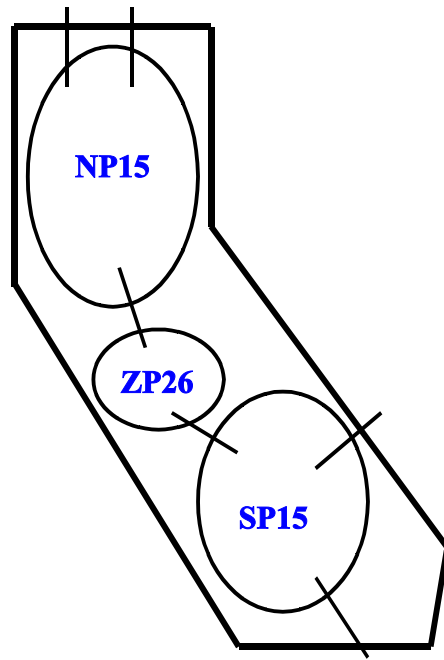CALIFORNIA ISO

Overview of Congestion Revenue Rights In the New California Energy Market

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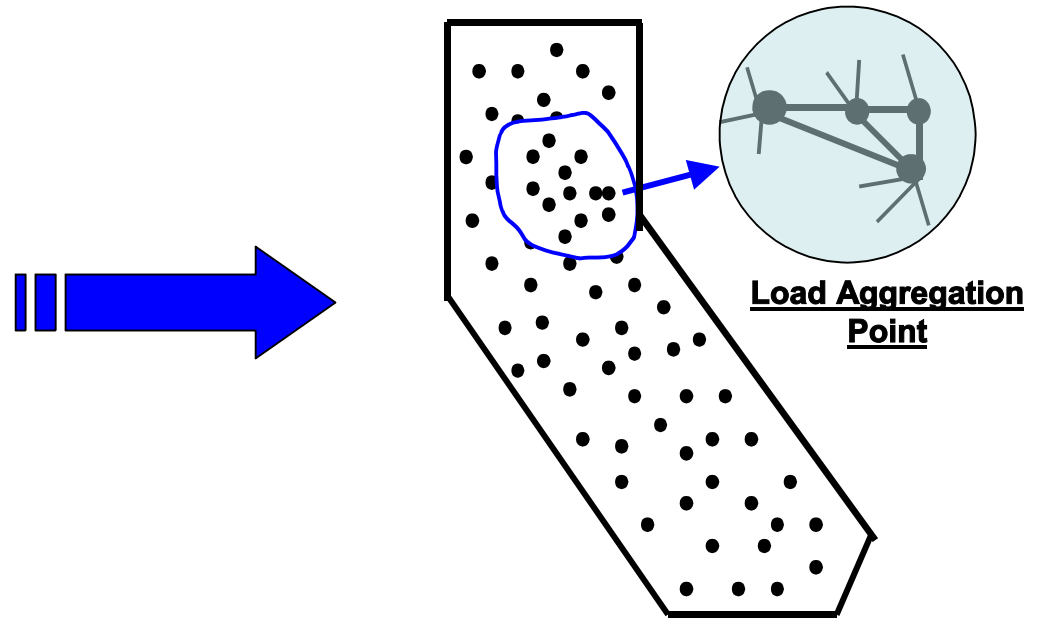Hyatt Regency, Sacramento
March 21, 2006**

Where are we now and where are we going?

Current Zonal World

- Radial Network Model (No intra-zonal constraints enforced)
- Three Internal Congestion Zones – Constraints enforced between zones
- Day-Ahead Transmission Market
- Firm Transmission Rights (FTRs) sold at Inter-Zonal Interfaces

New Nodal World

Load Aggregation Point

- Full Network Model (All constraints enforced)
- Locational Marginal Pricing at each node
- Day Ahead Energy Market
- Congestion Revenue Rights (CRRs) from source to sink

How do FTRs and CRRs Compare?

