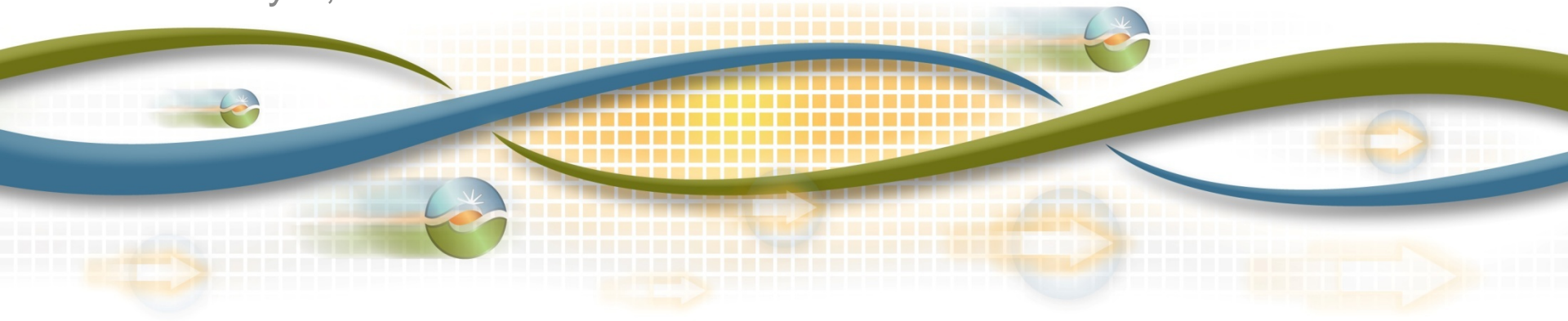


Energy Imbalance Market Year 1 Enhancements

Don Tretheway

Lead Market Design and Regulatory Policy Specialist

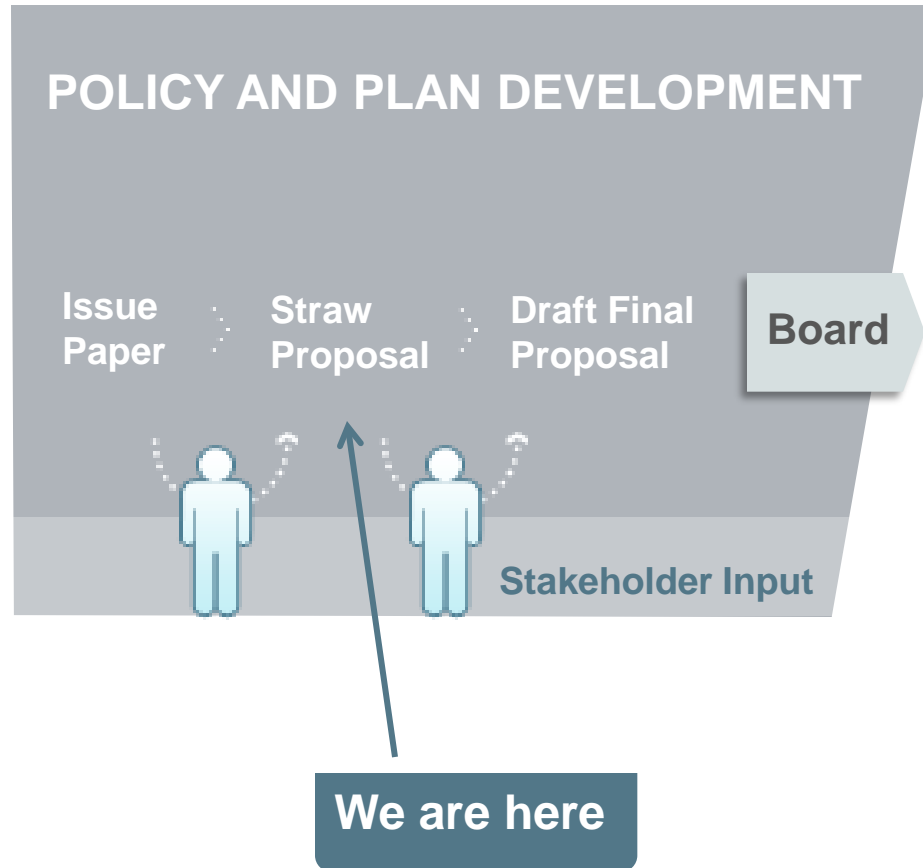
January 8, 2015



Agenda

Time	Topic	Presenter
10:00 – 10:15	Introduction	Kristina Osborne
10:15 – 12:00	Settlement of Non-Participating Resources Administrative pricing GHG Flag and Cost Based Adder	Don Tretheway
12:00 – 1:00	Lunch	
1:00 – 3:50	EIM Transfer Limit Constraint EIM Transfers using ATC 15-Minute Intertie Bidding Transition Period Measures Administrative 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
- Resources Sufficiency Evaluation Applied to ISO BAA

- Establishment of EIM Transfer Limits Using ATC
- Modification of EIM Transfer Limit Constraints
- 15-Minute Bidding on Intertie Scheduling Points
- Additional Transition Period Measures
- EIM Administrative Charge Redesign

Phase 2 items informed by six month of operational experience

- EIM Transmission Charge
- Flow Entitlements
- Dynamic Market Power Mitigation
- Other Items Identified During Implementation

Settlement of Non-Participating Resources (1 of 2)

- Many stakeholders questioned how a non-participating resource could get BCR
- This is not unique to EIM
- With ISO implementation of FERC Order 764, real-time self-schedule energy category was eliminated to simplify implementation
 - FMM and RTD is optimal energy for self-schedule changes
 - Optimal energy is used in BCR calculations

Settlement of Non-Participating Resources (2 of 2)

- Optimal energy because self-schedule changes for physical reasons allowed and result in FMM instructed imbalance energy when known prior to start of FMM
- We reviewed 12/1 – 12/3 across EIM footprint, only one resource was paid a total of \$19 in BCR
- Propose no settlement changes, just remove from EIM tariff that only participating resources can receive a BCR payment
 - Consistent treatment for both ISO real-time SS and EIM 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

GHG Flag for EIM participating resources to opt out of being deemed delivered to ISO

- Previous proposal
 - Add flag in master file and cost based bid
 - GHG can only be awarded to participating resources that have elected to be considered for supporting EIM transfers into the ISO
 - Total EIM transfer can exceed the total bid range of participating resources selecting flag
 - Method to allocate GHG awards beyond bid range
- Stakeholders wanted more flexibility to bid and the process to award beyond bid range was overly complex

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

- On an hourly basis, submit the MW quantity by resource that can receive GHG award
 - MW quantity is independent of bid range
- The “flag” is equivalent to bidding 0 MW.
 - If a SC does not submit a GHG MW bid, the default will be zero
- EIM GHG import limit into ISO from all EIM BAAs can be no greater than total MW of GHG bids

