



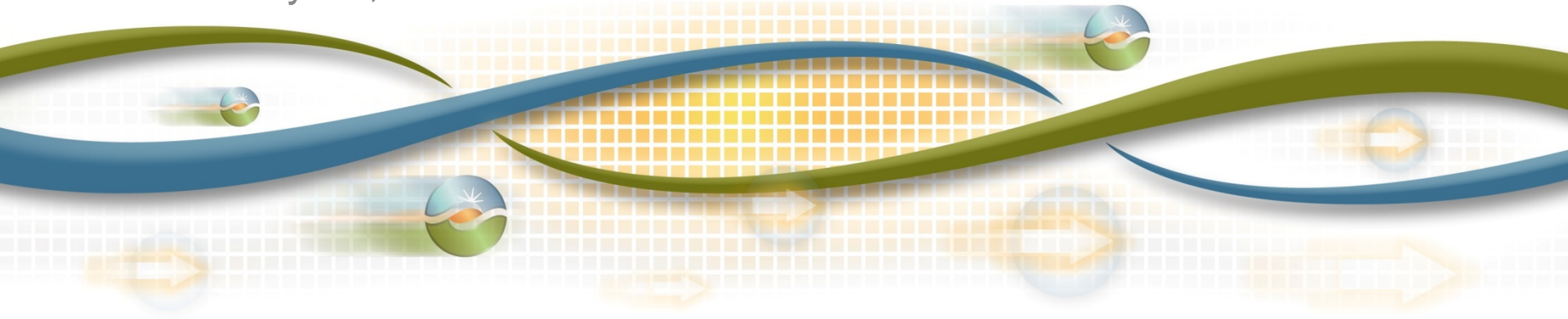
California ISO
Shaping a Renewed Future

Energy Imbalance Market Year 1 Enhancements

Don Tretheway

Lead Market Design and Regulatory Policy Developer

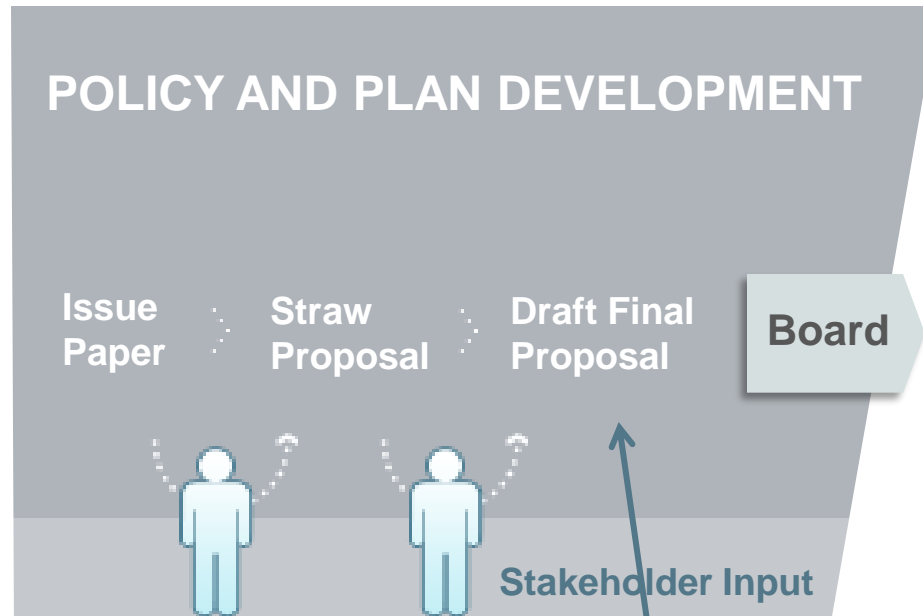
February 18, 2015



Agenda

Time	Topic	Presenter
10:00 – 10:15	Introduction	Kristina Osborne
10:15 – 12:30	Phase 1 Draft Final Proposal	Don Tretheway
12:30 – 1:30	Lunch	
1:30 – 3:50	Phase 2 Discussion 15-Minute Intertie Bidding Real-Time Congestion Offset Transmission Charge	Don Tretheway
3:50 – 4:00	Wrap-up and Next Steps	Kristina Osborne

ISO Policy Initiative Stakeholder Process



Phase 1 items planned for BOG decision in March 2015

- Settlement of Non-Participating Resources
- Administrative Pricing Rules
- GHG Flag and Cost Based Bid Adder
- Add Base Schedule Import/Export Decline to Resource Sufficiency Evaluation
- Resources Sufficiency Evaluation Applied to ISO BAA
- Modification of EIM Transfer Limit Constraints
 - Establishment of EIM Transfer Limits Using ATC
- EIM Administrative Charge Redesign
- Reduce Flexible Ramping Constraint Combinations

Settlement of Non-Participating Resources

- Consistent treatment for both ISO real-time SS and EIM non-participating resources
- BCR to non-participating resource is not unique to EIM
 - ISO is monitoring, investigating and resolving BCR payments made to all ISO and EIM non-participating resources
- ISO no longer believes ISO tariff changes are needed
- EIM entity OATT must recognize that UIE and IIE in all markets will be settled with non-participating resources

Administrative pricing rule

- If ISO must use day-ahead price for ISO, then in each EIM BAA use the price the EIM entity establishes through its OATT for market suspension

Updated GHG proposal provides more flexibility and maintains the “flag” concept

- On an hourly basis, submit single MW quantity and price by resource that can receive GHG award
 - GHG MW quantity and price is independent of bid range
- The “flag” is equivalent to bidding 0 MW
 - If SC does not submit a GHG MW bid, the default will be zero
- EIM transfers into ISO from all EIM BAAs can be no greater than total MW of GHG bids
 - If EIM transfers are limited by GHG bids will consider long term design change in Phase 2