FTRs

Path Based

Financial Right in Day Ahead and Hour Ahead Markets

Physical Right

Number of MWs of FTR capacity sold is determined statistically before the auction

No Simultaneous Feasibility Test or Optimization

CRRs

Point to Point

Financial Right in Day Ahead Market Only

No Physical Right

Number of MWs of CRR capacity sold depends on how others bids in the allocation or auction

Simultaneous Feasibility Test with Optimization

CRRs in the New Energy Market

Congestion Revenue Rights are a major component in the new California energy market --

- Minimize transmission congestion cost uncertainty

- Allow Market Participants to "lock in" a price for transmission usage

- Encourage competitive energy trading

- Enhance energy commerce in California

Congestion and Locational Marginal Pricing

- Congestion occurs when load cannot be served by lower cost energy due to transmission constraints

- Congestion causes higher cost energy to be used in place of lower cost energy to serve load

- Locational Marginal Pricing (LMP) will be used as the approach to transmission congestion pricing in the new energy market

Congestion and Locational Marginal Pricing

- LMPs will be calculated in the Day-Ahead and Real Time markets

- LMP is the marginal cost of supplying, at least cost, the next increment of electrical demand at a specific location (node) on the electric power network, taking into account both supply (generator/import) bids and demand (load/export) offers and the physical aspects of the transmission system, including transmission and other operating constraints.

- The LMP at a bus or a defined aggregated set of buses has three components:

LMP = energy component + congestion component + loss component

Congestion and Locational Marginal Pricing

- When congestion occurs in the Day-Ahead Market, this causes a differences in nodal LMP prices.

- The difference in the congestion component of these nodal LMP prices represent the congestion charge in moving energy between nodes on the grid.

- The congestion charge for moving Q megawatts of energy from a point of injection (source) to a point of withdrawl (sink) is calculated as follows:

Congestion Charge = Q x (LMP$_{Sink}$ – LMP$_{Source}$)

CRR Payments Help Offset Congestion Charges

Transmission congestion charges are uncertain when scheduling energy on the grid.

Owning suitable CRRs can provide cash payments from the CAISO to offset or even eliminate transmission congestion charges incurred when scheduling energy in the Day Ahead market.
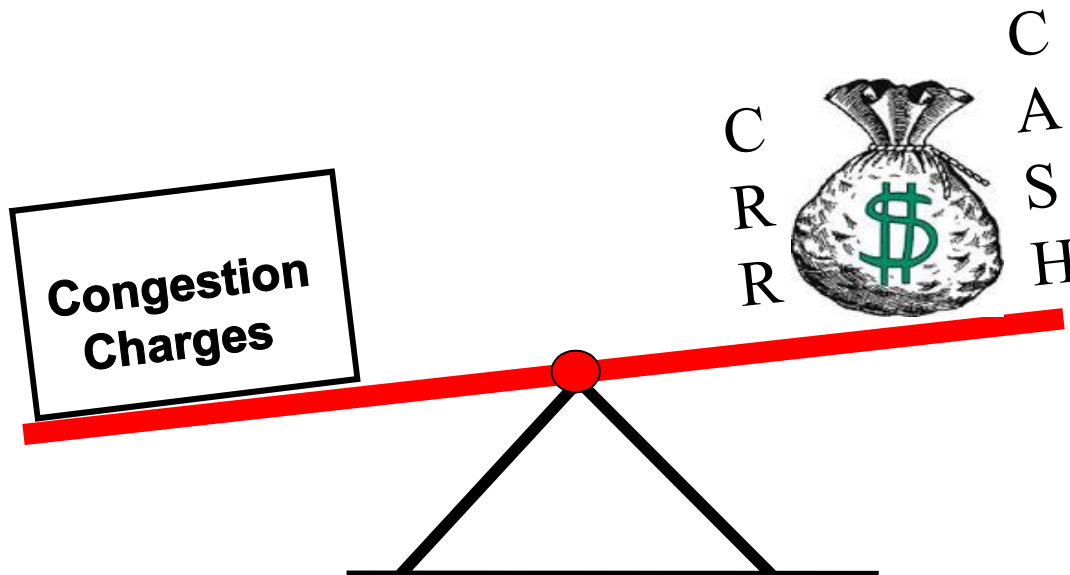
Point-to-Point CRR "Obligations" In Action – Examples