Cost based GHG bid adder follows the same rules as GHG compliance costs in ISO resource's default energy bid – no change

- Negotiated Option and Variable Cost Option
- On a daily basis, the variable cost option considers
 - Incremental heat rate
 - GHG emissions rate authorized by CARB
 - Applicable GHG compliance obligation cost
 - Plus 10% adder
- Resource must submit a daily GHG Bid adder \leq Cost
 - If Bid Adder $>$ Cost, ISO will override with resource's cost
 - GHG Bid adder must be greater than zero

Operation of EIM when using available transmission capacity

- Objective of discussion
 - Understand market timing
 - Understand how transmission profile and energy profile on dynamic e-tag relate to market optimization

T-40 versus T-20 issue is not unique to EIM, this is a result of ISO's response to FERC Order 764

- When developing the FMM market design, the ISO grappled with the issue of transmission remaining hourly and the final tagging deadline not changing
- ISO working assumption was BAAs allow transmission profiles to exceed transmission limits, but final checkout is based on the energy profile
- ISO market does not award energy schedules that exceed intertie scheduling limits, so updated energy profiles will checkout in external BAAs

Hour ahead scheduling process (HASP) optimizes expected energy across various bidding options

1. Self-scheduled hourly block
2. Self-scheduled variable energy resource forecast
3. Economic bid hourly block
4. Economic bid hourly block with single intra-hour economic schedule change
5. Economic bid with participation in 15-minute market
6. Dynamic Transfer

Only option 5 & 6 eligible for bid cost recovery

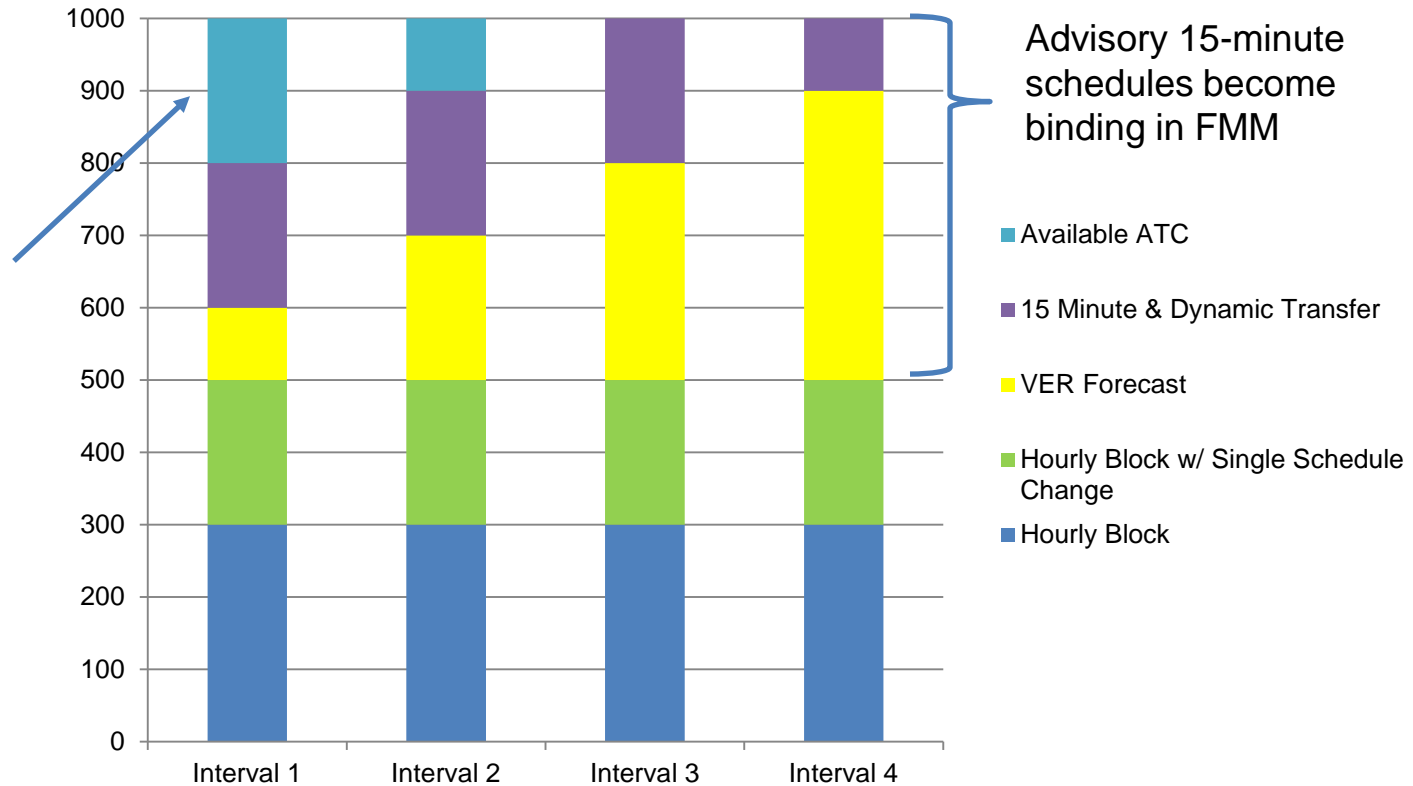
HASP process ensures intertie scheduling limit is not exceeded in any 15-minute interval of operating hour

- Hourly Blocks
 - Enforce constraint that energy schedule $T = T+15 = T+30 = T+45$
- 15 Minute and Dynamic Schedules
 - 15 minute interval advisory schedules can have different MW energy schedule
- VER forecast over intertie
 - 15 minute interval advisory schedules, based on forecast, can have different MW energy schedule

HASP economically allocates intertie scheduling limit to hourly block schedules and 15-minute schedules*

This is not unused transmission. Energy awards are not economic in HASP. Transmission remains available in FMM.

