Energy Imbalance Market
Revised Straw Proposal

Stakeholder Meeting

June 6, 2013

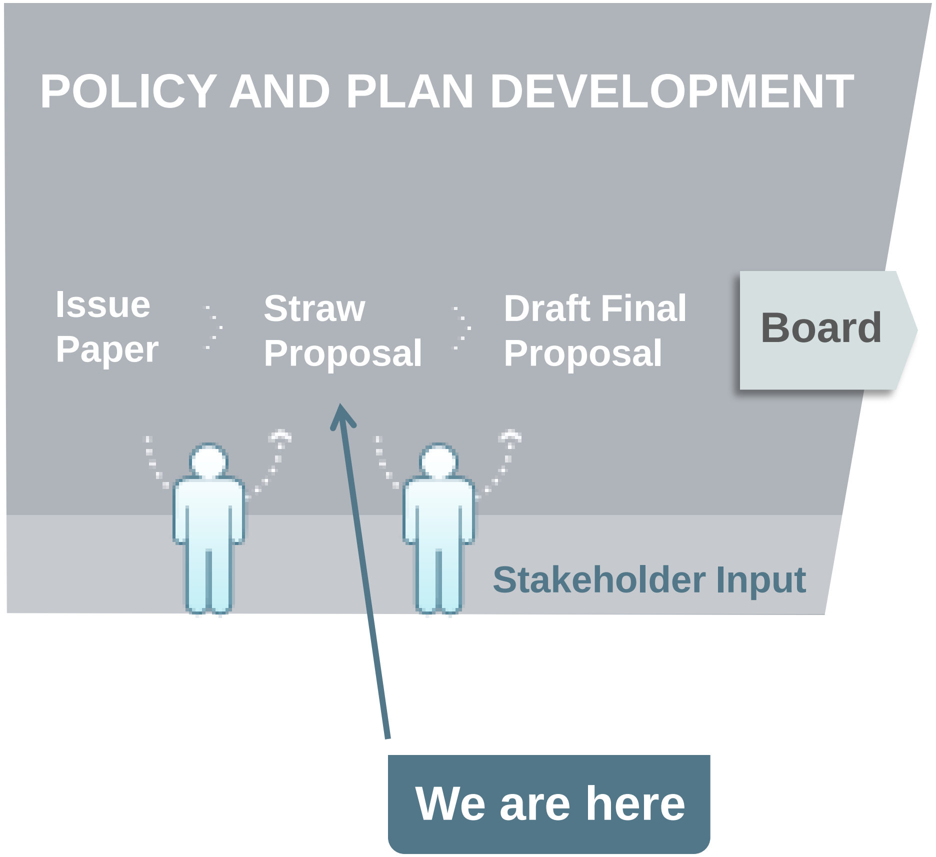
Agenda

Time	Topic	Presenter
10:00 – 10:10	Introduction	Mercy Parker-Helget
10:10 – 12:00	EIM Definitions and Overview	Don Tretheway
12:00 – 1:00	Lunch Break	
1:00 – 1:30	Flexible Ramping & LMPM	Don Tretheway
1:30 – 2:00	RT Uplifts and Cost Allocation	Don Tretheway
2:00 – 2:45	Greenhouse Gas	George Angelidis
2:45 – 3:00	Break	
3:00 – 3:45	Transmission Service	Jim Price
3:45 – 4:00	Wrap-up and Next Steps	Mercy Parker-Helget

ISO Policy Initiative Stakeholder Process

We are here

ISO Policy Initiative Stakeholder Process



Changes to straw proposal (1 of 2)

- Clarified and expands definition of new terms. Ensures consistent usage of new terms throughout the revised straw proposal.

- Discusses the minimum shift optimization to establish the adjusted base schedule.

- Includes proposal for local market power mitigation.

- Includes proposal for allocation of real-time market uplifts.

Changes to straw proposal (2 of 2)

- Discusses the flexible ramping constraint and planned flexible ramping product.
- Introduces proposal for greenhouse gas emission costs.
- Introduces proposal for settlement of transmission service.
- Establishes a parallel stakeholder initiative to discuss market rule oversight.

Defined terms (1 of 4)

- **Energy Imbalance Market (EIM)** is operation of the ISO's real-time market to manage transmission congestion and optimize procurement of energy to balance supply and demand for the combined ISO and EIM footprint.

- **Market Operator** is the ISO.

- **EIM Entity** is a balancing authority that enters into the pro forma EIM Entity Agreement to enable the EIM to occur in its balancing authority area (BAA). By enabling the EIM, real-time load and generation imbalances within its BAA will be settled through the EIM.

Defined terms (2 of 4)

- **EIM Entity Scheduling Coordinator** is the EIM Entity, or a third-party designated by the EIM Entity, that is certified by the ISO and that enters into the pro forma EIM Entity Scheduling Coordinator Agreement. The EIM Entity Scheduling Coordinator is responsible for compiling and submitting balanced schedules for the EIM Entity BAA to the Market Operator, for imbalance energy settlement of resources not participating in EIM, and for distributing costs or revenues from uplift allocations to the EIM Entity BAA.

Defined terms (3 of 4)

- **EIM Participating Resource** is resource located within the EIM Entity BAA that is eligible and elects to participate in the EIM and that enters into the pro forma EIM Participating Resource Agreement, under which is responsible for meeting the requirements specified in Tariff Section 29. In the 5-minute market, eligible resources may include Generating Units, Physical Scheduling Plants, Participating Loads, Proxy Demand Resources, Non-Generator Resources and Dynamic Schedules. In the 15-minute market, imports and exports that can be scheduled on a 15-minute basis are eligible to participate in addition to all resources eligible to participate in the 5-minute market.