The Grid

25 MW Withdrawl at B

Sink

25 MW Injection at A
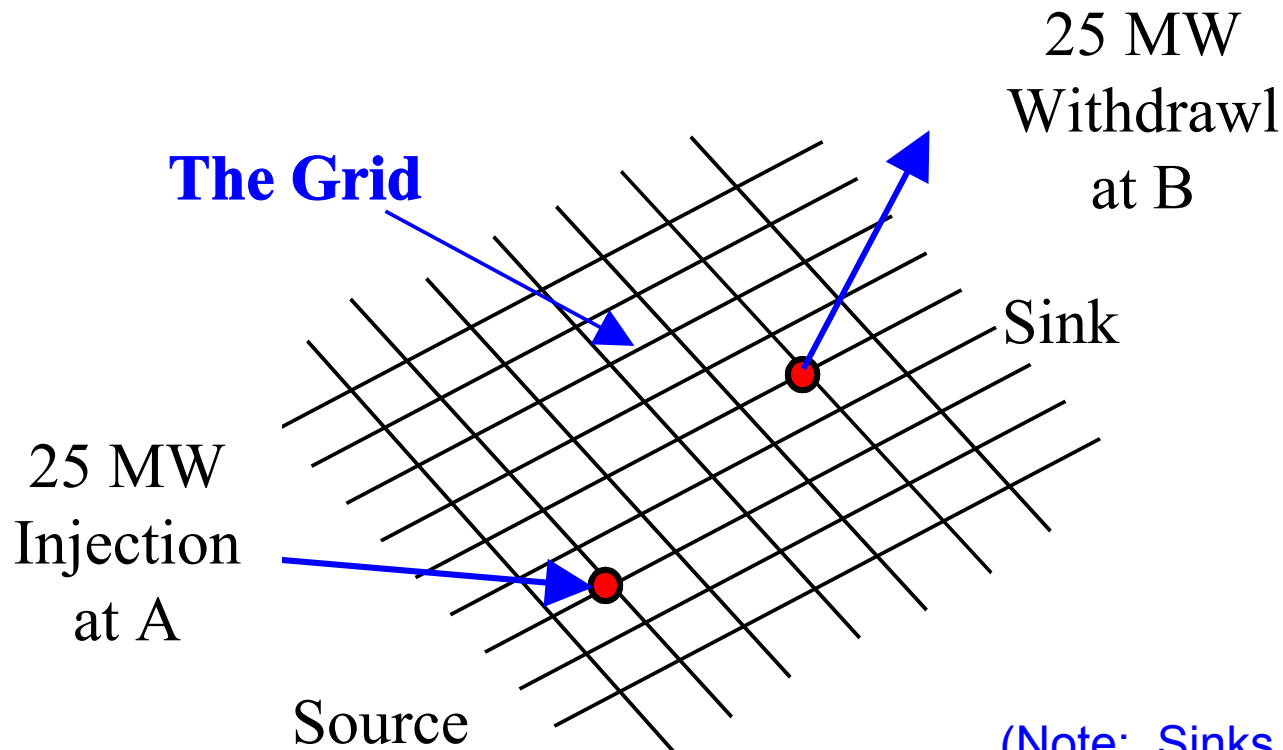
Source

(Note: Sinks will generally be load aggregation points rather than buses as suggested in this simplified example.)

Point-to-Point Congestion Revenue Rights

Example – Part A (LMP higher at Sink than Source)

25 MWs of CRRs

25 MW of CRRs

LMP @ Source A = $20/MWh

LMP @ Sink B = $25/MWh

Day-Ahead Energy Settlement =

(LMP_A) X (Scheduled Source MW_A) – (LMP_B) X (Scheduled Sink MW_B)

($20 X 25 MW) – ($25 X 25 MW) = -$\underline{250}$ (LSE Pays to ISO)

Day-Ahead CRR Entitlement Settlement =

$(LMP_B - LMP_A)$ (CRR MWs owned)

($25 - $20) X 25 MW = +$\underline{250}$ (LSE Receives from ISO)