ISO will calculate a daily maximum GHG bid allowed by resource

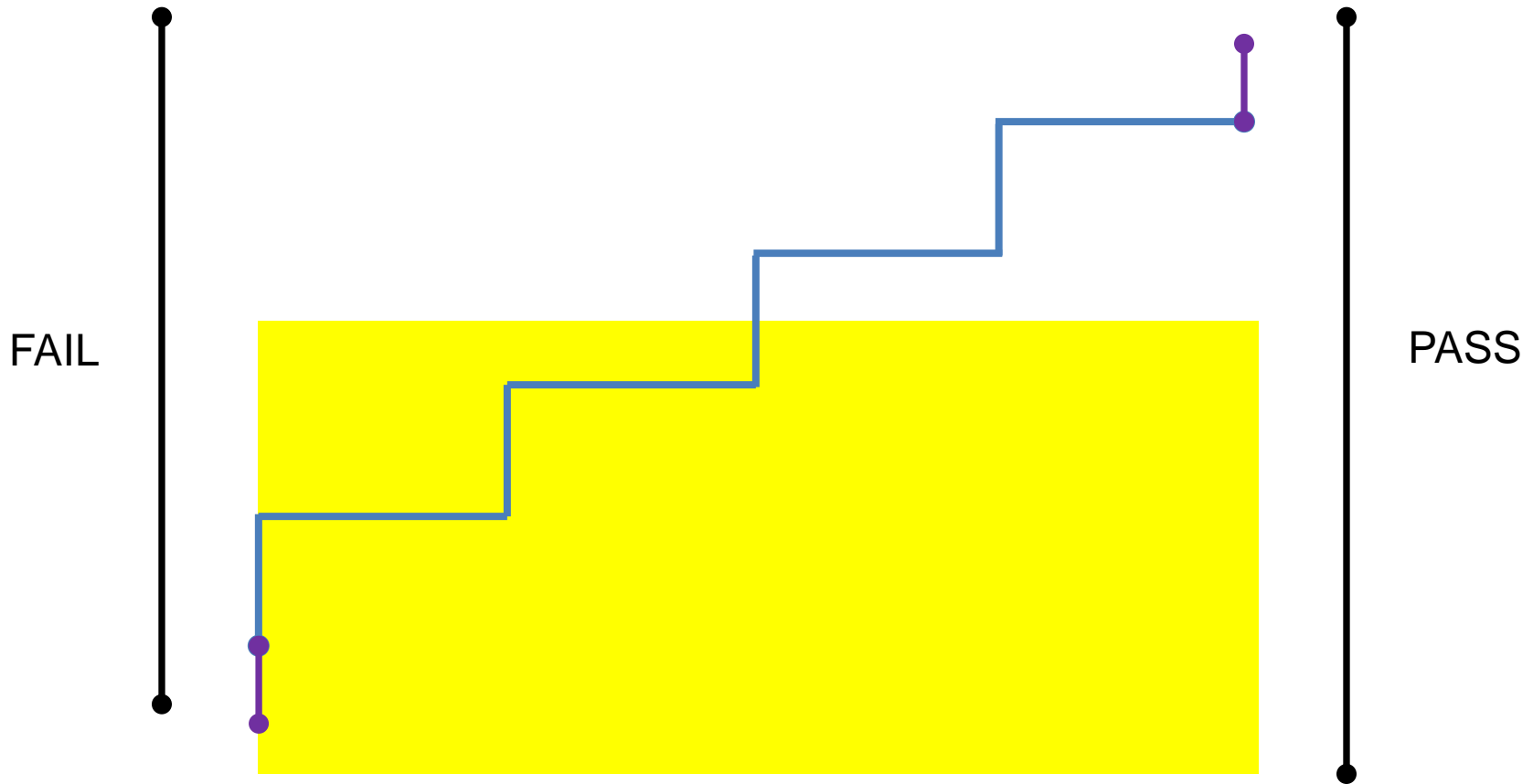
- Similar to how ISO calculates GHG cost to be included in ISO resource's DEB
 - However, ISO calculates a cost curve based upon incremental heat rates to align with multi-segment bid curve
- Daily maximum GHG bid = max heat rate * GHG allowance price index * GHG emissions rate + 10%
- SC can bid on an hourly basis less than its daily maximum GHG bid
- If a MW quantity is submitted, but no price, the daily maximum GHG bid will be used by default

Enhanced capacity test ensures sufficient bid range from participating resource to meet RTUC load forecast

●—● Load Forecast

■ Supply Base Schedule

●—● Bid Range



—●—● Historical import/export not tagging

Enhance capacity test to cover potential imports and exports not tagging to base schedules

- Separate monthly calculation for imports & exports
 - No netting of imports and exports
 - Regardless of reason not tagged
 - For each hour, histogram developed to compare T-40 base schedules with actual tagged value at T-20
 - Calculate prior 15th to 15th, effective 1st day of month
 - Notification period to EIM Entity of increased bid range needed to pass test
 - If requirement was calculated on rolling basis limited time for EIM entity to react

Histogram developed for each hour independently for imports and exports

- Import histogram data
 - $(\text{Base schedule imports} - \text{actual tagged imports}) / \text{base schedule imports}$
- Export histogram data
 - $(\text{Base schedule exports} - \text{actual tagged exports}) / \text{base schedule exports}$
- ISO may combine similar hours to increase sample size and will outline in BPM

Changes in actual tagged base schedules can increase the need for both upward and downward bids

- If imports tag higher than the base schedules, additional downward bid range will be required
- If imports tag lower than the base schedules, additional upward bid range will be required
- If exports tag higher than the base schedules, additional upward bid range will be required
- If exports tag lower than base schedules, additional downward bid range will be required

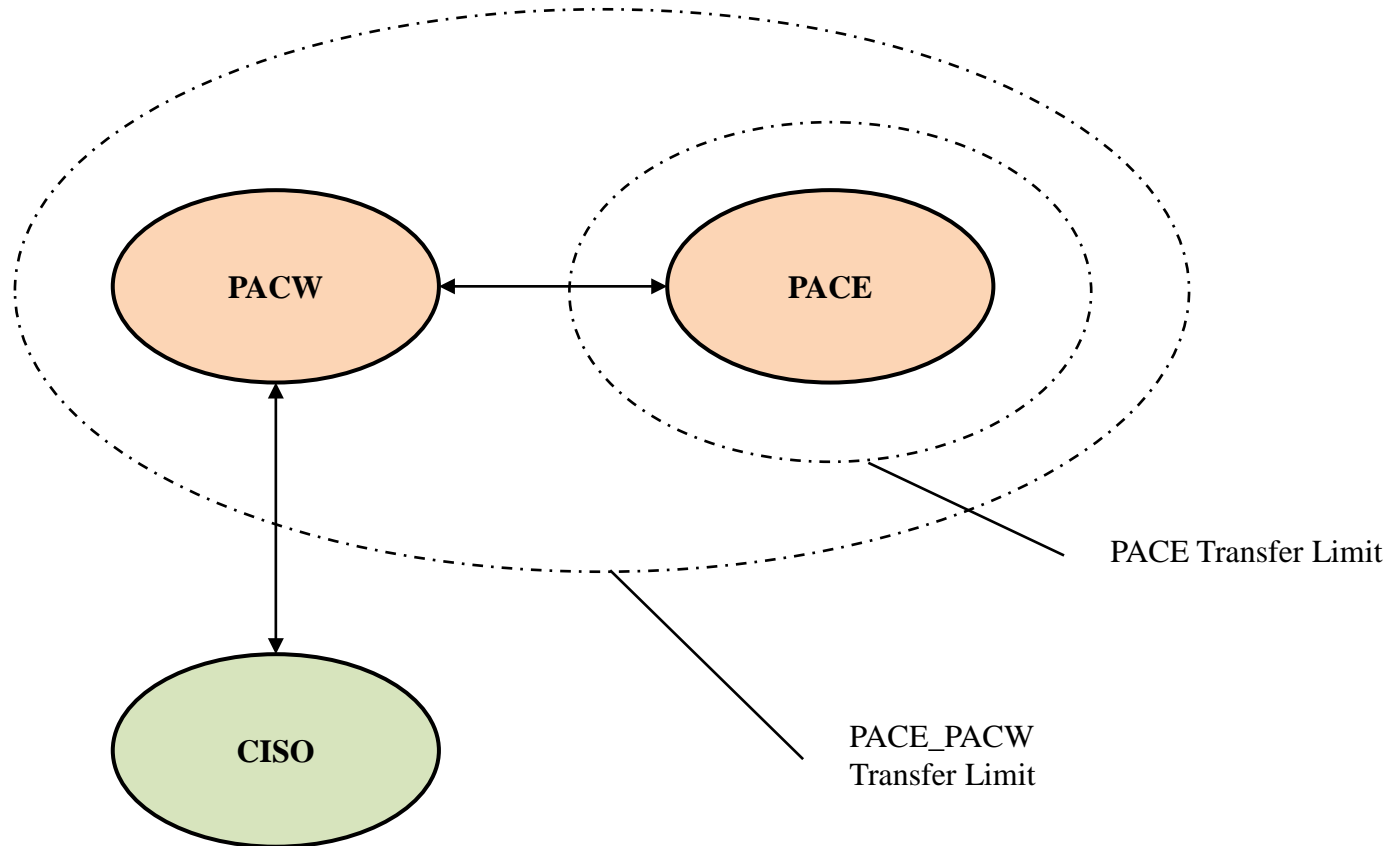
Hourly requirement calculated for upward and downward bid range cover 95% of historical changes