Defined terms (4 of 4)

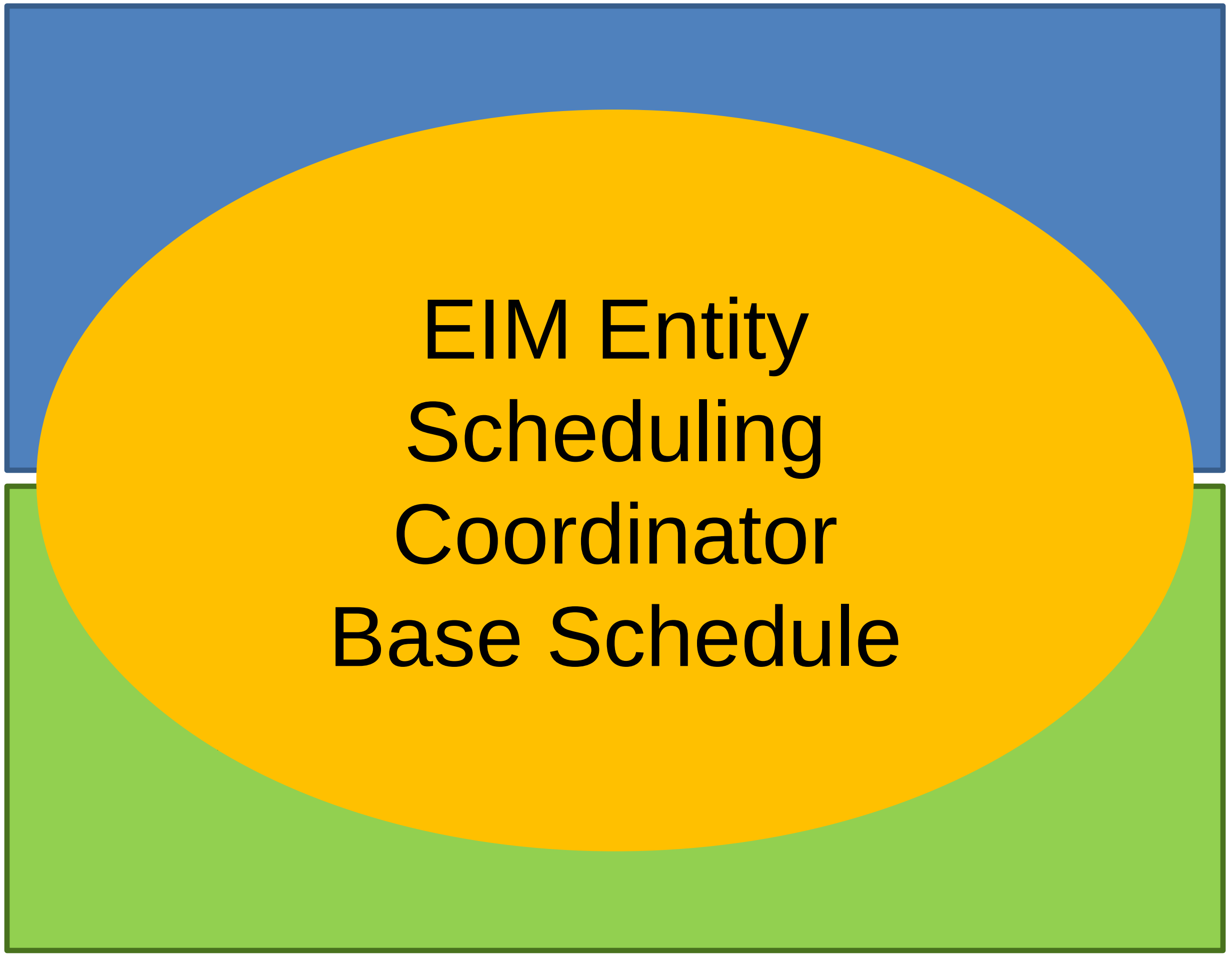
- **EIM Participating Resource Scheduling Coordinator** is the EIM Entity Scheduling Coordinator, or a third-party designated by the resource, that is certified by the ISO and enters into the pro forma EIM Participating Resource Scheduling Coordinator Agreement, under which it is responsible for meeting the requirements specified in Tariff Section 29 on behalf of the resource. The EIM Participating Resource Scheduling Coordinator interfaces with the Market Operator on behalf of resources in an EIM Entity BAA that voluntarily elect to economically participate in the EIM.

