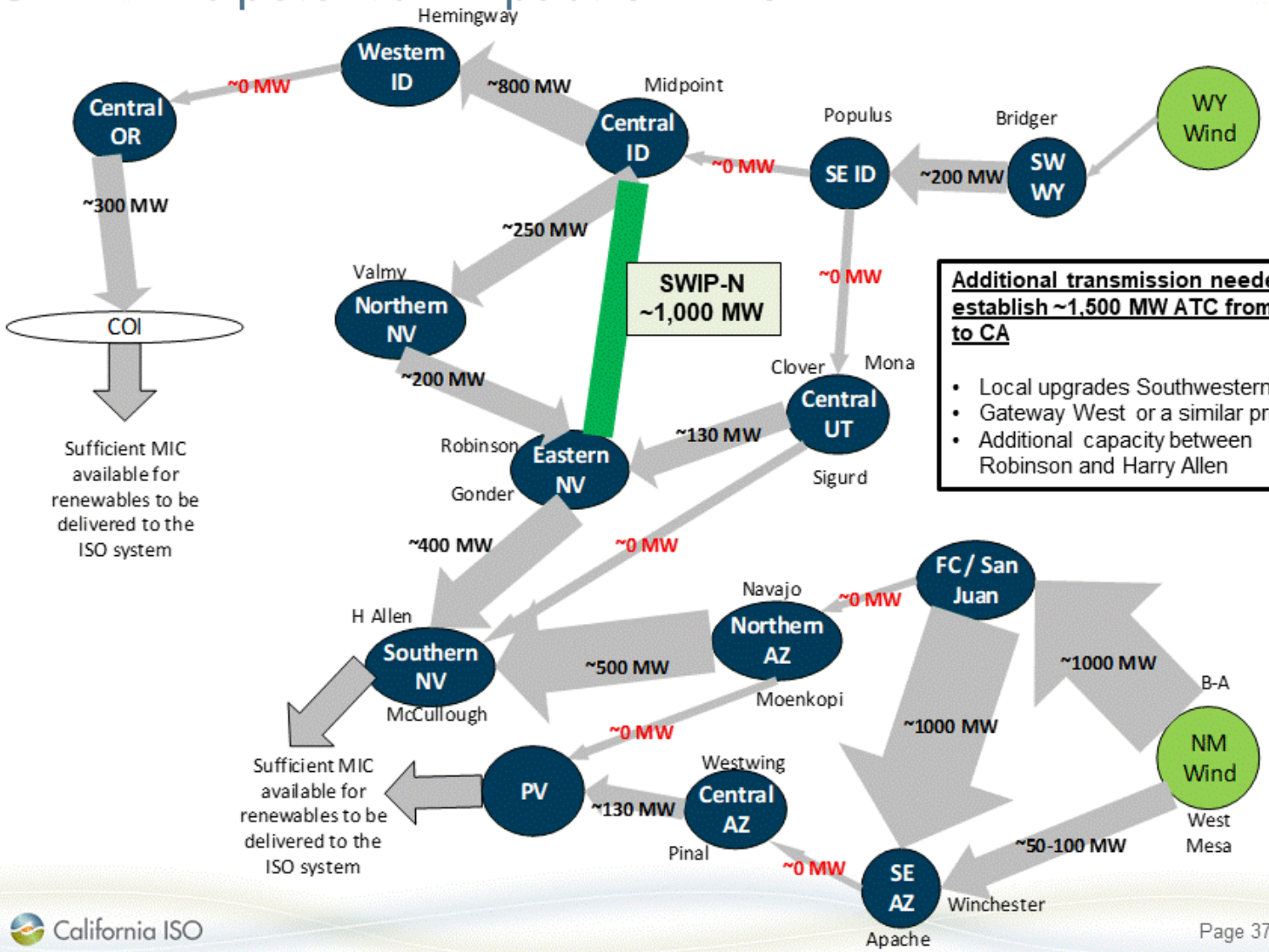
Representative ATC numbers



TWE's potential impact on ATC



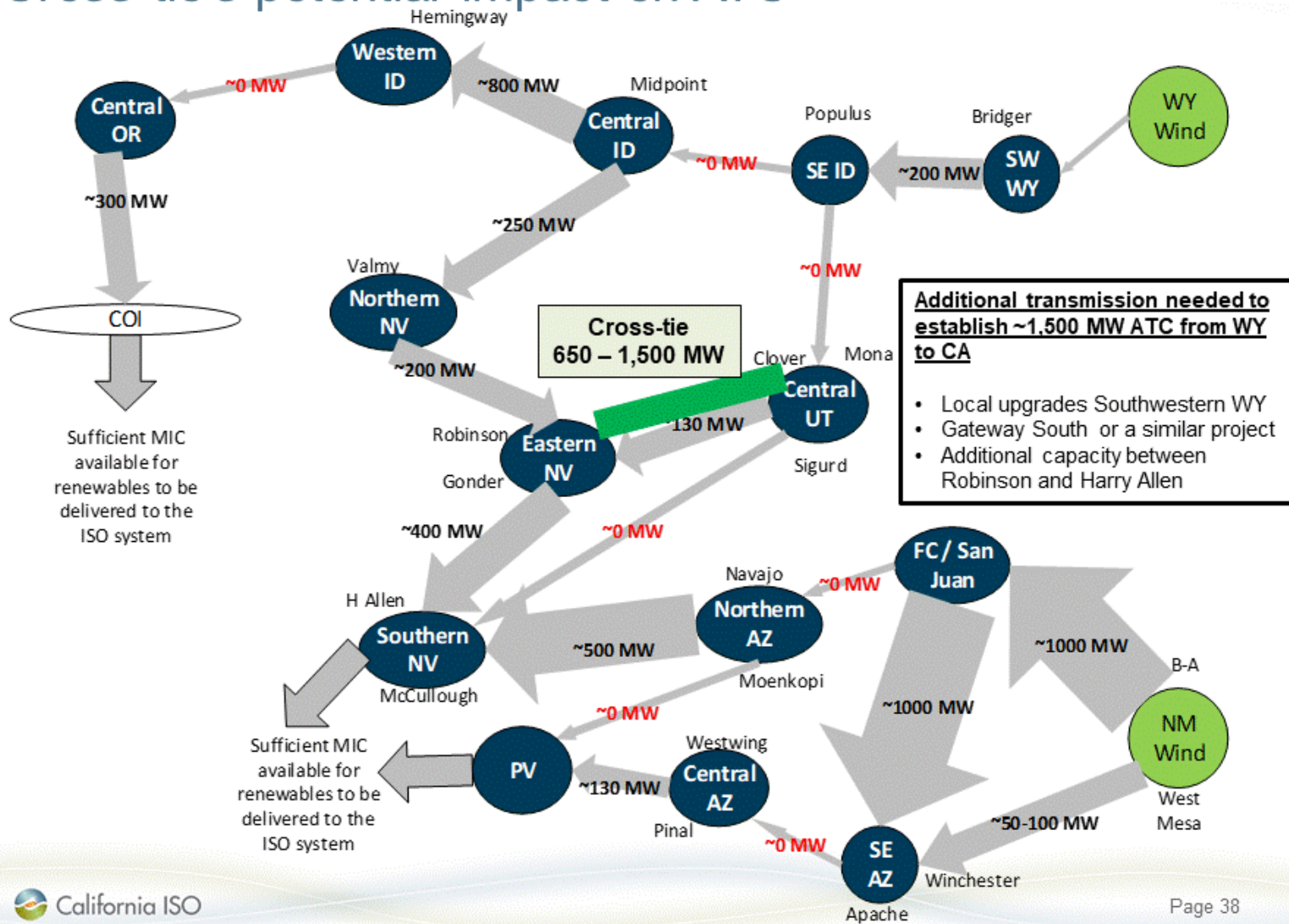
SWIP-N's potential impact on ATC



Sufficient MIC available for renewables to be delivered to the ISO system

Sufficient MIC available for renewables to be delivered to the ISO system

Cross-tie's potential impact on ATC



ATC assessment conclusion

- The schematic on the previous slide shows a severe lack of ATC to deliver Wyoming and New Mexico wind to California
- None of the ITPs except TWE will create sufficient long-term, firm ATC from the renewable resource area all the way to the ISO without relying on other transmission not owned by the project sponsor



Summary and Next Steps

Summary of Findings

PCM simulations

1. The ISO renewable curtailment did not show a noticeable reduction after adding any of the ITPs.
2. Relaxation of ISO Net Export Limit resulted in almost zero renewable curtailment. This indicates that the renewable curtailment under 2,000 MW ISO Net Export scenario is not primarily related to transmission congestion.
3. ITPs show a variation in transmission congestion performance. It is important to note that this congestion is driven by overall dispatch which includes non-renewable resource

Power flow studies

1. Power flow performance of TWE, SWIP-N (with Gateway West) and Cross-tie (with Gateway South) is comparable
2. SWIP-N and Cross-tie projects without the corresponding Gateway segments do not provide much thermal relief when delivering resources from WY to CA