Intertie Limit = 1000 MW



ISO will approve e-Tags with transmission profiles \geq scheduling limit
 ISO ensures market awards in 15-minute interval \leq scheduling limit

HASP and FMM use all available transmission while preventing external tag denials by transmission priority

- Transmission and energy profile assumptions
 - BAAs sell non-firm transmission that exceeds the intertie scheduling limit
 - BAAs check out e-tags based upon the energy profile on the tag, not the transmission profile
- ISO markets enforce intertie scheduling limit and observe tagged transmission profile in FMM when awarding imports/exports
 - Independent of external transmission type
- ISO does not approve energy profiles that exceed HASP hourly expected energy or FMM schedule

Dynamic schedules to support EIM transfers are treated the same as any other dynamic schedule in HASP and FMM

- In HASP, 15-minute advisory energy schedules reflect expected EIM transfers
- In HASP, all hourly blocks compete economically with all 15-minute import/exports and dynamic schedules
- In FMM, all dynamic schedules compete economically with all 15-minute intertie bids
- In RTD, all dynamic schedules and pseudo-ties compete economically

After 764 go-live, some market participants with dynamic schedules attempted to tag an energy profile = transmission profile, in excess of ISO market award

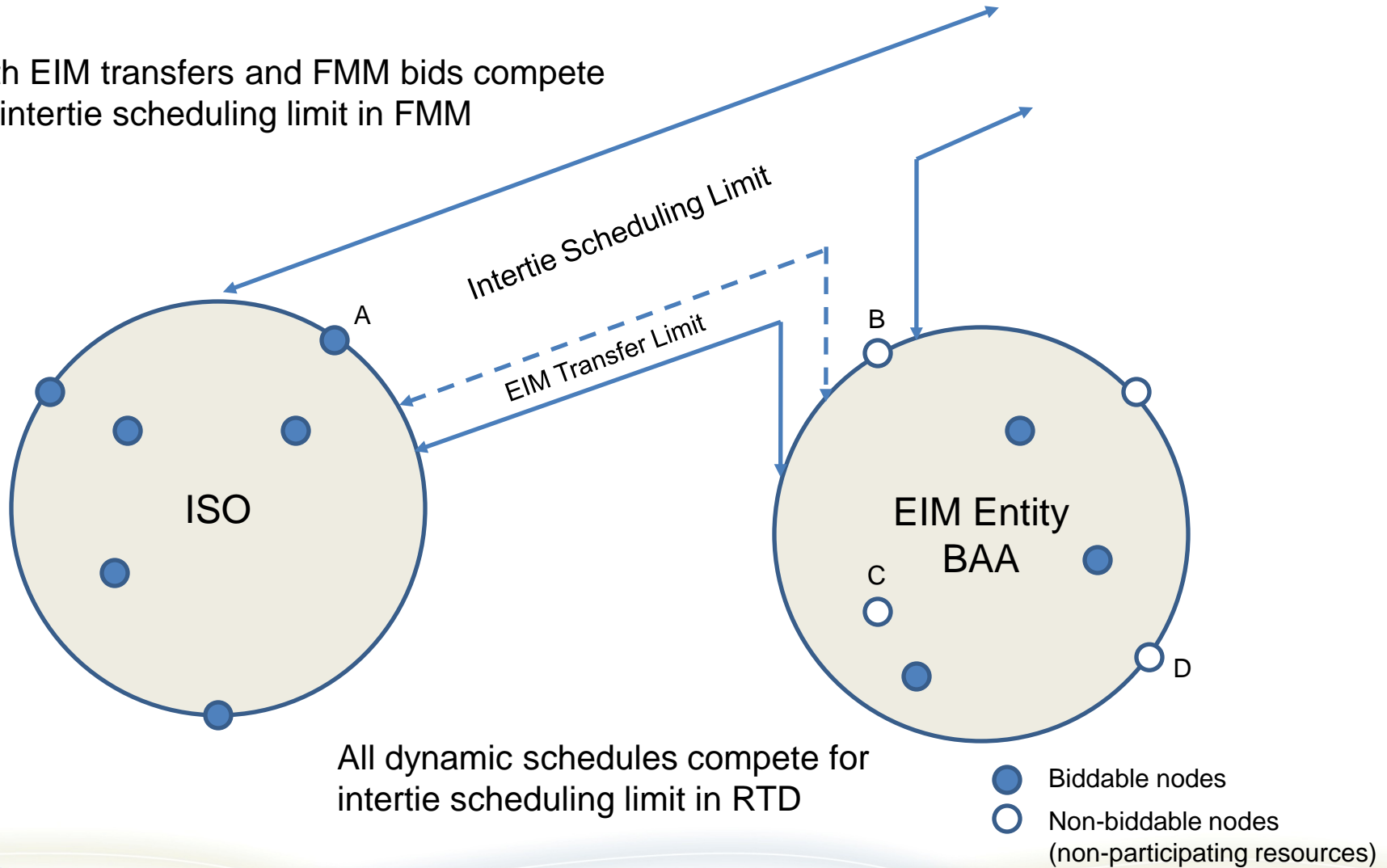
- The ISO denied dynamic schedules with energy profiles in excess of hourly expected delivery consistent with WECC business practices
- If allowed, dynamic schedules could force other intertie schedules with ISO market awards to be denied by other BAAs based upon transmission priority
- This would result in unused transmission capacity and reduce market liquidity

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



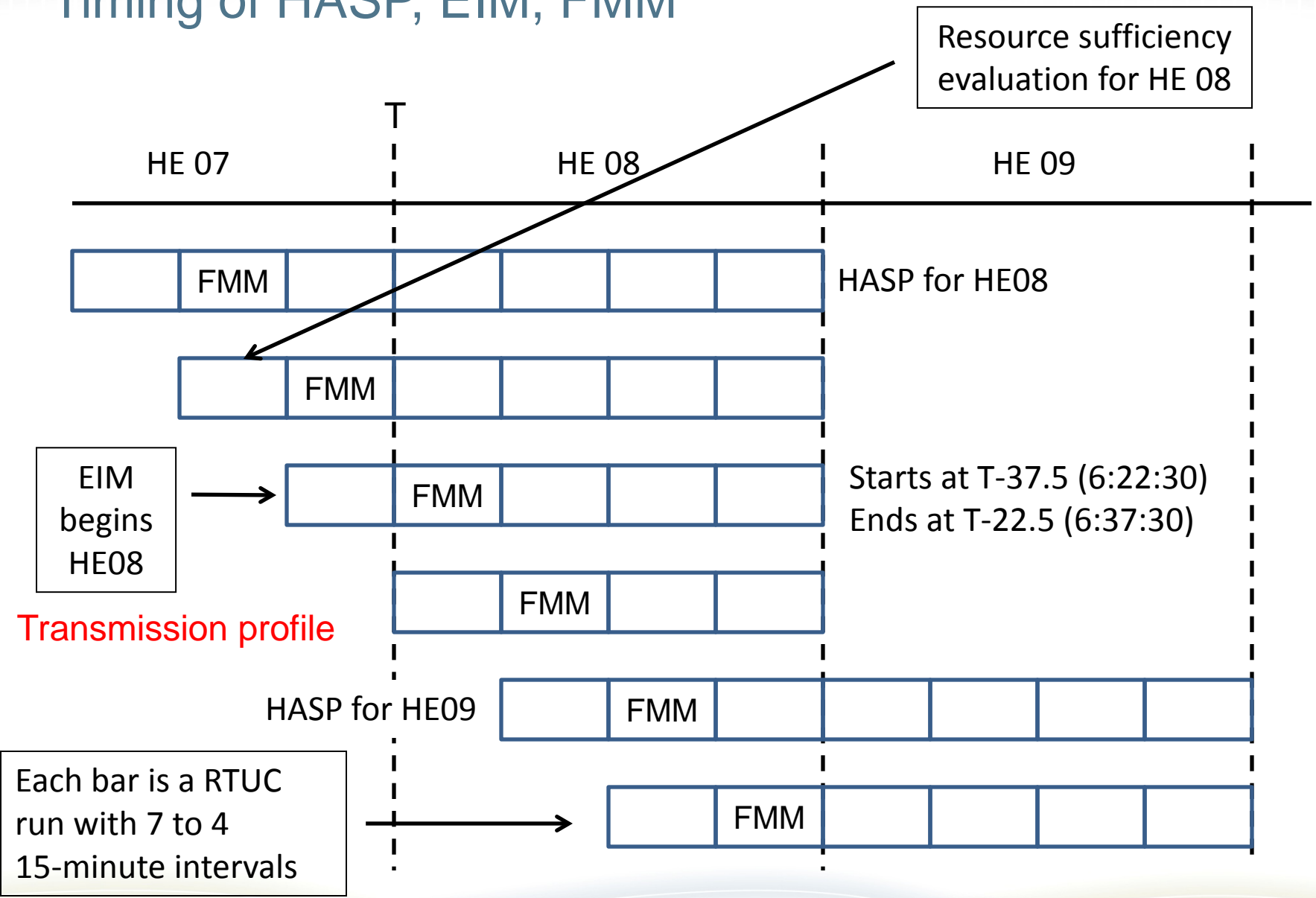
Market optimization enforces intertie scheduling constraints in the import and export direction (3 of 3)