EIM Process Overview

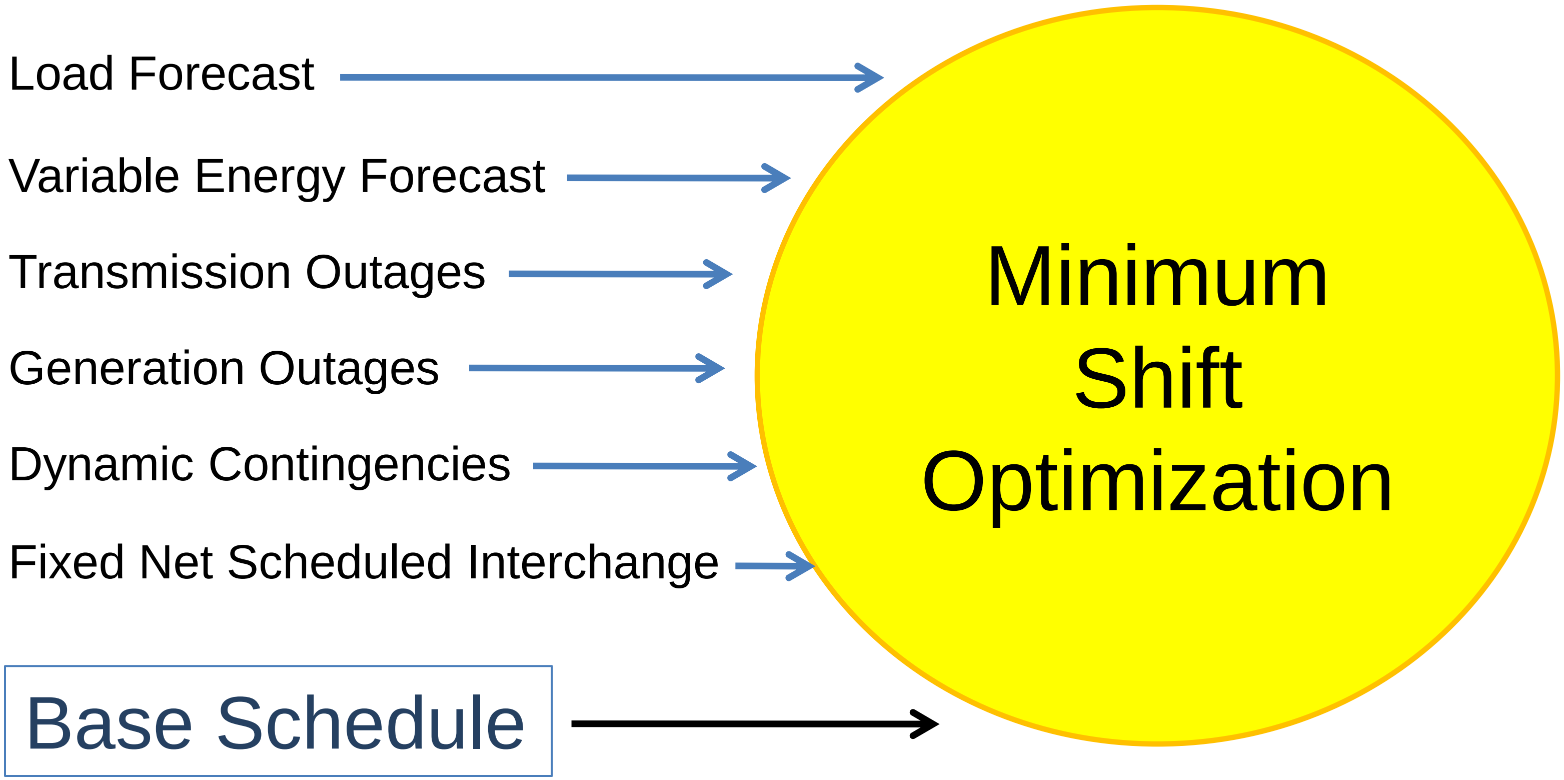
Full Network Model

Resource Master File

EIM Process Overview



EIM Process Overview



EIM Process Overview

Minimum Shift Optimization → Adjusted Base Schedule

EIM Process Overview

Economic Bids

Load Forecast

Variable Energy Forecast

Transmission Outages

Generation Outages

Dynamic Contingencies

