WESTERN ENERGY MARKETS

Parallel Flow Implications for Physical and Financial Transmission Rights

Susan L. Pope
WEM Governing Body Market Expert

WEM Governing Body Meeting
General Session
April 8, 2025

An understanding of parallel transmission flow assists in evaluating concerns raised about the allocation of EDAM congestion revenue among EDAM balancing area authorities (BAAs) and possible impacts on the net EDAM congestion cost charges paid by OATT customers.*

- Topics:
  - Parallel flow challenges
  - EDAM congestion revenue allocation issue
    - Observations regarding concerns and suggestions
    - Considerations moving forward

Parallel flows pose challenges for ensuring the feasibility of physical transmission rights and for transitioning physical rights to financial rights

* Throughout, the term "OATT customers" is inclusive of both point-to-point (PTP) and network service customers. Also, for simplicity, this presentation refers to the entities joining EDAM (EDAM entities or EDAM BAAs) as providers of OATT transmission service, although the transmission service provider (TSP) and BAA may differ for some customers.

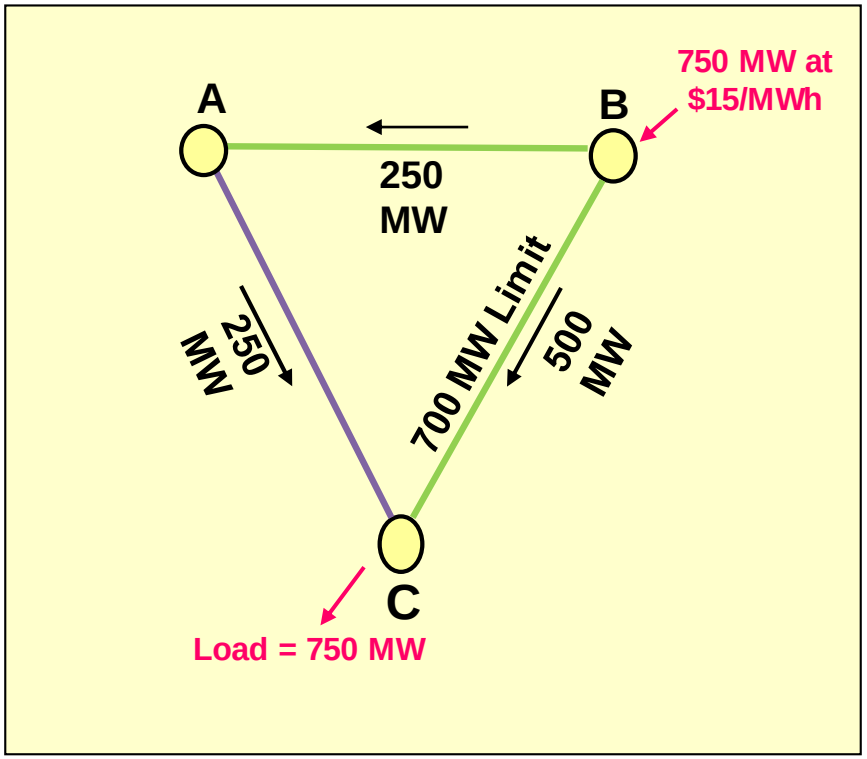
PARALLEL FLOW CHALLENGES

Parallel flow (also called “loop flow”) occurs because energy moving from an injection source to a load sink on AC transmission systems flows on all paths connecting the source and sink.

- Energy flows do not follow contractual “transmission paths”
- Energy “follows the paths of least resistance.” The flow on each path is inversely proportional to the electrical impedance of the path, compared to other paths

(Easiest, intuitively, to equate impedance with resistance, ignoring reactance)