3. REX HVDC project does not greatly impact power flow performance when delivering resources from NM to CA

ATC assessment

1. ATC assessment shows severe shortage of contractual capacity to deliver WY and NM resources to CA over the existing transmission system
2. TWE would provide ~1,500 MW of ATC from Southwestern WY to Southern CA
3. SWIP-N and Cross-tie would rely corresponding segments of Gateway project and some existing facilities to establish ~1,500 MW ATC between WY and CA
4. REX HVDC would not add ATC at the most constrained locations along the NM to CA path

Attributes requiring further consideration given the differing nature of the projects and dependencies:

- How the transmission would be procured – interregional project, regional project, or component of generation procurement?
- Arrangements with other non-ISO transmission owners for capacity, and for development of non-ISO transmission
- Costs and cost responsibilities
- Staging and sequencing of transmission and generation resources

Recommendations for next steps

- Utilize the results obtained from this study for future out-of-state RPS portfolio creation
- Create a framework for accounting for interdependencies of ITPs and other non-ITP infrastructure projects while evaluating ITPs
- Incorporate ATC assessment as part of the ITC evaluation framework for future ITP RW submittals
- Explore further the other attributes that would be taken into account in selecting a “preferred” project to access out of state wind resources



Thank you!

Appendix B – ATC Assessment of representative transmission routes from WY to CA and NM to CA