EIM
15-Minute
Market

Adjusted Base Schedule

Baseline for financial settlement

EIM Process Overview

EIM
15-Minute
Minute

→

Awarded
15-Minute
Schedule

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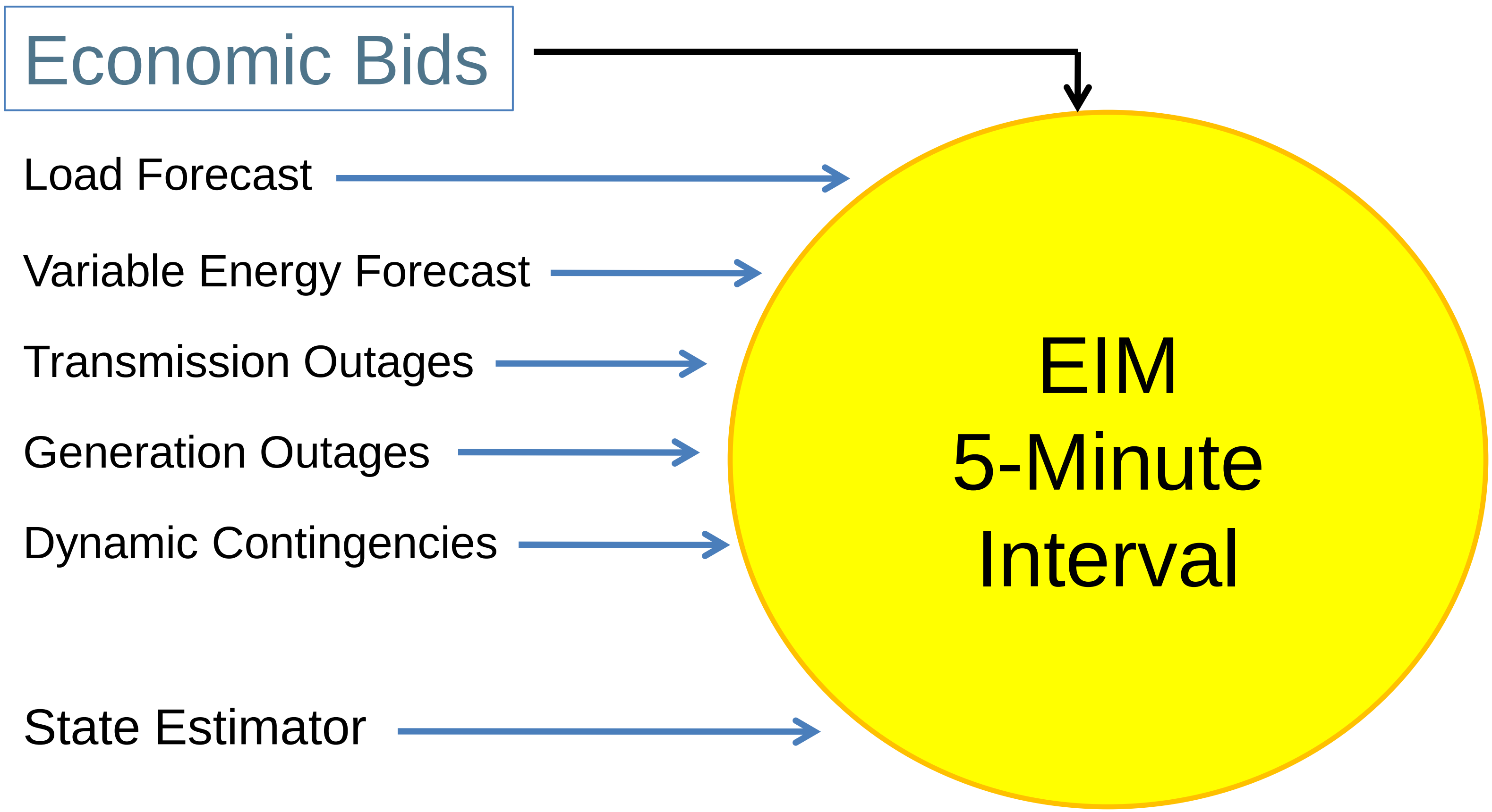
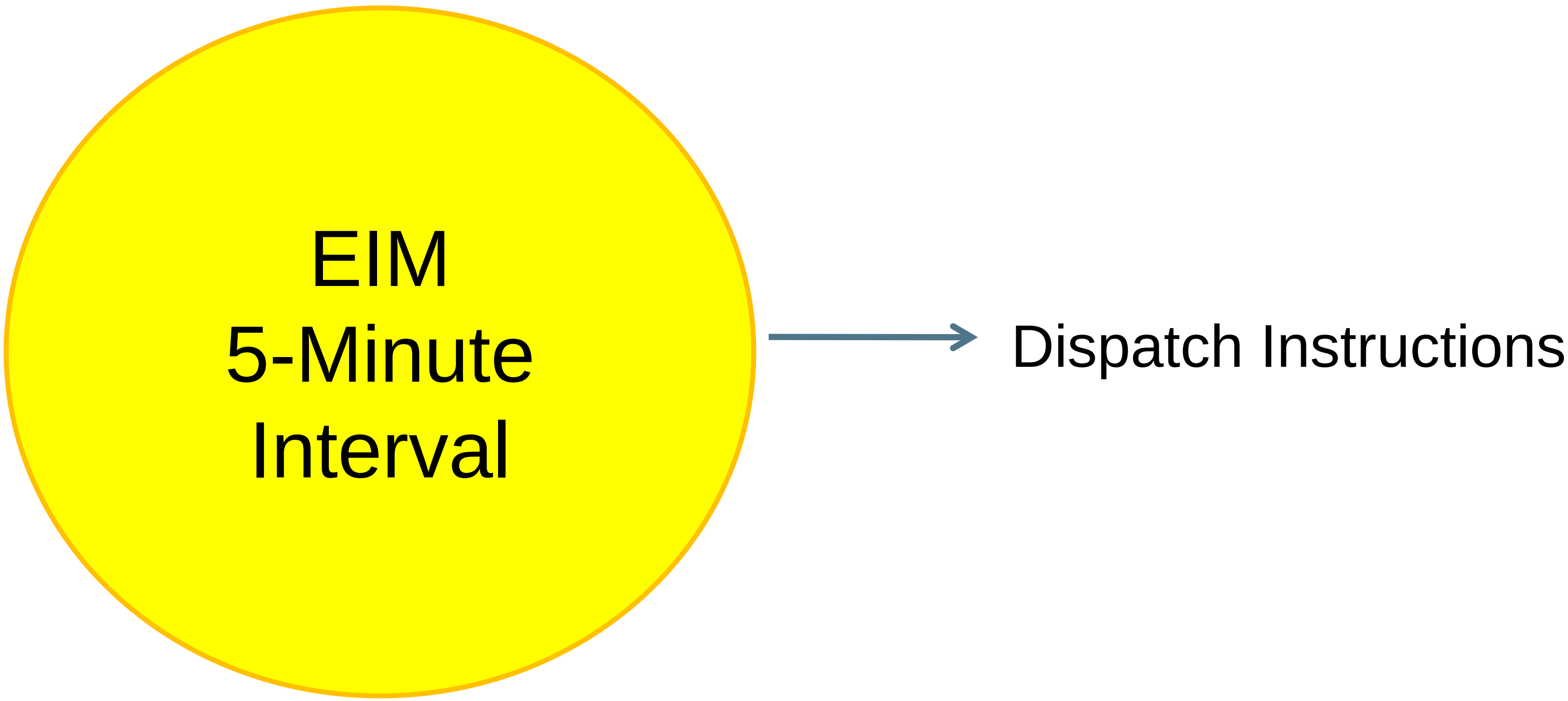
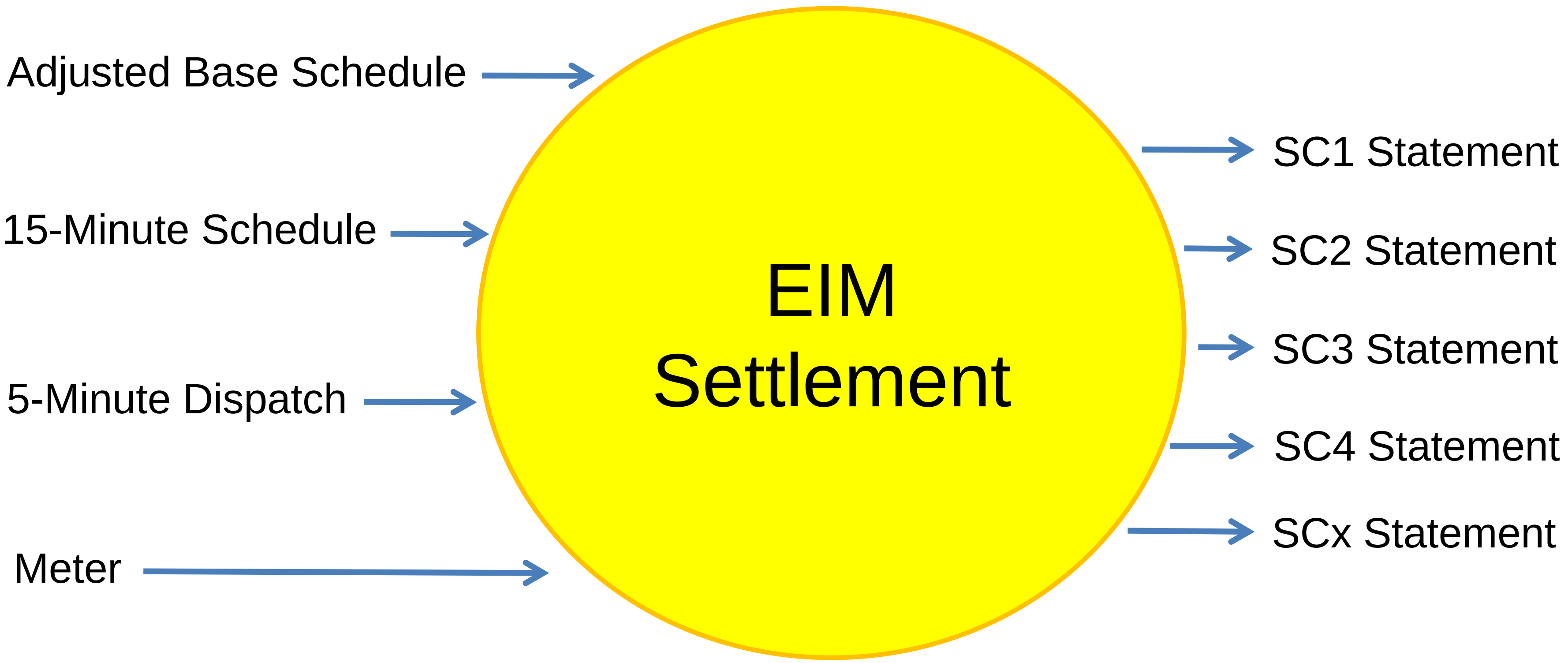
EIM Process Overview