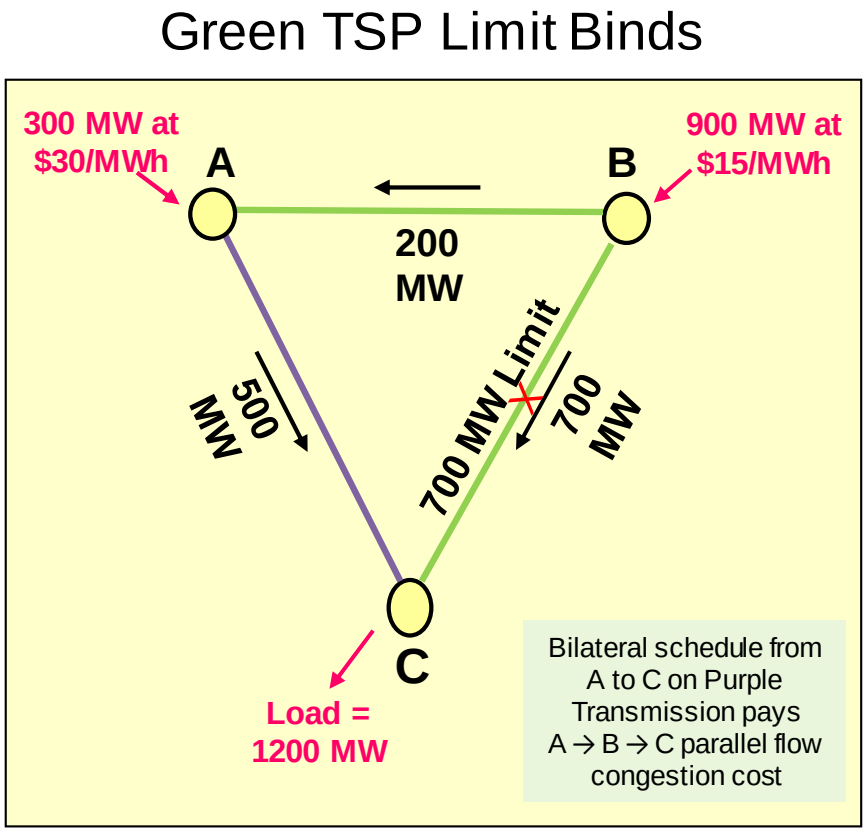
Illustration of Loop Flow



Purple and Green are transmission of different TSPs
All lines have equal reactance and zero resistance

Observation #1: Bilateral schedules using PTP rights as well as the dispatch of generation to meet load using network service within one EDAM entity can lead to parallel energy flows on transmission within neighboring balancing areas (BAs).

- Parallel flow from OATT transmission service drives the main concern raised about OATT revisions to implement EDAM
- Under current EDAM market rules, OATT customers will pay congestion cost charges for parallel flow across binding transmission constraints in neighboring BAs

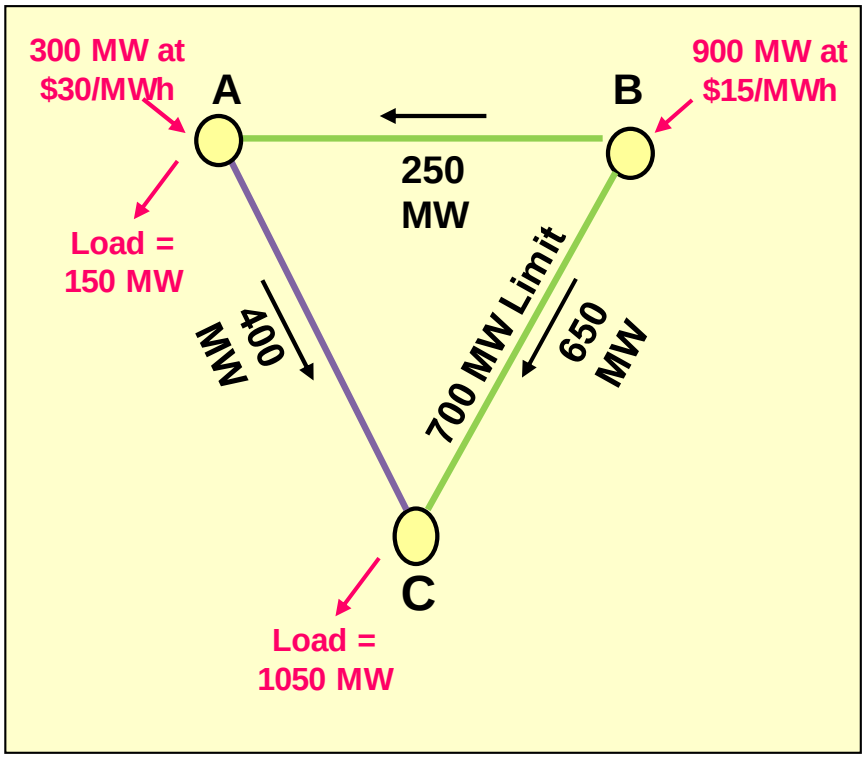


Purple and Green are transmission of different TSPs
All lines have equal reactance and zero resistance

Observation #2: The parallel flow through neighboring BAs *varies depending on energy injections and withdrawals;* it is not fixed by the amount of PTP transmission reserved.