- Additional incremental requirement
 - 97.5^{th} percentile of import histogram * gross import base schedule – 2.5^{th} percentile of export histogram * gross export base schedule
- Additional decremental requirement
 - 97.5^{th} percentile of export histogram * gross export base schedule – 2.5^{th} percentile of import histogram * gross import base schedule

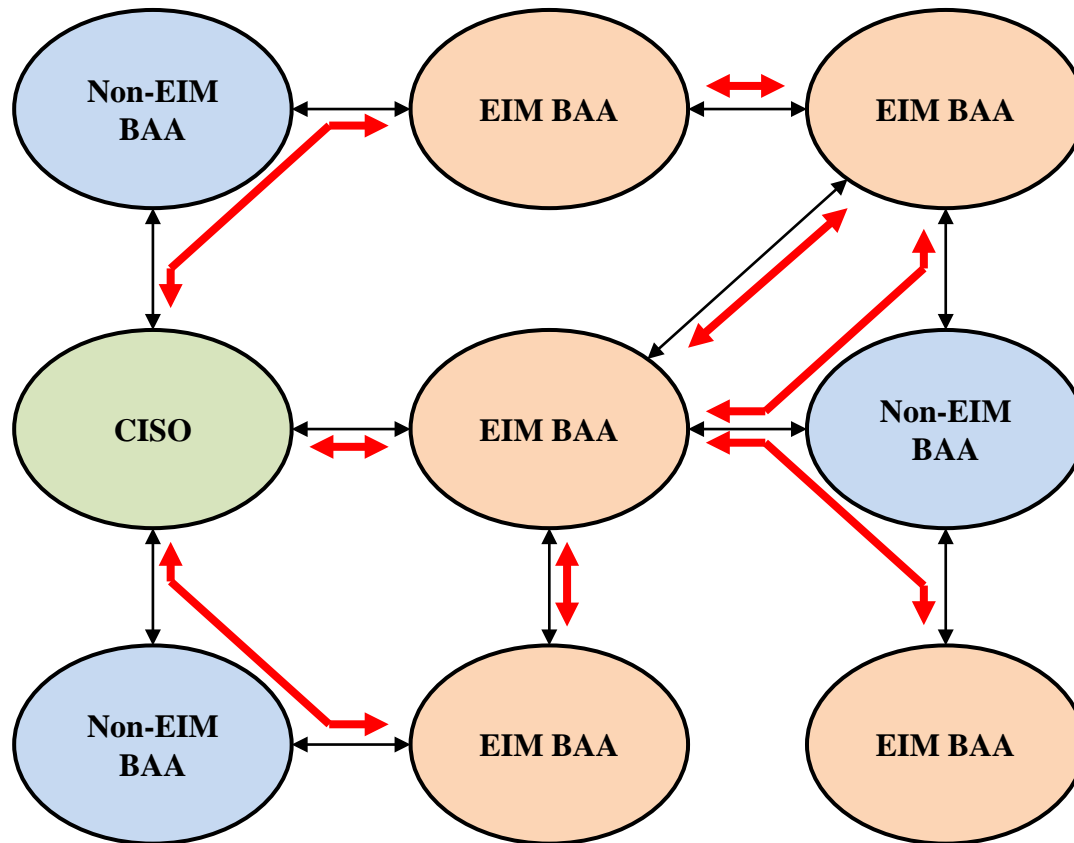
BAAs may put in place mitigation measures to address imports/exports assumed at T-40 not tagging

- ISO
 - Hourly schedules decline charge
 - Real-time must offer obligation
- PacifiCorp
 - Must tag hourly base schedules at T-55
- Other EIM Entities
 - Flexibility to design own measures within OATT

EIM Transfer Constraints (Current)



EIM Transfer Constraints (Future)



Energy Transfer Schedule Definition

- Portion of the EIM Transfer distributed to an intertie (or between tags on the same intertie) with another BAA in the EIM Area for accounting and tagging
- Constrained by Energy Transfer limits
 - Limits reflect transmission rights released for EIM
 - Limits may be 15 min static (RTUC) and 5 min dynamic (RTD), or only 5min dynamic (RTUC/RTD)
 - If using contractual rights, provided by EIM entity
 - If using ATC, calculated with priorities provided by EIM entity
- Constrained by Scheduling Limits (ISL/ITC) on interties with CISO or non-EIM BAAs

Energy Transfer System Resources

- Used to anchor the Energy Transfer Schedules
- Used to identify Energy Transfer Schedule tags
- Defined at the Default Generation Aggregation Point (DGAP) of an EIM BAA
- Registered in pairs across interties:
 - In BAA₁ for export from BAA₁ to BAA₂ on intertie T
 - In BAA₂ for export from BAA₂ to BAA₁ on intertie T
- No imbalance energy settlement for transfers
 - The settlement is with resources in the EIM BAA
- Financial value of EIM transfer uses the DGAP price

Creation of tags by EIM entity

- Between EIM BAAs, each EIM entity creates an export tag
- Between ISO and EIM entity, EIM entity creates both an import and exports tag
- Multiple tags can be created per intertie scheduling point
 - For example, 15-minute static, two dynamic schedules
- Assume single intertie between ISO, NVE, PACE

<u>Creator</u>	<u>Direction</u>
NVE	ISO to NVE
NVE	NVE to ISO
NVE	NVE to PACE
PACE	PACE to NVE