EIM Process Overview



EIM Process Overview



15-minute base schedule submitted by EIM Entity Scheduling Coordinator at T-40 min

Load Forecast	1000 MW
Export A	100 MW
Export B**	200 MW
Total	1300 MW

=

Gen A	500 MW
Gen B*	400 MW
Gen C*	150 MW
Import A*	100 MW
Import B**	150 MW
Total	1300 MW

* Economic bids in RTUC & RTD
** Economic bids in RTUC

15-minute adjusted base schedule uses resources with economic bids to resolve congestion

Load Forecast	1000 MW
Export A	100 MW
Export B**	200 MW
Total	1300 MW

EIM Transfer	N/A

=

Gen A	500 MW
Gen B*	350 MW
Gen C*	200 MW
Import A*	100 MW
Import B**	150 MW
Total	1300 MW

Gen B reduced 50 MW
Gen C increased 50 MW

The changes to base schedules are not settled by EIM.
Settled under rules of the EIM Entity

* Economic bids in RTUC & RTD
** Economic bids in RTUC

15-minute market (RTUC) schedules resources to meet load forecast

Load Forecast	1100 MW
Export A	100 MW
Export B**	140 MW
Total	1340 MW

EIM Transfer Out	10 MW

=

Gen A	500 MW
Gen B*	350 MW
Gen C*	250 MW
Import A*	100 MW
Import B**	150 MW
Total	1350 MW

Load forecast up 100 MW
Export B reduced 60 MW
EIM Transfer Out 10 MW

Gen C increased 50 MW

All deviations settled in EIM at the 15-minute LMP

* Economic bids in RTUC & RTD
** Economic bids in RTUC

5-minute market (RTD) dispatches resources to meet load forecast

RTD Interval 1 of the 15-minute RTUC interval

Load Forecast	1050 MW
Export A	100 MW
Export B**	140 MW
Total	1290 MW

EIM Transfer Out	10 MW

=

Gen A	500 MW
Gen B*	350 MW
Gen C*	200 MW
Import A*	100 MW
Import B**	150 MW
Total	1300 MW

Load forecast 50 MW lower

Gen C decreased 50 MW

All deviations settled in EIM at the 5-minute LMP

* Economic bids in RTUC & RTD
** Economic bids in RTUC

5-minute market (RTD) dispatches resources to meet load forecast

RTD Interval 2 of the 15-minute RTUC interval

Load Forecast	1100 MW
Export A	100 MW
Export B**	140 MW
Total	1340 MW

=

Gen A	450 MW
Gen B*	350 MW
Gen C*	280 MW
Import A*	100 MW
Import B**	150 MW
Total	1330 MW

EIM Transfer In	10 MW

Load has no deviation from 15-min schedule

Gen A outage (negative deviation) of 50 MW
Gen C dispatch 30 MW above 15-min schedule

EIM Transfer direction changes to Import of 10 MW

All deviations settled in EIM at the 5-minute LMP

* Economic bids in RTUC & RTD
** Economic bids in RTUC

5-minute market (RTD) dispatches resources to meet load forecast

RTD Interval 3 of the 15-minute RTUC interval

Load Forecast	1200 MW
Export A	100 MW
Export B**	140 MW
Total	1440 MW

EIM Transfer In	10 MW

=

Gen A	450 MW
Gen B*	400 MW
Gen C*	300 MW
Import A*	130 MW
Import B**	150 MW
Total	1430 MW

Load forecast up 100 MW

Gen A outage of 50 MW (hold prior RTD)
Gen C increased 50 MW (hold prior RTD)
Gen B increased 50 MW
Import A (dynamic schedule) increased 30 MW

All deviations settled in EIM at the 5-minute LMP

* Economic bids in RTUC & RTD
** Economic bids in RTUC

EIM Entity unit commitment and Outages are reflected in next 15-minute base schedule