- Energy flowing over all lines and constraints of interconnected BAs varies with the locations and quantities of all injections and withdrawals
- Impacts on neighboring BAs decline with distance (greater impedance)
- Parallel flow can contribute to neighboring constraints or relieve them
- Real-time dispatch must account for parallel flow

New Load at A Reduces Parallel Flow



Purple and Green are transmission of different TSPs
All lines have equal reactance and zero resistance

Observation #3: Existing PTP rights for the EDAM footprint in combination with network service would likely overload transmission constraints under a variety of conditions if all were used at the same time or in different combinations.

- OATT PTP service is awarded without fully accounting for parallel flow
- Although ATC amounts are generally conservative, enabling TSPs to separately sell transmission, TSPs make ongoing sales concurrently
- Management of infeasible OATT schedules today requires measures, such as:
  - Curtailment of non-firm service
  - Out-of-merit redispatch by impacted BAA to manage congestion
  - TLRs

EDAM CONGESTION COST CHARGE ISSUE

Under EDAM, OATT customers will be charged for congestion costs, including charges for parallel flow over binding transmission constraints in other BAs.

- Congestion cost charges will be paid by both network and PTP customers
- There is strong justification for charging OATT customers for EDAM congestion costs
  - Aligns with economic principles: the charge is tied to the marginal cost of redispatch to manage congestion on the binding constraints impacted by the OATT schedule
  - Supports economic dispatch: congestion cost charges for self-scheduled transactions are aligned with those that are not self-scheduled, removing a potential disincentive for flexible bidding
  - Aligns with practice in other locational marginal price (LMP) markets
- The congestion cost "charge" can be a credit if a customer's transaction relieves binding constraint(s)

EDAM congestion cost payments by OATT customers can be offset through allocation of a portion of the congestion charges accruing from EDAM settlements (called "congestion revenues" or "congestion rents")

- Under the approved EDAM market rules:
  - Each EDAM BAA will be allocated congestion revenue arising from congestion charges for binding constraints within its footprint
  - EDAM entities determine the sub-allocation of this revenue through revisions to their OATTs
  - EDAM BAAs will not be allocated congestion revenue corresponding to the congestion charges their OATT customers pay for parallel flows on binding constraints in other BAs
- *Concern has focused on the allocation among EDAM BAAs of congestion charges for parallel flow over constraints in other EDAM BAs*

The EDAM design could be improved by providing an avenue for OATT customers to more fully hedge or otherwise manage EDAM congestion cost charges.

- Approaches to address this concern that have been suggested:
  - CRRs or a similar financial transmission rights system
  - Changes to the EDAM congestion revenue allocation design to enable BAA entities to more fully offset the parallel flow congestion charges of OATT customers through revisions to their OATT tariffs
  - "Opt-out" and other approaches that would modify the scheduling of OATT PTP rights
- These differ in possible impacts on:
  - The allocation of congestion revenue between PTP and network customers and among the customers of different BAAs
  - Overall WEM market efficiency and potential EDAM cost savings due to "use-it-or-lose-it" incentives
  - Reliability

It has been suggested that CRRs could be readily added to EDAM to provide OATT customers with a hedge against EDAM congestion charges.

- For PTP customers, the hedge would be provided by assigning CRRs in the same MW quantity as OATT firm transmission rights
  - CRRs are financial instruments that have settlements calculated from hourly day-ahead market congestion costs
  - In a perfect world, the congestion charge for a 100 MW bilateral energy transaction from source A to sink B would be offset by the congestion revenue paid to a 100 MW CRR from source A to sink B; because of the CRR "hedge," the net variable cost of the transaction would be zero, as with OATT service
- However, a CRR design has not been developed for EDAM
- Material issues would need to be addressed to introduce CRRs to the EDAM design

Issue #1: CRR designs in other markets do not accommodate on-going sales of OATT service by individual TSPs, as in the EDAM.