- 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
- As we discussed last meeting, duplicative resources not efficient for internal interties to have FMM import and export bids

Import and export dynamic schedule for each EIM internal intertie supporting EIM transfers need to be created by T-40

- In the FMM, the market observes the transmission profile to ensure awards do not exceed lowest path on the tag
- In order to maximize potential counter flows the transmission profile should equal TTC less any encumbrances plus any base schedule counter flows
- Expected energy at T-40 should be the average of the four advisory 15-minute intervals in HASP

Timing of HASP, EIM, FMM



Resource sufficiency evaluation for HE 08

HE 07

HE 08

HE 09

FMM

FMM

FMM

FMM

FMM

FMM

HASP for HE08

Starts at $T-37.5$ (6:22:30)
Ends at $T-22.5$ (6:37:30)

HASP for HE09

Transmission profile

Each bar is a RTUC run with 7 to 4 15-minute intervals

HASP can be used to establish hourly expected energy for dynamic schedule for EIM transfer

- EIM Entity managing intertie scheduling point is responsible for creating the dynamic schedule tag
- HASP schedules are advisory and include anticipated EIM transfers
- HASP results published at T-52.5, can be used for expected energy for dynamic schedule energy profile

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

- See Appendix L of ISO Tariff
 - This methodology can apply for any EIM external intertie
 - This methodology can apply for any EIM internal intertie
- Intertie scheduling limit is distinct from 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 dynamic schedule

Example – dynamic schedule transmission profile to maximize EIM transfer capability

- Assumptions

- TTC in import direction = 500 MW
- TTC in export direction = 400 MW
- Encumbrances for specific scheduling rights
 - 100 MW in both the import and export direction
 - For example, the ISO excludes ETC since the ISO cannot use this capacity until after T-20
- Base Schedule imports 350 MW
- Base Schedule exports 150 MW

- Import transmission profile = 550 MW = 500 – 100 + 150

- Export transmission profile = 650 MW = 400 – 100 + 350

- Note: Base schedules don't need to tag prior to start of EIM

The transmission profile of the dynamic schedule can exceed the intertie scheduling limit in EIM

- Transmission profile is the maximum potential EIM transfer that could occur
 - Market observes transmission profile as a maximum limit when awarding energy
- The intertie scheduling limit is enforced in FMM and RTD
- Intertie schedule limit constraint ensures energy schedules in FMM and RTD don't violate transmission limits
 - Market clears energy schedules and dispatches

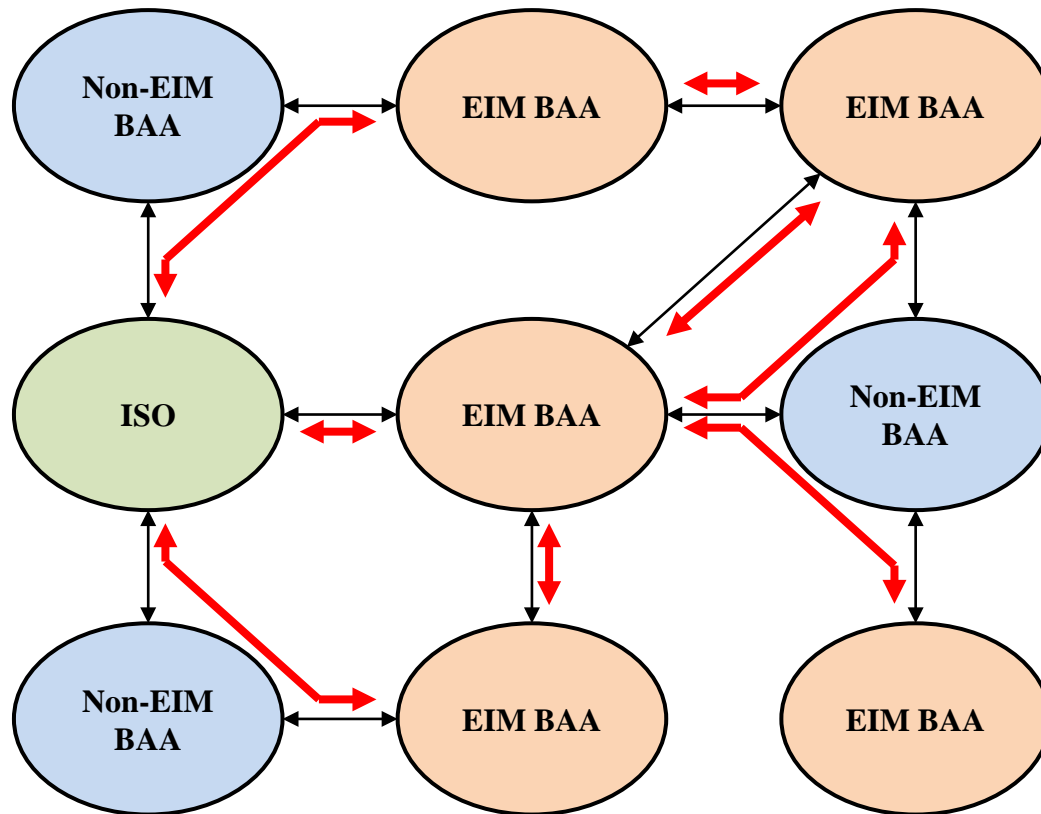
Since two dynamic schedules needed for each EIM internal intertie using current NSI for EIM transfer limit constraint is not scalable (1 of 3)