Point-to-Point Congestion Revenue Rights

25 MWs of CRRs

25 MW of CRRs

LMP @ Source A = $25/MWh   LMP @ Sink B = $20/MWh

Day Ahead Energy Settlement =

$(LMP_A) \times (\text{Scheduled Source MW}_A) - (LMP_B) \times (\text{Scheduled Sink MW}_B)$

($25 X 25 MW) – ($20 X 25 MW) = +$250   (LSE Receives from ISO)

Day-Ahead CRR Entitlement Settlement =

$(LMP_B - LMP_A) \times (\text{CRR MWs owned})$

($20 - $25) X 25 MW = -$250   (LSE Pays to ISO)

Multi-Point CRR Obligations in Action -- Examples

Network

60 MW
Withdrawl
at D

20 MW
Injection
at A

10 MW
Injection
at B

50 MW
Injection
at C

20 MW
Withdrawl
at E

Sinks

Sources

Note: Sum of Source MWs =
Sum of Sink MWs
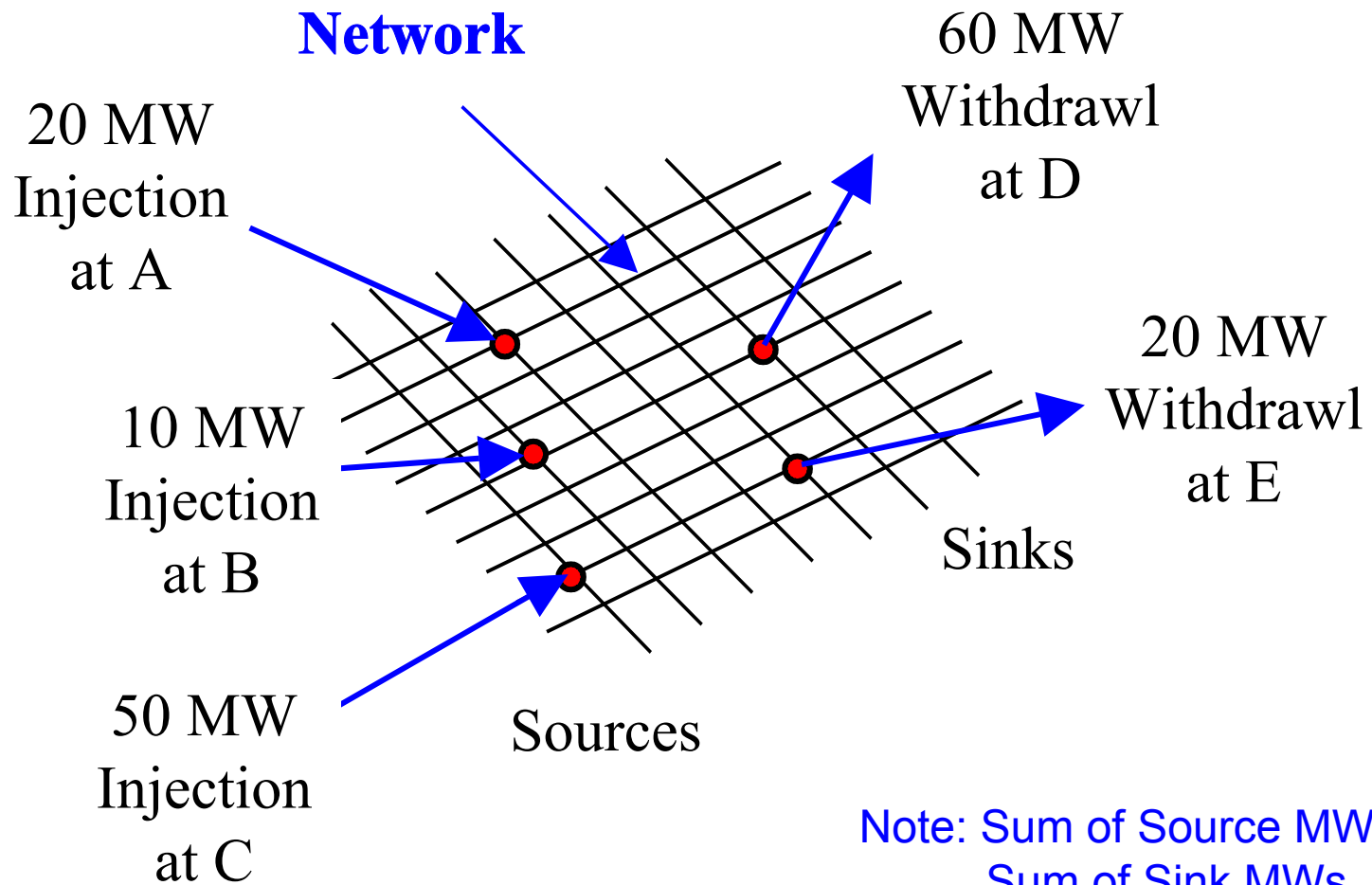
Multi-Point Congestion Revenue Rights