Outage in Base

Load Forecast	1200 MW
DA Export to ISO	100 MW
Export B**	200 MW
Total	1500 MW

=

Gen A	450 MW
Gen B*	400 MW
Gen C*	250 MW
Gen D	150 MW
Import A*	100 MW
Import B**	150 MW
Total	1500 MW

DA import/exports to the ISO are included in Base

Real time transfers are Gen specific & cleared through EIM

Meet higher load and replace Gen A outage

* Economic bids in RTUC & RTD
** Economic bids in RTUC

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Minimum shift optimization (MSO) to establish adjusted base schedule that is balanced and feasible

- Minimize changes to base schedules subject to power balance and EIM Entity BAA transmission constraints
- Only resources with economic bids may be adjusted
  - Energy bid range will be observed
  - Base schedule adjustments will not be settled in EIM
    - Settlement via EIM Entity rules
- If MSO is unable to balance base schedules
  - Distributed load net of losses will be adjusted
- If MSO is unable to resolve congestion
  - Transmission constraints will be relaxed
    - Relaxed transmission limits will be enforced in EIM
- The ISO will inform the EIM Entity SC and the relevant EIM Participating Resource SCs about adjusted base schedules

Local market power mitigation in real-time market

- Process starts with hour-ahead process and continues in to RTUC
  - All constraints run identifies awards and prices that are potentially impacted by market power
  - Dynamic competitive path assessment determines if constraint is competitive

- EIM Participating Resources will need to provide information to allow default energy bid calculation

- ISO and the EIM Entity will determine the mitigation reference bus

Flexible ramping constraint (FRC) ensures sufficient upward ramping capability in EIM

- FRC is enforced in RTUC and managed in RTD
  - System wide procurement requirement in RTUC and release percentages in advisory RTD intervals
- Resources that resolve the FRC are compensated
  - MIN ($800/MWh, MAX ($0, Spin Price, FRC Shadow Price – 75% * MAX ($0, Average (RTD SMEC))
- FRC costs will be allocated using approach for other RT market uplifts
- Flexible Ramping Product initiative will recommence in late 2013

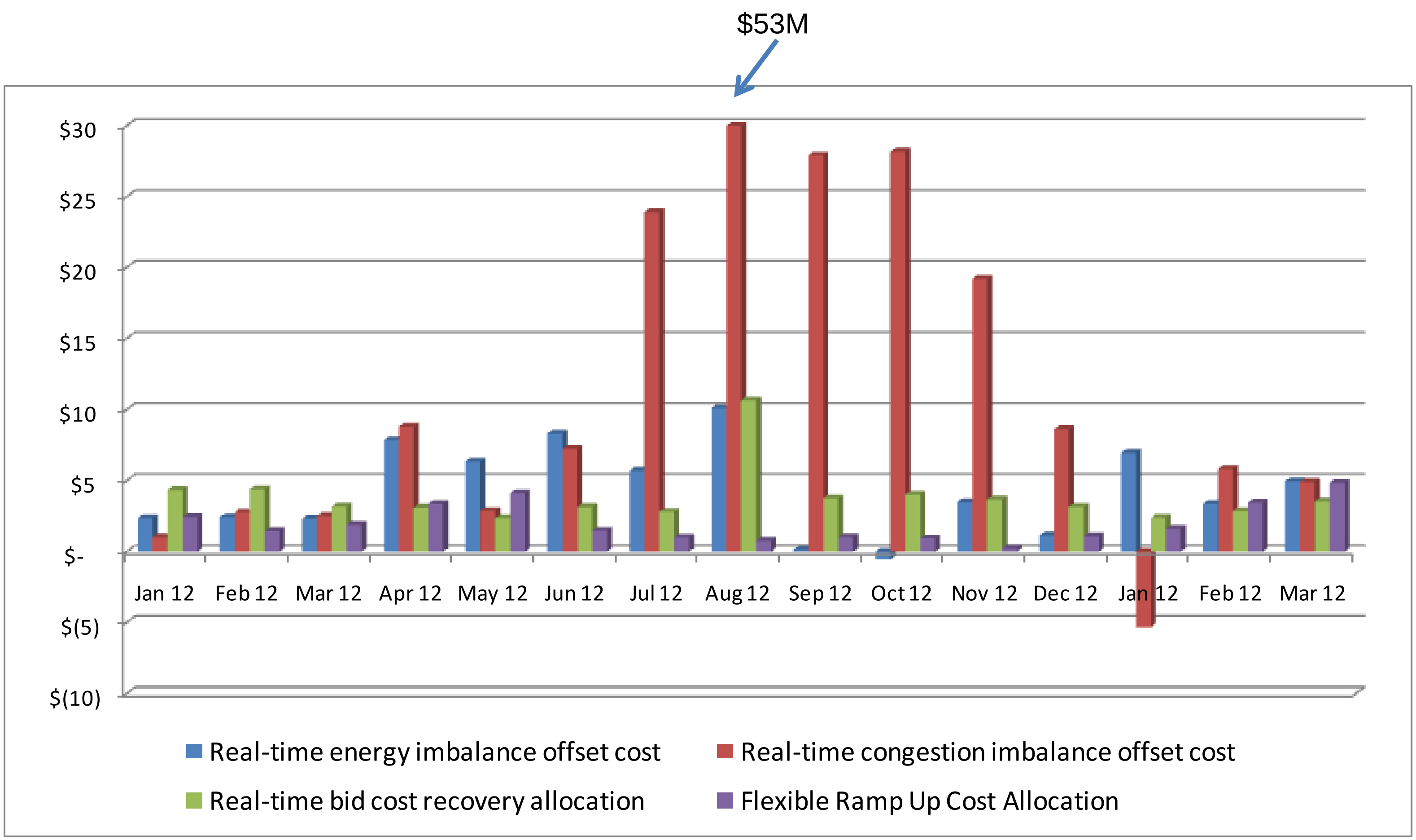
Real-time market uplifts

- CC6477 Real Time Imbalance Energy Offset
- CC6774 Real Time Congestion Offset
- CC6678 Real Time Bid Cost Recovery Allocation
- CC7024 Flexible Ramp Up Cost Allocation