- ISOs with CRRs have eliminated the sale of OATT transmission by individual TSPs
  - At a high level, transmission embedded costs are recovered from ISO transmission access charges, revenue from grandfathered transmission agreements, inter-TSP agreements negotiated to compensate owners of backbone transmission, and, in some cases, sales of OATT wheeling, import or export service *by the CAISO*
  - Elimination of individual TSP OATT transmission sales stabilizes the transmission capacity available to support CRRs
- Introduction of CRRs in EDAM will require the design of new rules to establish transmission capability for CRRs while also enabling TSP transmission cost recovery

Issue #2: Experience demonstrates that CRRs cannot be allocated for the full MW amount of existing OATT transmission service (PTP and network).

- Most ISOs with CRRs converted existing OATT transmission service to CRRs when LMP was introduced
- CRR design processes in many ISOs (NYISO, PJM, MISO, CAISO) found that, taken as a whole, the OATT transmission reservations for the region were infeasible
- Physical infeasibility was not encountered continuously under the OATT paradigm because not all reservations were fully used all the time
- In contrast, all CRRs settle financially in every hour of the day-ahead market, by design. *Side points to note*:
  - This design choice means that scheduling of uneconomic OATT transactions is not undertaken in order to be eligible for CRR payments
  - This is the key to why CRRs enable lower cost dispatches

Issue #2 (continued): Experience demonstrates that CRRs usually cannot be allocated for the full MW amount of existing OATT transmission service.

- Parties generally want CRRs for the full amount of their OATT rights, but this is infeasible because insufficient congestion costs would be collected to fund payments to the CRRs (called "CRR revenue inadequacy")
  - The infeasibility is not a problem with CRRs themselves
  - It occurs because the OATT PTP service being converted into CRRs is often not simultaneously feasible in combination with existing network service entitlements -- in part because of the inherent inability to account for parallel flow under the OATT paradigm – so cannot be recast MW for MW into revenue adequate CRRs
- *PTP customers of EDAM entities would not be able to receive CRRs for the full MWs of their OATT service without either reducing the rights of network load or creating CRR revenue inadequacy*

Issue #3: ISOs with CRRs have required lengthy stakeholder processes to design the market rules for converting existing OATT service arrangements into CRR allocations.

- ISOs have worked with stakeholders to reach agreement (to the extent possible) regarding, e.g.:
  - Rules to define the CRR entitlements of network transmission customers, e.g., their allowed CRR sources and sinks
  - Multi-step pro-rationing systems with rules to address, e.g.:
    - PTP reservations that provide counterflow
    - PTP reservations of different durations
    - PTP service that includes a TSP obligation to redispatch
- Changes to existing designs would likely be needed to add CRRs to EDAM, e.g., to address differences in the direction of power flows during different hours of the day in the west

The introduction of CRRs for hedging EDAM congestion costs would likely enable more efficient scheduling and decrease the cost of serving EDAM load, but it will take time to design and implement CRRs when agreed upon by EDAM participants.