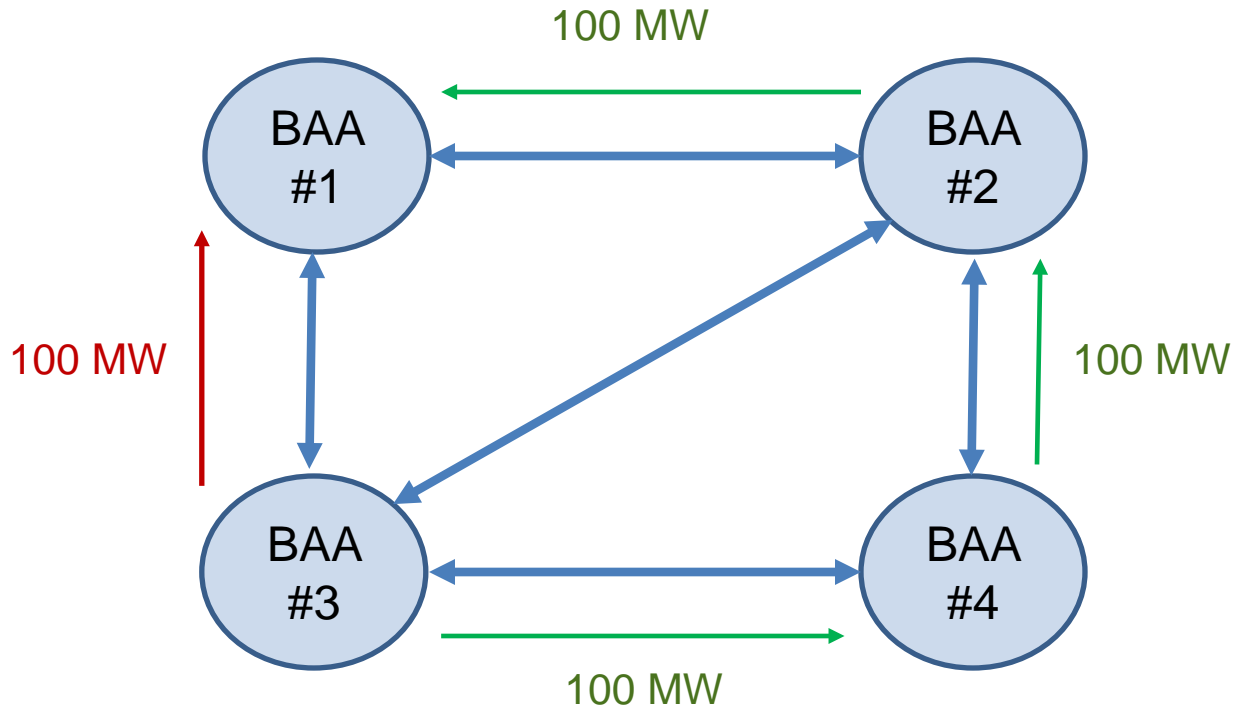
Tagging of dynamics schedules when using full interties scheduling limit (ie ATC)

- Intertie scheduling limits are calculated the same for EIM external interties and EIM internal interties
- Transmission profile calculated consistent with Appendix L of ISO tariff
 - Total transfer capability less encumbrances
 - Counterflows on base schedules allow EIM transfers
- Expected energy should be tagged based on advisory EIM transfers in HASP

Example of transmission profile and expected energy to allow the maximum EIM transfers

- Assumptions:
 - TTC in import direction = 500 MW
 - TTC in export direction = 400 MW
 - Encumbrances import direction = 100 MW
 - Encumbrances export direction = 100 MW
 - Base schedules in import direction = 350 MW
 - Base schedules in export direction = 150 MW
 - HASP advisory EIM transfer in import direction = 100 MW
- Calculations of dynamic schedule:
 - Import transmission profile = 550 MW = $500 - 100 + 150$
 - Import expected energy = 100 MW
 - Export transmission profile = 650 MW = $400 - 100 + 350$
 - Export expected energy = 0 MW

Transfer cost ensures unique solution and most direct path is used to tag EIM transfers



3x to tag on green path, than the red path

Transfer cost allows implementation of priority order of which tags to schedule EIM transfers

- Direct paths will have higher priority over indirect paths
- Paths that 5-minute scheduling is allowed on will have different priority over paths that only 15-minute scheduling is allowed on
- Paths with firm transmission will have higher priority over paths with non-firm transmission
- Paths that experience less-frequent curtailments will have higher priority than paths with more-frequent curtailments

Transfer cost used in market will balance the benefits with minimizing impact to LMPs

- Based on simulations, the ISO will propose a maximum transfer cost allowed
- The maximum transfer cost will be in the ISO tariff
- EIM entity can provide priority of tags, the ISO will determine the transfer cost used to implement priority

Objective of the EIM administrative charge design is to recover ISO operational costs

- Similar charge for similar real-time market services between ISO market participants and EIM market participants
- Minimum charge to cover ongoing operational costs independent of imbalance volumes

Redesign of EIM administrative charge needed to align billing determinants with two ISO GMC real-time market rates

- Market services rate is \$0.0562 per MWh of ...
 - FMM IIE = Gross FMM Instructed Imbalance Energy excluding FMM Manual Dispatch Energy
 - RTD IIE = Gross RTD Instructed Imbalance Energy excluding RTD Manual Dispatch Energy Standard Ramping Deviation, Ramping Energy Deviation, Residual Imbalance Energy, and Operational Adjustments.
- System operations rate is \$0.1303 per MWh of ...
 - Gross real time energy flow which is the absolute difference between the meter and the base schedules.

Remove rate certainty and minimum charge while EIM entity is in EIM

- ISO market services and system operations rates updated as needed on quarterly basis
 - Greater of 2% or \$1 million annual cost/revenue
 - Apply the cost of service % of ISO rate to update EIM rates
 - This percentage is valid for three years and updated by a new cost of service study
 - EIM rates go to four decimal points, same as ISO rates
- Minimum charge of 5% Load + Exports and 5% Generation + Imports applied only during period when EIM entity is withdrawing from EIM
 - Both market services rate and system operations rate

Historical rate changes for ISO GMC and updated EIM administrative charge

ISO Grid Management Charge	1/1/12	7/1/12	10/1/12	1/1/13	8/1/13	1/1/14	1/1/15
Market Services	\$0.0851	\$0.0950	\$0.0840	\$0.0931	\$0.0754	\$0.0867	\$0.0876
System Operations	\$0.2845	\$0.2845	\$0.2845	\$0.2872	\$0.2874	\$0.2890	\$0.2978
Cost of Service Study	1/1/12	7/1/12	10/1/12	1/1/13	8/1/13	1/1/14	1/1/15
EIM % of ISO Market Services	67%	67%	67%	67%	67%	67%	61%
EIM % of ISO System Operations	48%	48%	48%	48%	48%	48%	45%
EIM Administrative Charge	1/1/12	7/1/12	10/1/12	1/1/13	8/1/13	1/1/14	1/1/15
Market Services	\$0.0570	\$0.0637	\$0.0563	\$0.0624	\$0.0505	\$0.0581	\$0.0534
System Operations	\$0.1366	\$0.1366	\$0.1366	\$0.1379	\$0.1380	\$0.1387	\$0.1340
Total	\$0.1936	\$0.2003	\$0.1929	\$0.2003	\$0.1885	\$0.1968	\$0.1874