Example – Part A (LMPs higher at Sinks than the Sources)

Pt. on Grid	Source	Sink	LMP ($)
A	20 MW	--	10.00
B	10 MW	--	5.00
C	50 MW	--	15.00
D	--	60 MW	25.00
E	--	20 MW	20.00
Total	80 MW	80 MW	--

DA Energy = [Sum LMP Sources X Source MWs] - [Sum LMP Sinks X Sink MWs]
Settlement

DA Energy = [$10(20) + $5(10) + $15(50)] - [$25(60) + $20(20)] = - $450 (Owed to ISO)
Settlement

DA CRR Entitlement = [Sum LMPs Sinks X CRRs] - [Sum LMPs Sources X CCRs]
Settlement

DA CRR Entitlement = [$25(60) + $20(20)] - [$10(20) + $5(10) + $15(50)] = $450
Settlement   (Owed to CRR owner)

Multi-Point Congestion Revenue Rights

Example – Part B (LMPs higher at Sources than the Sinks)

Pt. on Grid	Source	Sink	LMP ($)
A	20 MW	--	30.00
B	10 MW	--	15.00
C	50 MW	--	25.00
D	--	60 MW	10.00
E	--	20 MW	5.00
Total	**80 MW**	**80 MW**	--

DA Energy = [Sum LMP Sources X Source MWs] - [Sum LMP Sinks X Sink MWs]
Settlement

DA Energy = [$30(20) + $15(10) + $25(50)] - [$10(60) + $5(20)] = + $1,300
Settlement   (Owed to CRR owner)

DA CRR Entitlement = [Sum LMPs Sinks X CRRs] - [Sum LMPs Sources X CCRs]
Settlement

DA CRR Entitlement = [$10(60) + $5(20)] - [$30(20) + $15(10) + $25(50)] = - $1,300
Settlement   (Owed to ISO)

Allocation and Auction Process Overview

- The quantity of CRRs created through the Allocation and Auction process is based on the following:

- Allocations --
  - Upper bounds on the amounts that can be nominated per Market Participant
  - Simultaneous Feasibility Test

- Auctions --
  - Collateral limit posted per Market Participant
  - Simultaneous Feasibility Test

Allocation and Auction Process Overview

- Simultaneous Feasibility Test (SFT)
  - Apply nominations/bids to FNM to ensure resultant flows are within constraint limits (feasibility)
  - Adjust nominations/bids to maintain feasibility (optimization)
  - Helps to ensure revenue adequacy (i.e., CRR revenue paid out by ISO is less than congestion revenue collected by ISO)

- Things that Impact Revenue Adequacy include
  - Topology of the Full Network Model (Shift Factors)
  - Aggregated Pricing Node / Pricing Node Mapping (Distribution Factors)
  - Operating Constraints

- The three data sets above are <u>similar</u> to those used to run the Integrated Forward Market

Allocation and Auction Process Overview

- Annual and Monthly processes
  - On-peak and Off-peak time-of-use (TOU) periods

- Annual Process --
  - Provides seasonal term CRRs with availability up to one year
  - Utilizes 75 percent of FNM capacity
  - May take into consideration long duration transmission outages
  - Comprised of
    - Three allocation tiers (each tier has an SFT)
    - One auction

Allocation and Auction Process Overview

- Monthly process --

    - Provides monthly term CRRs

    - Utilizes 100 percent of FNM capacity

    - Takes into consideration scheduled transmission outages for the month

    - Comprised of
        - Two allocation tiers (each tier has an SFT)
        - One auction