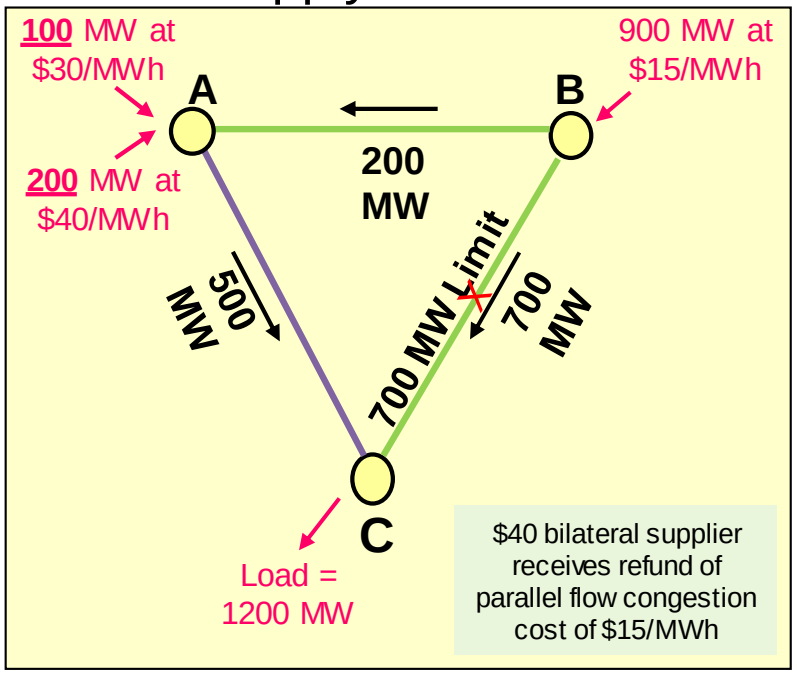
- A different approach is needed in the short-run to address concerns about OATT transmission customers' potential undue exposure to charges for parallel flow on binding constraints in other BAs
  - The CAISO has initiated an expediated stakeholder initiative to assess potential transitional modifications to the allocation of EDAM congestion revenues among EDAM BAAs
  - The allocation affects the extent to which EDAM entitles can offset their customers' PTP and network service congestion charges through revisions to their OATT tariffs
- CAISO suggests that financial rights could be considered in the future. Since a design would take time to develop, this discussion should be started when there is support from EDAM entities

Thoughts regarding transitional modified design for allocating congestion revenues among EDAM BAAs:

- Designs in which the allocation of congestion revenue to EDAM BAAs depends on the schedules of OATT customers could increase EDAM customer costs due to use-it-or-lose-it incentives

  - Incentive for bilateral schedules with supply that would not be part of the least cost unit commitment with flexible bidding
  - Inefficient bilateral schedules could *reduce customer cost savings because of less efficient unit commitment and dispatch*
  - Potential for bilateral schedules to increase if new PTP service is awarded that is profitable only because of the congestion revenue allocation design
  - Increased bilateral scheduling also could challenge system reliability during stressed conditions

$40 Supply Uneconomic



Purple and Green are transmission of different TSPs
All lines have equal reactance and zero resistance

Thoughts regarding transitional modified design for allocating congestion revenues among BAAs (continued):

- Designs where the system operator's allocation of EDAM congestion revenue depends on the schedules of OATT customers might be ringfenced to limit use-it-or-lose-it impacts
  - For example, the parallel flow MWs for which each BAA would be eligible for congestion revenue allocation could be capped
    - "Flow entitlements" could be set (or negotiated) for the parallel flows of each BAA on each EDAM constraint
    - Parallel flow entitlements could become complicated to set for each EDAM BAA flow constraint as EDAM participation expands
    - Parallel flow entitlements could be limited to a subset of material constraints, such as the market-to-market constraints in PJM and MISO
    - Capping the MWs for which a BAA would be allocated parallel flow congestion revenue could reduce the incentive for additional inefficient bilateral transactions
  - An allocation of parallel flow congestion revenue, even if ringfenced, would enable BAA entities to more fully offset the parallel flow congestion charges of OATT customers

Thoughts regarding transitional modifications that would enable PTP customers to "opt-out" of EDAM settlements:

- Some potential transitional measures could allow PTP customers to avoid congestion charges under all grid conditions
  - For example, self-scheduling rights before or after EDAM without paying congestion charges
  - CRR allocation process have demonstrated that this would provide a level of service superior to that of network customers
  - Like some designs for modifying the allocation of congestion revenues based on day-ahead schedules, these approaches could provide an inventive for additional fixed bilateral schedules, which could:
    - Reduce efficiency and customer cost savings from EDAM
    - Make it more difficult to maintain system reliability during stressed system conditions

Final thoughts regarding transitional approaches:

- The EDAM market design cannot follow the blueprint of other ISOs using LMP settlements because of its reliance on TSP sales of firm transmission to recover embedded transmission costs
  - EDAM will continue to need new design approaches to mesh centralized dispatch and LMP settlements with existing OATT PTP and network service
  - Improvements can be made over time
- A “reach” goal for short-term transitional modifications to the congestion revenue allocation would be to limit the impact of day-ahead schedules on the congestion revenue allocation among EDAM BAAs