- Note – the Load settlement has a neutrality charge that is allocated to metered demand by DLAP

- Unaccounted for energy is calculated also by BAA

Cost of real-time market uplifts January 2012 to March 2013



Propose to split real-time market uplifts by BAA, then actual cost allocation approach determined by BAA

- Define use of market as the gross absolute value of deviations to baseline
  - ISO is day-ahead schedule
  - EIM Entity is adjusted base schedule
- Calculated for each RTUC, then summed to create hourly percentage split by BAA

EIM Entity	Adjusted Base	Meter	Use
Load	1000	800	200
Gen A	500	500	0
Gen B	500	350	150
Total			350
Percentage			39%

ISO	Day Ahead	Meter	Use
Load	6000	6200	200
Gen A	3500	3750	250
Gen B	2500	2400	100
Total			550
Percentage			61%

* Note there is a 50 MW transfer from EIM Entity to ISO included in calculation

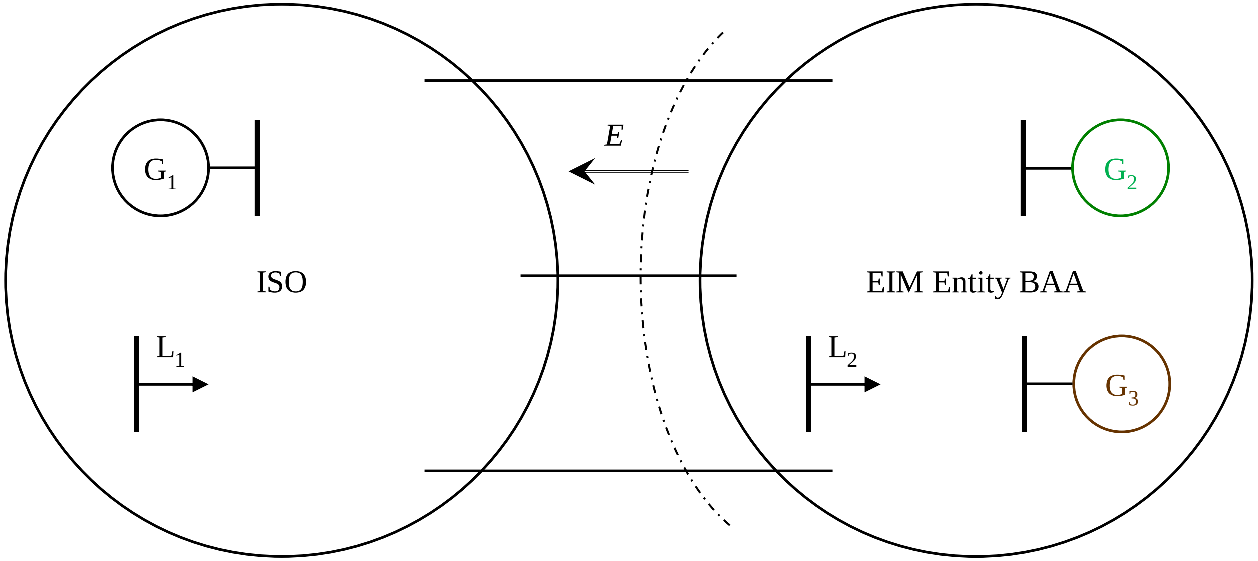
Incorporate greenhouse gas emission costs in the EIM market optimization software for ISO real-time imports

- Produce an efficient dispatch that takes into account all appropriate costs including GHG emission costs
- Similar treatment of GHG emission costs for energy produced in California and energy produced in EIM Entities outside California but imported into California
- Produce LMPs that reflect the marginal cost of serving demand taking into account all applicable costs, including GHG emission costs
- Allow for different GHG emission costs taking into account the individual resource emission properties

Proposed method for optimal dispatch that accounts for GHG emission costs of EIM Participating Resources

- Expand SCUC/SCED to optimally associate energy produced by EIM Participating Resources with imports into California
  - Include applicable GHG emission costs of associated imports in the objective function
- The relevant EIM Participating Resource SCs will be responsible for any applicable GHG emission allowances for associated imports
- Collect "emission rents" for imports into California
- Disburse emission rents to EIM Participating Resources for associated imports
  - Defray the cost of GHG emission allowances (emitting resources)
  - Pay opportunity costs for avoiding GHG emission costs (non-emitting resources)

GHG Emission Cost Example: Setup



- Transfer capability is 100MW between ISO and EIM Entity
  - G_2 is a non-emitting resource
  - G_3 is a GHG emitting resource
- Emission rate is $6/MWh

Load	Forecast (MW)
L_1	200
L_2	50

GHG Emission Cost Example 1

Assumptions

Load	Forecast (MW)
L_1	200
L_2	50

Generator	Minimum (MW)	Maximum (MW)	Bid ($/MWh)	Emission Factor
G_1	0	300	50	-
G_2	0	200	35	0.0
G_3	0	200	30	1.0

Optimal Dispatch

Resource	Dispatch (MW)	Export Allocation (MW)	LMP ($/MWh)
G1	100	-	50
G2	100	100	30
G3	50	0	30
L1	200	-	50
L2	50	-	30

μ = –$15/MWh

η = –$5/MWh

Settlement

Resource	Energy Cost	Emission Cost	Total Cost	Energy Payment	Export Allocation Payment	Total Payment
G_1	$5,000	-	$5,000	$5,000	-	$5,000
G_2	$3,500	$0	$3,500	$3,000	$500	$3,500
G_3	$1,500	$0	$1,500	$1,500	$0	$1,500
L_1				–$10,000		
L_2				–$1,500		
Congestion Revenue				$1,500		
Emission Revenue				$500		