- Need to enforce EIM transfer limit by each EIM internal intertie to correctly update the energy profile
- Assume NSI = 600 MW Import
- Two intertie scheduling points 100MW and 500MW
 - Can't tag 600MW on one tag

Modification to EIM Transfer Limit Constraint (2 of 3)

- Current implementation enforces net schedule interchange \leq aggregate EIM transfer capability made available
 - Straight forward for PacifiCorp implementation using contract rights to support EIM transfers
- As EIM entities increase, it is more appropriate to enforce EIM transfer limits by individual intertie point
 - Improved modeling when ATC used for transfers
 - Supports use of contract rights for EIM transfers
 - Supports tagging of multiple dynamic schedules

Modification to EIM Transfer Limit Constraint (3 of 3)



ISO will hold a technical workshop in late January

Operation of EIM when using available transmission capacity

- Objective of discussion
 - Understand settlement implications
 - Additional consideration in resource sufficiency evaluation

Since EIM starts before final tagging deadline, what issues do we need to consider?

- Settlement impact when base schedules don't tag?
 - Yes. See examples
- Does EIM transfer capability impact the resource sufficiency evaluation?
 - No. Transfer capability doesn't factor in until FRP constraints are formulated in FMM and RTD
 - Although EIM transfer outs (on prior hour's dynamic schedule) in last FMM interval of preceding hour receive credit for ramping test
 - But, potential for additional imbalance when schedule don't tag
- Do different available transmission capacity in FMM (first two runs) and RTD cause unique operational issues?
 - No, same for counter flow not tagging, outage, or de-rate
 - The market will re-dispatch resources within transmission limits

When discussing the settlement examples...

- All examples assume prices are positive
- Pays – means settled with the SC
 - Non-participating resource is EIM Entity SC
 - Participating resource is EIM Participating Resource SC

All deviations from base schedule are settled through the EIM (1 of 6)

- Start of EIM is T-40 (final base schedules)
- ISO does not require hourly block schedules, including EIM base schedules, to be tagged prior to start of EIM
 - But, dynamic schedules and FMM economic bids must tag transmission profile and hourly expected energy by T-40
- Hourly schedules must tag by T-20
- FMM assumes hourly block schedules will tag at T-20
 - Interval 1 starts at T-37.5: Schedule assumed
 - Interval 2 starts at T-22.5: Assumed
 - Interval 3 starts at T-7.5: Actual known
- RTD uses ATC that reflects final hourly intertie schedules
 - Interval 1 starts at T-7.5: Actual known
 - Interval 2 starts at T-2.5: Known

All deviations from base schedule are settled through the EIM (2 of 6)

- When a **import** tags an energy profile at T-20 below base schedule,
 - FMM Interval 1: No deviation from base schedule
 - FMM Interval 2: No deviation from base schedule
 - FMM Interval 3: Deviation from base pays FMM price
 - FMM Interval 4: Deviation from base pays FMM price
 - RTD Intervals 1-6: Deviation from FMM schedule pays RTD price
 - RTD Intervals 7-12: No deviation from FMM
 - Subject to flexible ramping product (up) cost allocation in RTD intervals 1-6

All deviations from base schedule are settled through the EIM (3 of 6)

- When a **import** tags an energy profile at T-20 above base schedule,
 - FMM Interval 1: No deviation from base schedule
 - FMM Interval 2: No deviation from base schedule
 - FMM Interval 3: Deviation from base paid FMM price
 - FMM Interval 4: Deviation from base paid FMM price
 - RTD Intervals 1-6: Deviation from FMM schedule paid RTD price
 - RTD Intervals 7-12: No deviation from FMM
 - Subject to flexible ramping product (down) cost allocation in RTD intervals 1-6

All deviations from base schedule are settled through the EIM (4 of 6)

- When a **export** tags an energy profile at T-20 below base schedule,
 - FMM Interval 1: No deviation from base schedule
 - FMM Interval 2: No deviation from base schedule
 - FMM Interval 3: Deviation from base paid FMM price
 - FMM Interval 4: Deviation from base paid FMM price
 - RTD Intervals 1-6: Deviation from FMM schedule paid RTD price
 - RTD Intervals 7-12: No deviation from FMM
 - Subject to flexible ramping product (down) cost allocation in RTD intervals 1-6

All deviations from base schedule are settled through the EIM (5 of 6)

- When a **export** tags energy profile at T-20 above base schedule,
 - FMM Interval 1: No deviation from base schedule
 - FMM Interval 2: No deviation from base schedule
 - FMM Interval 3: Deviation from base pays FMM price
 - FMM Interval 4: Deviation from base pays FMM price
 - RTD Intervals 1-6: Deviation from FMM schedule pays RTD price
 - RTD Intervals 7-12: No deviation from FMM
 - Subject to flexible ramping product (up) cost allocation in RTD intervals 1-6

All deviations from base schedule are settled through the EIM (6 of 6)

- When a **wheel** base schedule does not tag its base schedule at T-20,
 - FMM Interval 1: No deviation from base schedule
 - FMM Interval 2: No deviation from base schedule
 - FMM Interval 3: Deviation from base pay/paid differential
 - FMM Interval 4: Deviation from base pay/paid differential
 - RTD Intervals 1-6: Deviation from FMM pay/paid differential
 - RTD Intervals 7-12: No deviation from FMM
 - Subject to flexible ramping product cost (up & down) allocation in RTD intervals 1-6
- Net Settlement Differential is LMP export – LMP import
 - SMEC and GHG components are the same for each LMP
 - Congestion and Loss components are different for each LMP

Resource sufficiency evaluation ensures ...