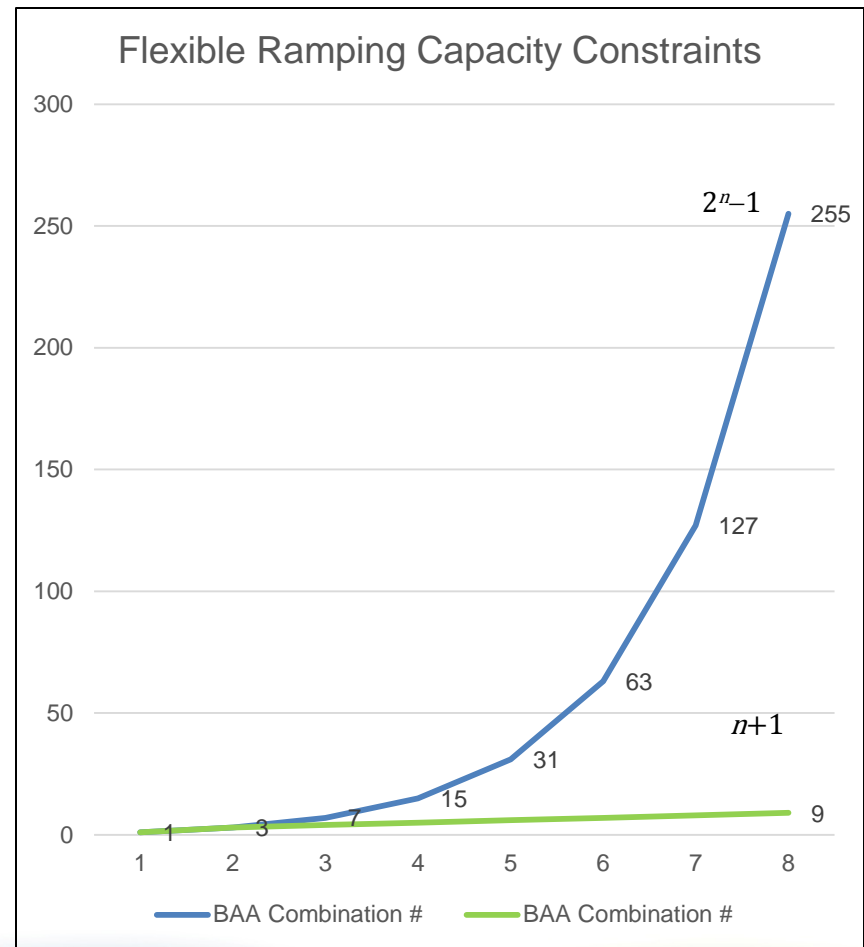
Flexible ramping combination constraints rapidly increase as new EIM BAAs join

- Currently, all BAA combinations:

$$\sum_{1 \leq k \leq n} \binom{n}{k} = \sum_{1 \leq k \leq n} \frac{n!}{k!(n-k)!} = 2^n - 1$$

- Impractical as more EIM Entities join
- Instead: Use a constraint for each BAA and one for all:

$$\binom{n}{1} + \binom{n}{n} = n + 1 \text{ for } n > 1$$



Reduce the number of flexible ramping constraint combinations

- Currently 7 combinations for PACE, PACW, ISO
- Adding NVE would result in 15 combinations
- Adding another EIM entity would result in 31 combinations
- Propose to enforce system wide constraint and each BAA
 1. PACE + PACW + ISO + NVE
 2. PACE – EIM transfers in from PACW, ISO & NVE
 3. PACW – EIM transfers in from PACE, ISO, & NVE
 4. ISO – EIM transfers in from PACE, PACW, NVE
 5. NVE – EIM transfers in from PACE, PACW, ISO

Phase 2 items informed by six month of operational experience or need additional discussion

- 15-Minute Bidding on Intertie Scheduling Points
- Additional sub-allocation of RTCO (Flow Entitlements)
- EIM Transmission Charge

- Dynamic Market Power Mitigation
- Additional Transition Period Measures
- Long Term Changes to GHG Design
- Other Items Identified During Implementation

Ability to bring design changes for BOG decision before 1 year of operational data

How does the ISO calculate intertie scheduling limits used in the market optimization?

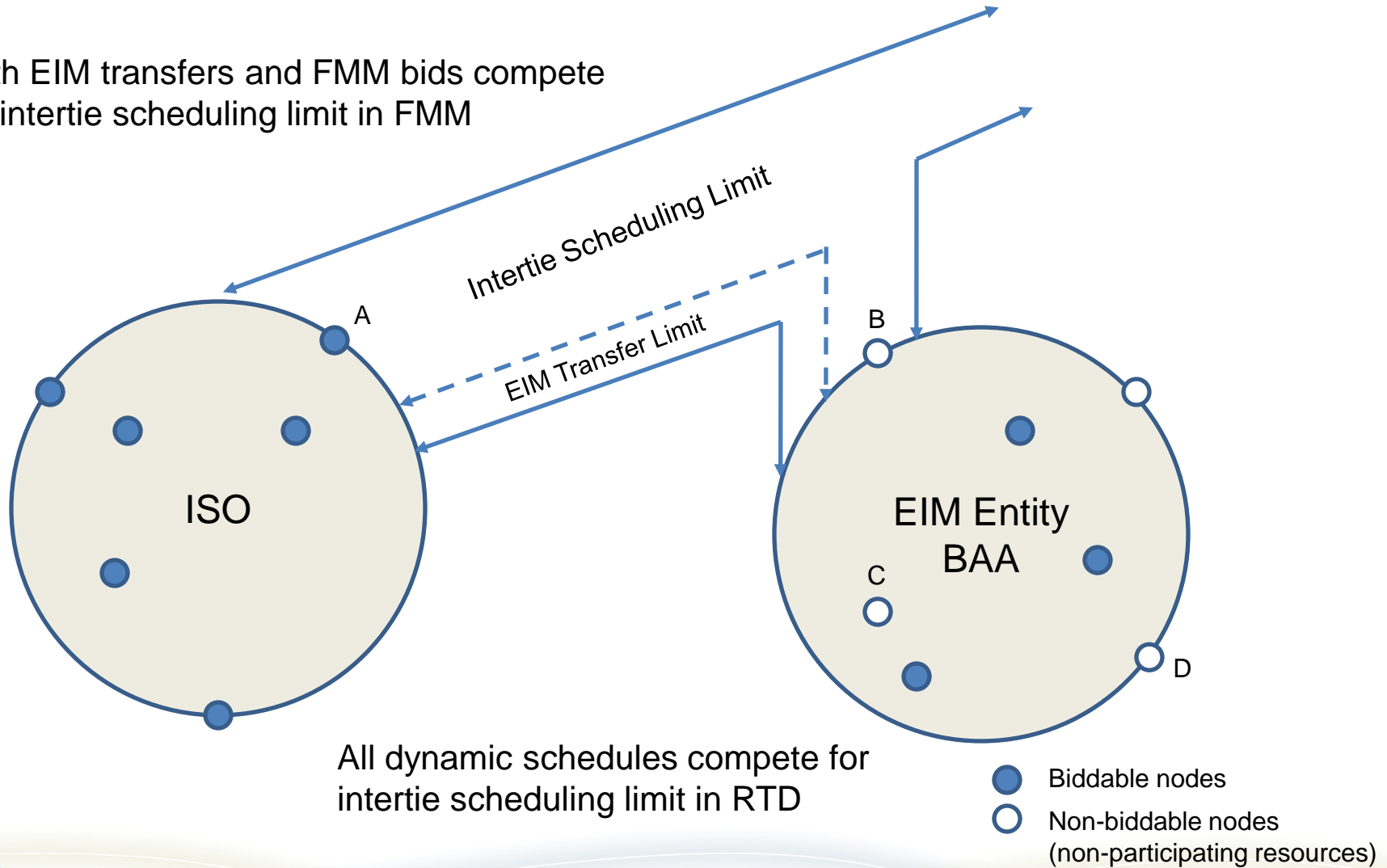
- See Appendix L of ISO Tariff
 - This methodology applies for any EIM external intertie
 - This methodology applies for any EIM internal intertie
- Intertie scheduling limit may be different than EIM transfer limit
 - PAC is unique because they don't manage the EIM internal intertie to the ISO, but BPA does.
 - PAC is using contract rights on a static and dynamic schedule