GHG Emission Cost Example 2: G_3 reduces its bid

Assumptions

Load	Forecast (MW)
L_1	200
L_2	50

Generator	Minimum (MW)	Maximum (MW)	Bid ($/MWh)	Emission Factor
G_1	0	300	50	-
G_2	0	200	35	0.0
G_3	0	200	28	1.0

Optimal Dispatch

Resource	Dispatch (MW)	Export Allocation (MW)	LMP ($/MWh)
G1	100	-	50
G2	0	0	28
G3	150	100	28
L1	200	-	50
L2	50	-	28

μ = –$16/MWh

η = –$6/MWh

Settlement

Resource	Energy Cost	Emission Cost	Total Cost	Energy Payment	Export Allocation Payment	Total Payment
G_1	$5,000	-	$5,000	$5,000	-	$5,000
G_2	$0	$0	$0	$0	$0	$0
G_3	$4,200	$600	$4,800	$4,200	$600	$4,800
L_1				–$10,000		
L_2				–$1,400		
Congestion Revenue				$1,600		
Emission Revenue				$600		

GHG Emission Cost Example 3: G_3 has a derate

Assumptions

Load	Forecast (MW)
L_1	200
L_2	50

Generator	Minimum (MW)	Maximum (MW)	Bid ($/MWh)	Emission Factor
G_1	0	300	50	-
G_2	0	200	35	0.0
G_3	0	75	28	1.0

Optimal Dispatch

Resource	Dispatch (MW)	Export Allocation (MW)	LMP ($/MWh)
G1	100	-	50
G2	75	75	29
G3	75	25	29
L1	200	-	50
L2	50	-	29

μ = –$15/MWh;
η = –$6/MWh

Settlement

Resource	Energy Cost	Emission Cost	Total Cost	Energy Payment	Export Allocation Payment	Total Payment
G_1	$5,000	-	$5,000	$5,000	-	$5,000
G_2	$2,625	$0	$2,625	$2,175	$450	$2,625
G_3	$2,100	$150	$2,250	$2,175	$150	$2,325
L_1				–$10,000		
L_2				–$1,450		
Congestion Revenue				$1,500		
Emission Revenue				$600		

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GHG Emission Cost Example 4: Transfer limit 300MW

Assumptions

Load	Forecast (MW)
L_1	200
L_2	50

Generator	Minimum (MW)	Maximum (MW)	Bid ($/MWh)	Emission Factor
G_1	0	300	50	-
G_2	0	200	35	0.0
G_3	0	200	28	1.0

Optimal Dispatch

Resource	Dispatch (MW)	Export Allocation (MW)	LMP ($/MWh)
G1	-	-	35
G2	50	50	29
G3	200	150	29
L1	200	-	35
L2	50	-	29

μ = $0/MWh

η = –$6/MWh

Settlement

Resource	Energy Cost	Emission Cost	Total Cost	Energy Payment	Export Allocation Payment	Total Payment
G_1	$0		$0	$0		$0
G_2	$1,750	$0	$1,750	$1,450	$300	$1,750
G_3	$4,200	$900	$5,100	$5,800	$900	$6,700
L_1				–$7,000		
L_2				–$1,450		
Congestion Revenue				$0		
Emission Revenue				$1,200		

Summary of GHG emission cost proposal (1 of 2)

- Imbalance energy imported into the ISO BAA would be allocated optimally to supply resources in the respective EIM Entity BAA
- Supply resources in each EIM Entity BAA are only differentiated in terms of their respective energy and emission costs, not in terms of their physical location
- Each supply resource in an EIM Entity BAA is registered with a greenhouse gas emission factor that reflects greenhouse gas emissions per unit of generated power
- The cost for acquiring the necessary GHG emission allowances is added to the objective function for an efficient cost-effective imbalance energy dispatch

Summary of GHG emission cost proposal (2 of 2)

- If there is no imbalance export to the ISO, there is no associated export allocation or GHG emission cost
- Marginal GHG emission costs are reflected in EIM Entities through a fourth LMP component that effectively reduces the marginal energy component
- ISO BAA does not have a fourth LMP component; ISO Market Participants do not have to modify their systems
- Emission rent payments adequately compensate EIM Participating Resources for energy and GHG emission costs without a need for any side payments or uplift
- The proposal is scalable to any number of EIM Entities

Transmission Service

- Since limited transfer capability, first year implementation will have no charge for use of as-available transmission

- Potential long term alternatives
  – No charge for as-available transmission
  – Creation of an EIM transmission access charge to real-time withdrawals
  – Incorporate transmission charge in the shadow price of transfers between the ISO and EIM Entities

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

Parallel stakeholder process to discuss governance

- ISO to initiate stakeholder engagement and present proposal in August
- ISO to work with stakeholders to finalize a proposal in a timeframe consistent with EIM tariff development

Next Steps:
Comments to EIM@caiso.com by June 14

Item	Date
Post Revised Straw Proposal	May 30, 2013
Stakeholder Meeting (Folsom)	June 6, 2013
Stakeholder Comments Due	June 14, 2013
Post 2nd Revised Straw Proposal	July 2, 2013
Stakeholder Meeting (Phoenix)	July 9, 2013
Stakeholder Comments Due	July 19, 2013
Post Draft Final Proposal	August 13, 2013
Stakeholder Meeting (Portland)	August 20, 2013
Stakeholder Comments Due	August 27, 2013
Post Draft Tariff Language	September 16, 2013
Stakeholder Comments Due	September 23, 2013
Stakeholder Meeting (Folsom)	September 30, 2013
Board Decision	November 8, 2013

The ISO offers comprehensive training programs

- Welcome to the CAISO
- Introduction to CAISO Markets
- Market Transactions
- EIM specific training is under development

Training calendar - http://www.caiso.com/participate/Pages/Training/default.aspx
Contact us - markettraining@caiso.com