- Balance
- Capacity
- Ramping
- Unresolved Congestion Identified

Resource sufficiency evaluation if known a base schedule import would tag higher

- Balance
 - Lower imbalance demand
- Capacity
 - Need decremental dispatchable supply
- Ramping
 - Downward ramp rate used to meet lower demand, not forecast
- Unresolved Congestion not Identified
 - If was providing counter flow, RTCO accrues from re-dispatch

Resource sufficiency evaluation if known a base schedule import would tag lower

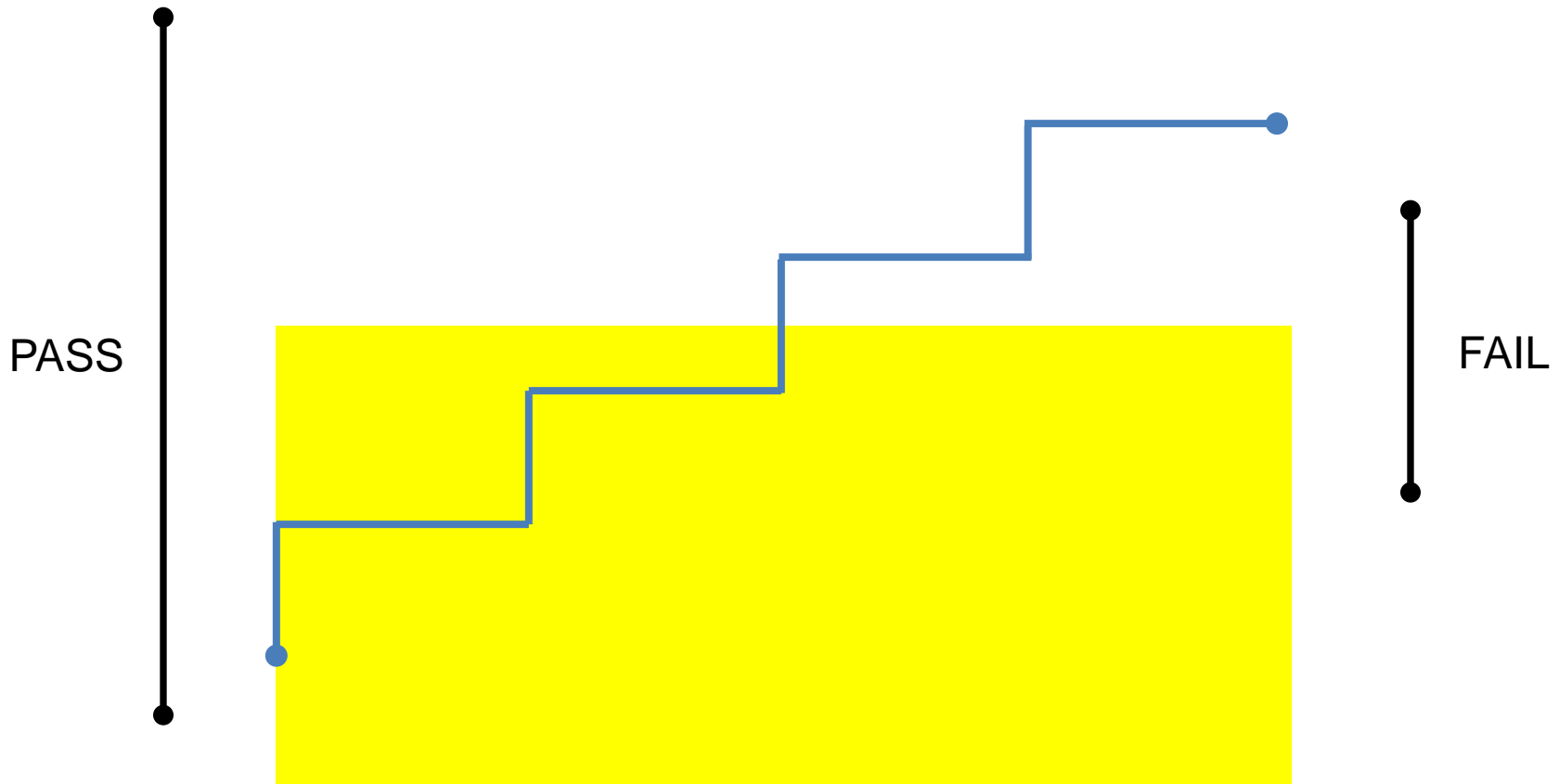
- Balance
 - Additional imbalance demand
- Capacity
 - Need incremental dispatchable supply
- Ramping
 - Upward ramp rate used to meet additional demand, not forecast
- Unresolved Congestion not Identified
 - If was providing counter flow, RTCO accrues from re-dispatch

Current capacity test ensures sufficient bid range from participating resource to meet FMM load forecast

●—● Load Forecast

■ Supply Base Schedule

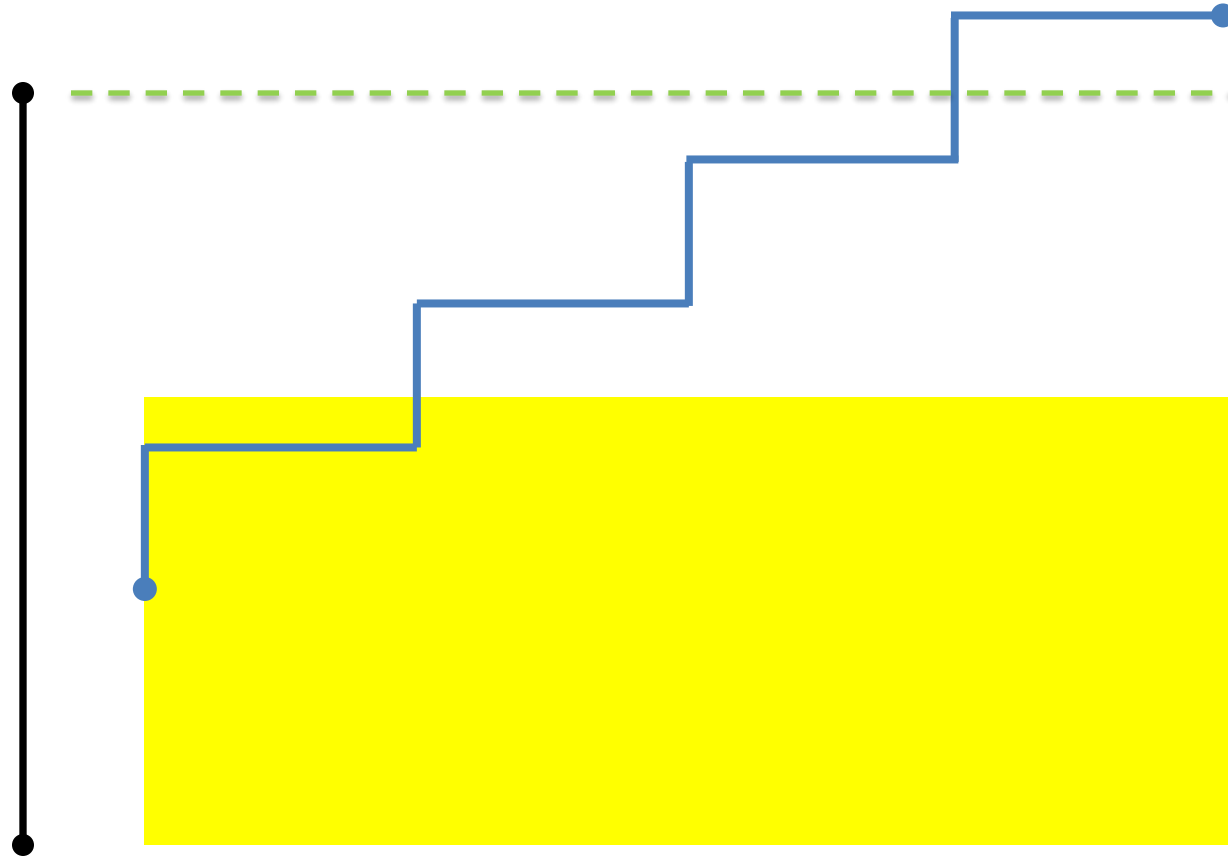
●—● Bid Range



Both start and end of load forecast must be within bid range

Resource sufficiency evaluation if known a base schedule import would tag lower

●—● Load Forecast ■ Supply Base Schedule ●—● Bid Range



Supply base schedule & bid range drops EIM entity may fail test

Enhance capacity test to cover potential imports and exports not tagging to base schedules (1 of 2)