Market optimization enforces intertie scheduling limit constraints in the import and export direction (1 of 3)

- **EIM External Interties (Assume FMM economic bidding)**
 - Counterflows are allowed
 - Hourly energy schedules, FMM awards, dynamic transfer awards must be below scheduling limit in HASP, FMM, and RTD
- **EIM Internal Interties**
 - Counterflows are allowed
 - Hourly energy schedules, FMM EIM transfers, RTD EIM transfers must be below scheduling limit
- **Shared EIM External Interties and EIM Internal Interties**
 - Counterflows are allowed
 - Hourly energy schedules, FMM award, FMM EIM transfers, dynamic transfer awards, RTD EIM transfers must be below scheduling limit

Every transaction competes equally for intertie transmission capacity (2 of 3)

Both EIM transfers and FMM bids compete for intertie scheduling limit in FMM



All dynamic schedules compete for intertie scheduling limit in RTD

- Biddable nodes
- Non-biddable nodes (non-participating resources)

Market optimization enforces intertie scheduling constraints in the import and export direction (3 of 3)

- Dynamic transfers on EIM External Interties and dynamic schedule supporting EIM transfers on EIM Internal Interties are managed the same
- The transmission profile is not used by market to ensure intertie scheduling limits are not violated
- The market awards ensure the energy profiles on e-tags will not result in a denial

Economic bidding at EIM external interties, market also observes the transmission profile of the tag

- In FMM, awards are limited by the minimum transmission profile tagged on any path outside the EIM footprint
- Tag must be created by T-40, prior to the start of the FMM for first 15-minute interval of the operating hour
- Energy schedules must be within the intertie scheduling limit
- Market operator updates the energy profile with FMM award

Two scenarios for EIM internal interties

1. Transmission for EIM transfer to intertie scheduling point
2. Transmission for EIM transfer across intertie scheduling point

Propose to not allow economic bidding at EIM internal interties

- Base schedules, including ISO day-ahead schedules deemed delivered
- If sourced within the EIM footprint, then bid in real-time market at the resource
- If source outside the EIM footprint, then bid at the EIM external intertie based upon the source/sink non-EIM BAA
 - Phase 2 full network model (FNM) is implemented on EIM external interties for EIM entities
 - Currently, only Phase 1 FNM is implemented on ISO interties with non-EIM BAAs (EIM external intertie)

Intertie is both an EIM external intertie and an EIM internal intertie

- This is the current implementation with PacifiCorp
- Propose FMM bidding allowed on EIM external intertie
- Propose FMM bidding not allowed on EIM internal intertie
- Bidding on EIM external intertie and EIM transfers compete within intertie scheduling limit

Real-time congestion offset is calculated for each BAA in the EIM footprint

- Neutrality account from re-dispatch of generation to resolve RT constraints
 - Charge or credit, but transmission outages can drive up charges
- Isolate neutrality account to each BAA
 - Resources across EIM footprint impact constraints in each BAA
 - To isolate, sum impact on constraint in each BAA separately

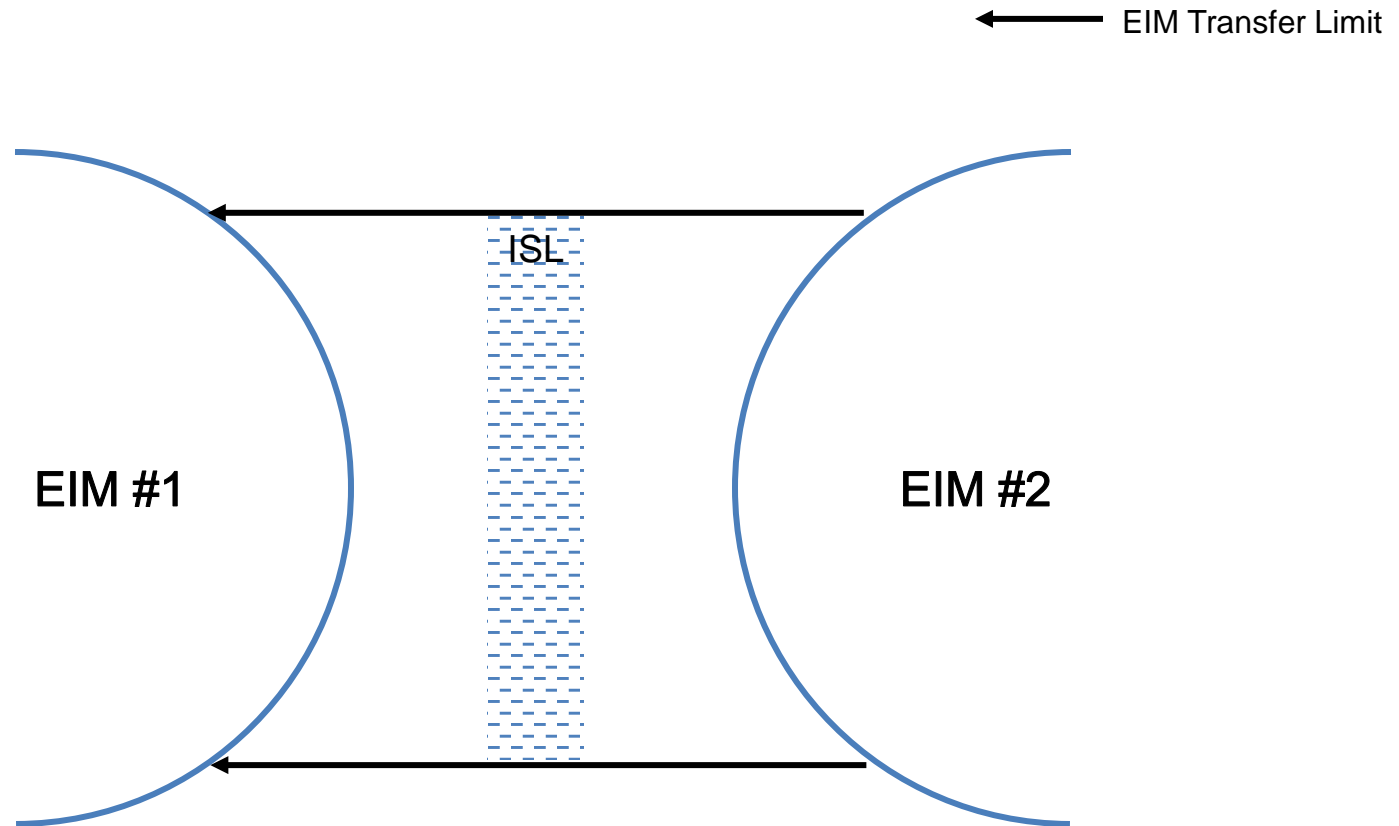
Real-time congestion offset is calculated for each BAA in the EIM footprint