Allocation and Auction Process Overview

Illustration of the annual and monthly allocation and
auction timeline. (Assuming there are four seasons)

One Year / Annual period

Season 1   Season 2   Season 3   Season 4

Month 1   Month 2   Month i Month 12

T_{M1} T_{M2} T_{Mi} T_{M12}

T_{A1} T_{A2}
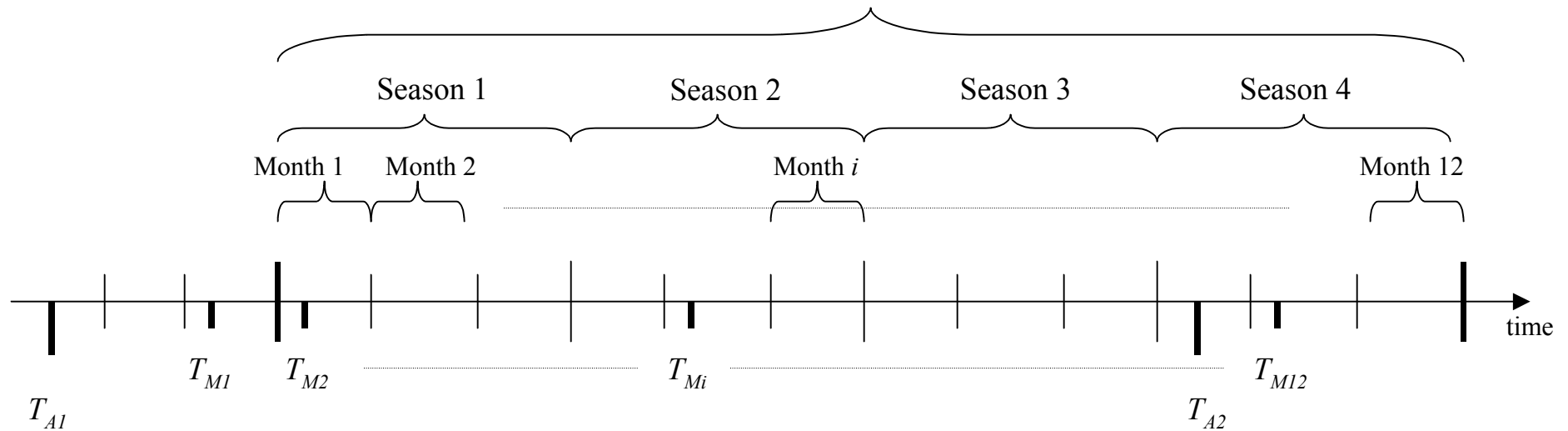
time

Allocation and Auction Process Overview

- The timeline is comprised of repeated steps starting at Year 1 for the annual process and month 1 in Year 1 for the monthly process

- T_{A1}: Approximately 2 months before the start of the first year (year 1), the annual allocation/auction process will begin, which will produce seasonal/TOU CRRs for Seasons 1, 2, 3 and 4

- T_{M1}: Approximately 3 weeks before the start of the first month (month 1), the monthly process will begin, which will produce monthly/TOU CRRs for month 1

- T_{M2}: Approximately 3 weeks before the start of the second month (month 2), the monthly process will begin, which will produce monthly/TOU CRRs for month 2

- T_{Mi}: Approximately 3 weeks before the start of the ith month (month i), the monthly process will begin, which will produce monthly/TOU CRRs for month i

- T_{M12}: Approximately 3 weeks before the start of the 12th month (month 12), the monthly process will begin, which will produce monthly/TOU CRRs for month 12

- T_{A2}: Approximately 2 months before the start of the second year (year 2), the annual allocation/auction process will begin, which will produce seasonal/TOU CRRs for Seasons 1, 2, 3 and 4

Allocation and Auction Process Overview

- The CAISO will designate a set of aggregated pricing nodes and pricing nodes that may be used by Market Participants as sources and sinks for the CRR allocation and auction