- Separate monthly calculation for imports & exports
 - No netting of imports and exports
 - Regardless of reason not tagged
 - For each hour, compare T-40 base schedules with actual tagged value at T-20
 - $\% = \text{Monthly deviations} / \text{Monthly base schedule}$
 - Calculate prior 15th to 15th, effective 1st day of month
 - Notification period to EIM Entity of increased bid range needed to pass test
 - Minimum threshold of 1%
 - Aligned with load scheduling accuracy

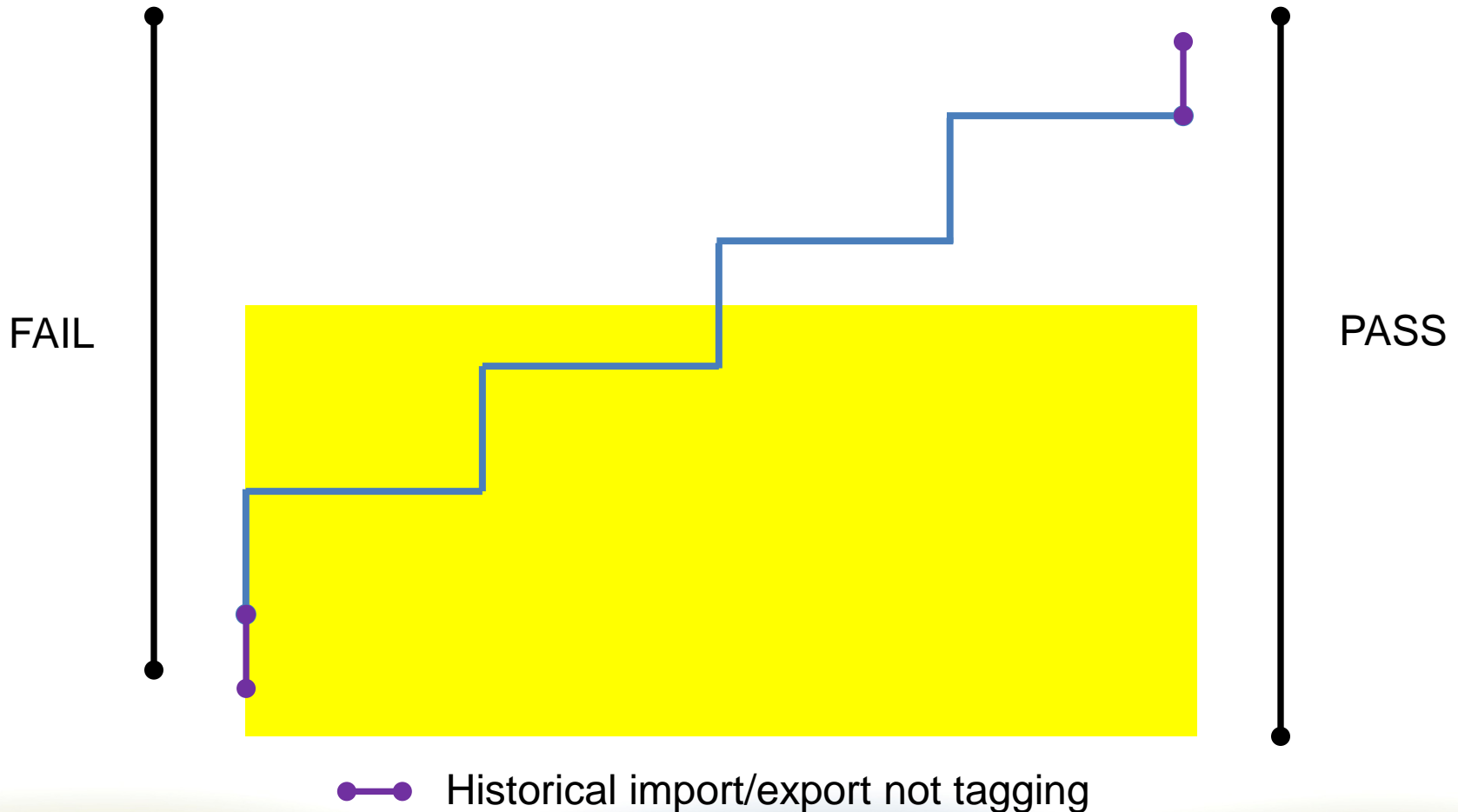
Enhance capacity test to cover potential imports and exports not tagging to base schedules (2 of 2)

- **Examples**

- Assume 5% of import MWs didn't tag in HE08, then must have sufficient upward bid range to cover 5% of imports in current HE08 base schedule
- Assume 3% of export MWs didn't tag in HE18, then must have sufficient downward bid range to cover 3% of exports in current HE18 base schedule

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

●—● Load Forecast ■ Supply Base Schedule ●—● Bid Range



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

Change from prior proposal: Hourly Schedules Decline Charge not applicable to EIM

ISO is strongly considering making intertie bidding on EIM external interties mandatory

- Additional liquidity to meet imbalances and pass the resource sufficiency evaluation
- Allows load serving entities to meet their imbalances from external resources
 - LSE able to hedge against imbalance charges from internal generation
- Bidding at point where import/exports enters or exits the EIM footprint will lead to more efficient FMM and RTD

Intertie scheduling points will allow the following real-time bids

- EIM external intertie (EIM BAA or ISO with non-EIM BAA)
 - Bidding allowed
- EIM internal intertie (EIM BAA or ISO with EIM BAA)
 - Submit base schedules for supply and demand
 - If supply resource is within EIM BAA, bid at its node.
 - Import (export) to EIM BAA, bid where energy enters (exits) EIM footprint
 - Wheels through EIM footprint bid where energy enters and exits the EIM footprint
- Intertie scheduling limit includes both EIM external interties and EIM internal interties
 - Modeled as two nodes, one internal and one external