- To calculate a resource's impact on a constraint
 - Shift factor of resource is the impact on constraint
 - Shadow price of the constraint represents the change in congestion costs
 - Delta between meter and base schedule is the change in flow
 - The product of the shift factor, shadow price and change in flow is the BAA real-time congestion balancing account
- Each BAA bears its own cost of infeasible schedules entering the EIM

Congestion on EIM transfer limits included in real-time congestion offset

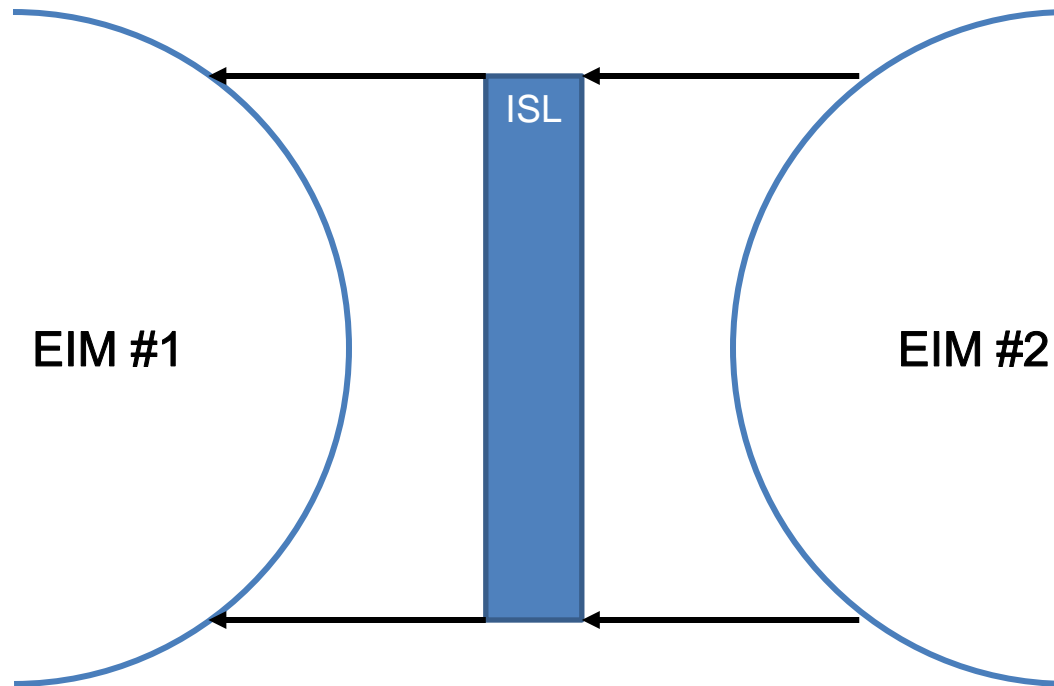
- For EIM internal interties, the congestion is split 50/50 in to each BAA's real-time congestion offset
- Should there be different treatment for ...
 1. Transmission for EIM transfer to intertie scheduling point
 2. Transmission for EIM transfer across intertie scheduling point

Scenario 1 – EIM transfer limit = intertie scheduling limit, rights across intertie



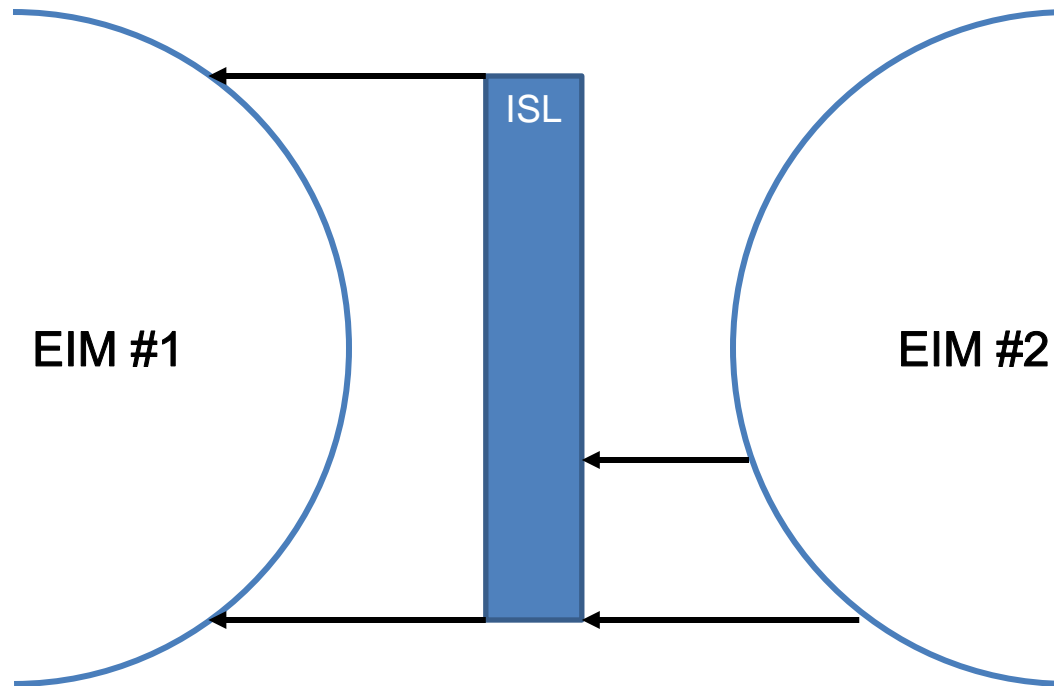
Congestion on EIM transfer limit shared between EIM #1 and EIM #2 RTCO