- Special source and sink validation will occur for allocation requests

Allocation and Auction Process Overview

- Allocation Process

  - Seasonal and Monthly tiers are validated per Market Participant

    - Source locations and source MW values (only for seasonal tiers 1 and 2 and monthly tier 1)

    - Sink locations and sink MW values for all tiers

    - Source and sink locations and MW values

      -- Initially are determined through verification process that will occur before Market Start-Up

      -- After year 1, will be determined through the priority nomination "Grandfathering" process

- Auction process has no source and sink validation

Allocation and Auction Process Overview

"Eligible Quantities" for CRR Allocation Requests
(as used in the following two slide)

Total Seasonal CRR Eligible Quantity

The quantity of CRRs that may be requested by a Load Serving Entity for each season in the annual allocation. This is determined by calculating for each LSE the 0.5 percent exceedence level of the <u>historical load</u> for a particular season, reducing this by the quantity of transmission ownership rights, converted rights, and existing contract rights held by the LSE, and then taking 75 percent of the result.

Total Monthly CRR Eligible Quantity

The quantity of CRRs that may be requested by a Load Serving Entity for each month in the monthly allocation. This is determined by calculating for each LSE the 0.5 percent exceedence level of the <u>forecasted load</u> for a particular month, reducing this by the quantity of transmission ownership rights, converted rights, and existing contract rights held by the LSE, and the quantity of CRRs already allocated to the LSE for that month in the annual allocation.

Allocation and Auction Process Overview
General Annual Process for a Season / Time of Use Period – Year 1

Historical Load Data

Eligible Quantity of CRRs that may be requested

FNM Capacity Scaled to 75 Percent

Tier 1
Input Nomination
Validate Source Location and Source MW
Validate Sink Location and Sink MWs to 50%
of total Seasonal CRR Eligible Quantity
Conduct SFT

Nominations

Cleared CRRs

Tier 2
Input Nomination
Validate Source Location and Source MWs
Validate Sink Location and Sink MWs to 75%
of total Seasonal CRR Eligible Quantity less by
the number of CRRs Awarded in Tier 1
Conduct SFT

Nominations

Cleared CRRs

Tier 3
Input Nomination
NO Validation of Source Location and Source MW
Validate Sink Location and Sink MWs to 100% of
total Seasonal CRR Eligible Quantity less the
number of CRRs Awarded in Tier 1 and Tier 2
Conduct SFT

Nominations

Cleared CRRs

Auction
Input Bids
Bids are used to compute estimated
exposure and this is compared against
posted Collateral
No Validation for Sources or Sinks
Conduct Auction and SFT

Bids

Cleared CRRs

CRR Participants interacting through the Market User Interface

Allocation and Auction Process Overview

General Monthly Process for a Month / Time of Use Period – Year 1

Forecasted Load Data

Eligible Quantity of CRRs that may be requested

FNM Capacity Restored to 100 Percent

Tier 1

Input Nomination
Validate Source Location and Source MWs
Validate Sink Location and Sink MWs to
50% of (total Monthly CRR Eligible
Quantity – Seasonal CRRs)
Conduct SFT

Nominations

Cleared CRRs

Tier 2

Input Nomination
NO Validation of Source Location and
    Source MW Levels
Validate Sink Location and Sink MWs to
    100% of total Monthly CRR Eligible
    Quantity less the Seasonal and Monthly
     Tier 1 CRRs
Conduct SFT

Nominations

Cleared CRRs

Auction

Input Bids
Bids are used to compute estimated
exposure and compare against posted
Collateral
No Validation for Sources or Sinks
 Conduct Auction and SFT

Bids

Cleared CRRs

CRR Participants interacting through the Market User Interface

Secondary Registration System (SRS)

- A robust secondary market for CRRs is desired

- The CAISO wishes to facilitate the trading of CRRs

- A Secondary Registration System is part of the CRR System Design

- The SRS facilitates transfers of CRRs via

    -- Electronic Bulletin Board functionality

    -- Ability for CRR owners to transfer ownership of CRRs, for settlement purposes, that result from external third party trades

- The ISO is not directly involved in secondary trades of CRRs

CRR Training at the California ISO

Consult the ISO website www.caiso.com for future CRR training opportunities to be offered at the California ISO