Base schedules at EIM internal interties are deemed delivered

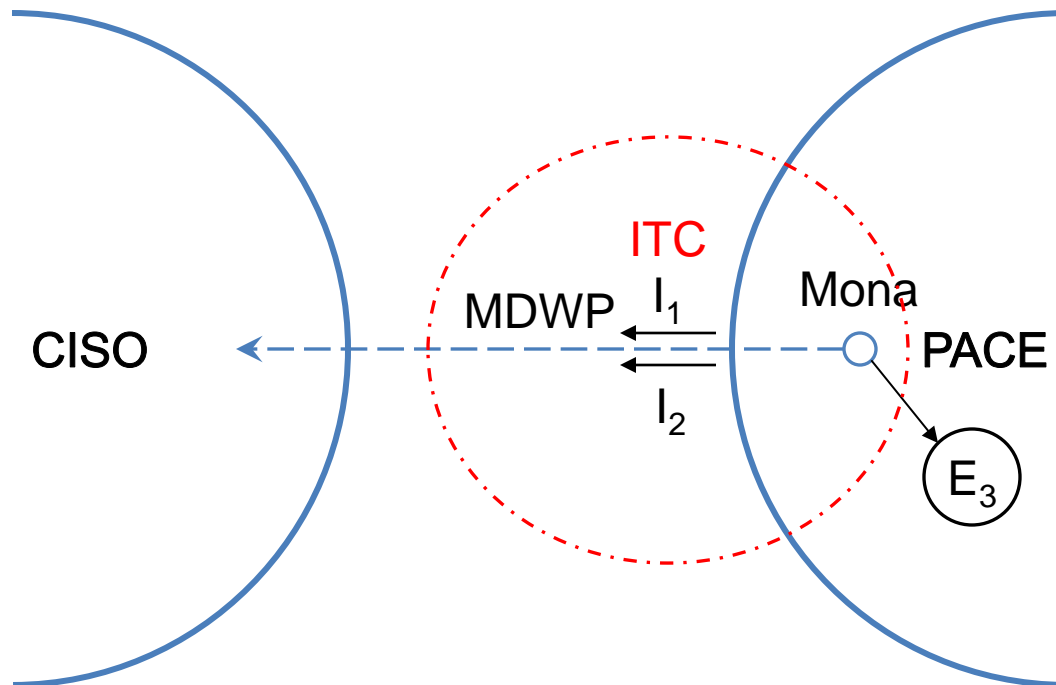
- Market will not make schedule changes
- Although no bids at this node, market will calculate LMP
- Out of market deviations are settled at the relevant LMP
 - If known prior to start of FMM, FMM LMP
 - Otherwise, RTD LMP
- This includes day-ahead transactions with the ISO that are in the EIM entity's base schedules

Scheduling at ISO Scheduling Points within EIM Entity BAAs with shared inertia scheduling limit

- Currently two Scheduling Points:
 - Cragview (CRAGVIEW_1_GN001) in PACW associated with the CRAG inertia
 - Mona (MONA_3_N501) in PACE associated with the MDWP inertia
- ISO import/export schedules are constrained by applicable Inertia Transmission Corridor (ITC) limits and are not part of EIM Transfers
- ISO gross import/export schedules are mirrored by export/import schedules at EIM System Resources to cancel out in the power flow

Scheduling at ISO Scheduling Points within EIM Entity Balancing Authority Areas

I_1 : SC01- MONA_3_N501-MDWP-I-P-F-PSE01 = 100MW
 I_2 : SC02- MONA_3_N501-MDWP-I-P-F-PSE05 = 150MW
 E_3 : PACE_MDWP_E_F_MIRROR = 250MW



Based on stakeholder feedback ISO modified the EIM transition period proposal

- Only include the first element: when modeled constraints are relaxed, energy priced on marginal economic bid
- The graduated bid caps will be discussed further in the EIM year 1 enhancements stakeholder initiative

Board approved 12-month EIM Transition Period on January 5th

The two elements of the proposed EIM transition period assumed import/export bids mandatory in FMM

1. When modeled constraints are relaxed, energy priced on marginal economic bid
2. Energy bid cap will start at \$250/MWh and gradually increase over the year as follows:

Time Period	Bid Cap
Months 1 – 6	\$250/MWh
Months 7 – 9	\$500/MWh
Months 10 – 12	\$750/MWh
Beyond transition period	\$1,000/MWh

With mandatory inertia participation, measures needed so use of marginal bid in transition period no undermined

- EIM external inertia bids are not subject to market power mitigation
 - \$1,000/MWh unmitigated bid would undermine lower relaxation parameter in EIM balancing authority area
- Since actual inertia participation is not known at go live, the graduated bid caps were proposed
- Must balance potential market inefficiencies from different bid caps with maintaining effectiveness of transition period

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

The current design of the EIM administrative charge is resulting in higher payments to ISO than expected

- Actual revenues are inconsistent with expectation of revenue slightly higher than minimum administrative charge

Administrative Charge (\$)	PACE	PACW	Total
Actual	\$99,144	\$118,741	\$217,885
Minimum	45,772	29,157	74,929

- Single EIM administrative rate resulting in different charges for same services if ISO market participant

Administrative Charge (\$)	PACE	PACW	Total
Actual EIM Charge	\$99,144	\$118,741	\$217,885
ISO GMC Charge	59,158	87,030	146,188

Board approved applying minimum charge during redesign on January 5th

Current EIM administrative charge design includes two elements

- \$0.19 per MWh of all gross deviations
 - Gross deviations = ABS (Base – FMM) + ABS (FMM – RTD) + ABS (RTD – Meter)
 - Load, exports, generation, and imports included
- Minimum charge of 5% load and exports plus 5% generation and imports

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

- Market services rate is \$0.06 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 \$0.13 per MWh of ...
 - Gross real time energy flow which is the absolute difference between the meter and the base schedules.

Should minimum charge still apply?

- Currently the EIM rates are fixed for 3 years
 - No change if costs increase or volumes decrease
 - No change if costs decrease or volumes increase
 - Minimum charge since there is price certainty, but not volume certainty
- ISO market services and system operations rates updated as needed on quarterly basis
 - Greater of 2% or \$1 million annual cost/revenue
 - Could apply the cost of service % of ISO rate to update EIM rates
 - Note: ISO rates go to four decimal points
- If yes, minimum charge could be applied to both individual rates on a daily basis as is currently done

Next steps

Item	Date
Post Presentation	January 6, 2015
Stakeholder Meeting	January 8, 2015
Stakeholder Comments	January 22, 2015
Post Draft Final Proposal	February 11, 2015
Stakeholder Meeting	February 18, 2015
Stakeholder Comments Due	February 25, 2015
Board of Governors Decision	March 26-27, 2015
Phase 2 Items	TBD

Please submit written comments to EIM@caiso.com by January 22