Scenario 2 – EIM transfer limit = intertie scheduling limit, rights to intertie



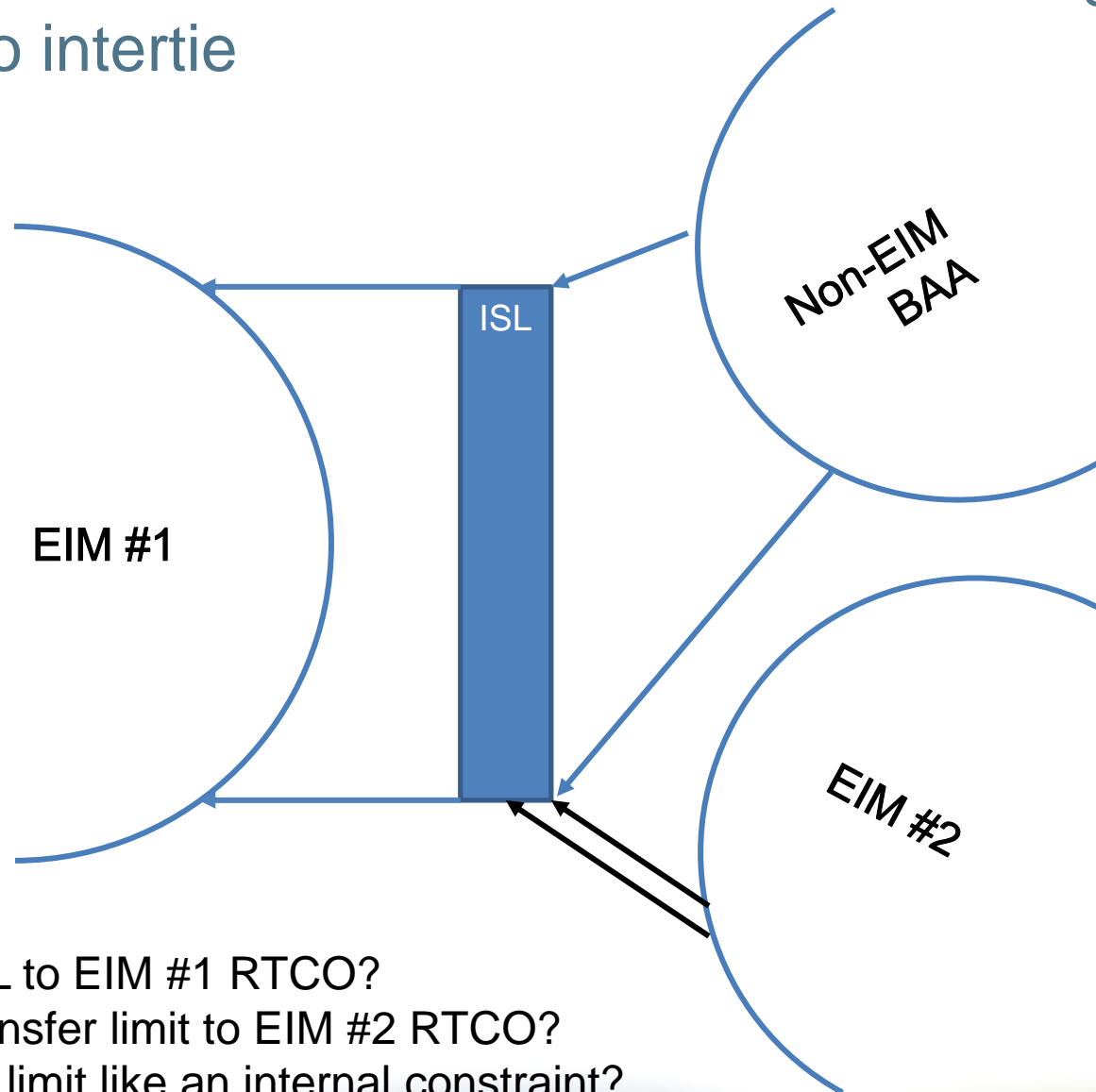
Should RTCO treatment be different from Scenario 1?

Scenario 3 – EIM transfer limit < intertie scheduling limit, rights to intertie



Why would EIM #2 have a transfer limit lower than ISL?
Should ISL go to EIM #1 RTCO, transfer limit to EIM #2 RTCO?

Scenario 4 – EIM transfer limit < intertie scheduling limit, rights to intertie



Congestion for ISL to EIM #1 RTCO?

Congestion for transfer limit to EIM #2 RTCO?

Is EIM #2 transfer limit like an internal constraint?

PacifiCorp described scenario 4 in their written comments to the technical workshop (1 of 2)

- Currently congestion on EIM transfer is split 50/50
 - Existing rule for EIM internal intertie
- If ISL congestion, 100% to ISO RTCO
- Assume ISL MCC = \$1.00, EIM transfer MCC = \$10.00
 - Under current methodology for each MW EIM transfer,
 - ISO RTCO = \$6.00 ($\$1.00 + \$10.00/2$)
 - PAC RTCO = \$5.00 ($\$10.00/2$)
 - If EIM transfer limit considered internal to PAC,
 - ISO RTCO = \$1.00
 - PAC RTCO = \$10.00

PacifiCorp described scenario 4 in their written comments to the technical workshop (2 of 2)

- Assume No ISL congestion, EIM transfer MCC = \$10.00
 - Under current methodology for each MW EIM transfer,
 - ISO RTCO = \$5.00 ($\$10.00/2$)
 - PAC RTCO = \$5.00 ($\$10.00/2$)
 - If EIM transfer limit considered internal to PAC,
 - ISO RTCO = \$0.00
 - PAC RTCO = \$10.00

Additional sub-allocation of RTCO (Flow Entitlements)

- Base schedules of one EIM entity can cause flows on another EIM entity's BAA
- Currently, the EIM assumes each EIM BAA is responsible for resolving congestion on its own system
- RTCO is calculated for each BAA
- Flow entitlements would allocate base schedule flows above entitlement to the other EIM entity's BAA RTCO

Additional sub-allocation of RTCO (Flow Entitlements)

- Agreement between two EIM BAAs on base schedule flows allowed on each other's BAA
 - Based upon historical flows? Need uniform methodology
- If EIM #1 base schedule flows exceed flow entitlement, cost of re-dispatch accrued in EIM #2 RTCO is allocated to EIM #1 RTCO
- Similar approach done today for ISO convergence bidding flows on EIM Entity BAAs
- Seek stakeholder recommendations on analysis to evaluate the benefit of added RTCO complexity

ISO committed to evaluate need for EIM transmission charge based upon 1 year operational experience

- Will begin evaluation with six months of operational experience
- ISO seeks stakeholder input on types of analysis
- Options were discussed in original stakeholder process and described in the draft final proposal
 - <http://www.caiso.com/Documents/EnergyImbalanceMarket-DraftFinalProposal092313.pdf>

Principles to consider appropriateness of transmission cost recovery (1 of 2)

1. There should be no pancaking for transmission service,
2. Each transmission owner should meet its transmission revenue requirement,
3. Resource owners should not have to estimate or attempt to incorporate where their production is going, as part of their supply bids,

Principles to consider appropriateness of transmission cost recovery (2 of 2)

4. The implementation cost of a transmission access charge approach should be consistent with the magnitude of the total transmission costs expected to be incurred through EIM operations and recovered in EIM-related rates, and
5. The transmission charge should be consistent regardless of whether the EIM Participating Resource is operated by an EIM Entity. In other words, transmission cost recovery should not be affected by whether or not a load is the native load of the business entity that also is the transmission provider.

Alternative 1: No charge for as-available transmission

- Reciprocity between EIM Entities and ISO
- Transmission revenue recovery fully compensated by existing transmission rates
- EIM Entity could require transmission service prior to participation in EIM

Alternative 2: EIM transmission access charge

- Develop ratio of transmission revenue requirement based upon incremental real-time demand versus total demand
- Combine EIM Entity and ISO real-time transmission revenue requirement to establish an EIM-wide transmission access charge
 - An alternative is a regional access charge: blended access charge only among EIM Entities
- Ensures the least cost dispatch without hurdles

Alternative 3: Transfer charge as a minimum shadow price

- Incorporate transmission charge in the market optimization for transfers between EIM Entities and the ISO
- Set a minimum shadow price that would be incurred for transfers
- Ensure RTD incorporates the cost of transmission in the LMP

Alternative 4 – Transmission access charge applicable to load and wheeling

- Same treatment across different market timeframes to avoid perceived market shifting activity to lowest cost market
- Would allocate total transmission costs to metered load and wheels

Next steps

Item	Date
Stakeholder Meeting (Las Vegas)	February 18, 2015
Stakeholder Comments Due	February 25, 2015
Board of Governors Decision	March 26-27, 2015
Phase 2 Items	TBD

In written comments, please clearly delineate between Phase 1 and Phase 2

Please submit written comments to EIM@caiso.com by February 25