

## **Alternative Market Paradigms**

The analysis is performed using a physical network model. It is also based on a paradigm assuming locational marginal pricing (LMP) throughout WECC. This combination, although most efficient and potentially conceivable for the future, will take years or even decades to implement and may likely not be implemented during the life cycle of the transmission projects considered here. At present, the California market is based on a zonal market paradigm (with no forward energy market), and most of the WECC operates based on contract path (rather than physical network model) scheduling. In near future California will move to an LMP paradigm (including a forward energy market). However, under both the current zonal market design and the LMP market paradigm (MRTU as currently envisioned for an indefinite period) scheduling at the ties with the neighboring control areas is checked for transmission feasibility using a scissors cut radial external network. This does not account for physical flows on individual lines comprising these interfaces. In this case, if the physical flows on one or more of these lines exceed the corresponding line ratings due to the looped external network (loop flows), these are managed in real time. This is how most of the congestion between Arizona and California is managed today and will continue to be managed under the initial LMP implementation.

In contrast, the PLEXOS model uses a full (meshed) external model respecting both the interface flow limits and the individual tie line limits, thus managing both the interface and tie line flows in the scheduling time frame. As a result, the model may generate congestion rents based on marginal pricing, whereas in practice congestion on these tie lines is managed in real-time using an as-bid paradigm and leading to uplift charges rather than congestion rents. The net result is that the network model with looped external (as in PLEXOS) may overestimate the loss of congestion rental associated with the upgrade (and thus underestimate the benefits of the upgrade) for California compared to what may occur in practice under the scheduling paradigm prevailing at present and in the near future.

Although it is possible to use a network model replicating contract path flows, it is unrealistic to attempt to model the behavior of various participants across WECC under an otherwise “inefficient” scheduling paradigm. Rather than attempting such a questionable modeling effort, we adopted a method to adjust the model results to capture higher short term and medium term benefits that the transmission upgrade would have for the California rate payers under the current WECC paradigm. To this end we identified three interfaces, namely the East of River (EOR), West of River (WOR) and Palo Verde West (PV West), and 20 major lines that generate the majority of the transmission rents associated with transfers between Arizona and Nevada to California. All of the congestion revenue resulting from these 20 lines that was associated with congestion that would be mitigated in real-time was removed as a cash flow to the ISO. A share of the congestion rental associated with relevant day-ahead interface scheduling limit(s) was directed to the ISO. For today’s system, and for the foreseeable future, the only congestion that could result in a cash flow to the ISO in this group of facilities is the congestion on the East of River (EOR) Scheduling interface. Congestion on the individual lines and on the other two interfaces is in practice managed in real-time and will continue to be managed in real-time under the initial California LMP paradigm. We

thus adopted the following adjustments in computing the transmission rental for the California region before and after the upgrade:

(1) Divide the 20 lines of interest into 4 categories as follows:

- CA: Both terminals of the line are in CAISO. Regardless of rental allocation ratio, the optimized scheduling program (Plexos) allocates 100% of congestion rents to CAISO.
- N: Neither of the two line terminals is in CAISO. Regardless of rental allocation ratio, the optimized scheduling program (Plexos) allocates 0% of congestion rents to CAISO.
- R: The "TO" terminal of the line is in CAISO, but the "FROM" terminal is not. Plexos allocates the congestion rents to CAISO based on the rental allocation factor R.
- 1-R: The "FROM" terminal of the line is in CAISO, but the "TO" terminal is not. Plexos allocates the congestion rents to CAISO based on  $(1 - R)$ .

(2) Retrieve the congestion rents for each of the 20 lines as produced by Plexos. These include congestion rents due to interfaces containing the line as well as the line itself.

(3) Using the line category (CA, N, R, or 1-R) for each of the 20 lines, back compute the congestion rents that Plexos allocated to CAISO from these 20 lines.

(4) Retrieve the CAISO congestion rent from all lines from Plexos.

(5) Compute the CAISO congestion rents due to lines other than the 20 lines of interest by subtracting (3) from (4)

(6) Obtain the congestion rent due to the EOR constraint from Plexos (EOR is assumed to be the principal scheduling bottleneck under the current and near future scheduling paradigm between California and the Southwest.)

(7) Compute the CAISO share of EOR congestion rents: 55% before PVD2 upgrade; 60% after PVD2 upgrade based on the ISO's share of the scheduling rights.

(8) The adjusted CAISO rental is computed by adding (5) and (7).

The above adjustments are carried out both before and after the upgrade. The net impact is generally an increase in transmission upgrade benefits for the CAISO ratepayers, more closely reflecting the upgrade benefits to the ratepayers under the WECC scheduling rules in the foreseeable future.

This approach is believed to more accurately estimate the economic benefits of the PVD2 Project to the CAISO ratepayers than the assumption that LMP pricing will be adopted uniformly across the entire interconnection. However, this approach has the following shortcomings:

- 1) The adjustment for the difference between physical flow and contract path scheduling is applied only in so far as it impacts California rate payers. To ensure consistency between overall WECC and the regional benefits, one of the following approaches may be adopted: (a) Keep track of the adjustment in a separate "benefit bucket" without attempting to allocate it to any specific region;

- (b) Allocate the adjustment to selected regions based on their interconnection with CAISO through the 20 lines of interest. In either case since the underlying network model still assumes physical scheduling in the rest of WECC such allocation may be unrealistic. Thus we have made no attempt to perform overall regional adjustments that would replicate the benefit allocation under the current WECC contract path scheduling practices for regions other than the CAISO.
- 2) In the ISO's planned MRTU, load would pay prices based on the results of the day-ahead scheduling process. In calculating these prices, the MRTU computer model would use a contract path approach for inter-tie schedules, which could mask much of the congestion that would show up in real-time. This is expected to result in a lower price difference to consumers and generators before and after the addition of the project than the PLEXOS computer model would produce. As a result, the PLEXOS results may be overstating the benefit to consumers and the impact to generators in California compared to what may occur under MRTU, and therefore may overstate the ISO Ratepayer benefits of the PVD2 project. This means that the adjustment performed here may somewhat exaggerate the benefits of the upgrade to the CAISO rate payers.
  - 3) This approach does not capture the costs to the ISO ratepayers of having to clear congestion in real-time through the INC'ing and DEC'ing of generators. This cost can be substantial. The congestion that the ISO has had to mitigate recently at Miguel resulted in a cost to the ISO ratepayers of \$50 million in a one-year period. Although this cost is not necessarily eliminated after the upgrade under the contract path paradigm, it is expected to be lower. This cost differential (benefit of the upgrade) is not captured by the model, nor by the adjustment procedure mentioned above; so the model may be underestimating the benefits of the PVD2 Project despite the adjustment.
  - 4) This approach assumes that all schedules on the EOR path would be set in the day-ahead market. In reality, the ISO only controls slightly over half of this capability. As a result, if schedules are not accepted in the ISO's day-ahead process, generators and customers can access the other half of the transmission scheduling rights to deliver the same generation to California. These transactions could be arranged anytime between when the day-ahead market closes and real-time. The end result would be that the ISO would end up clearing the congestion twice, once in day-ahead and once in real-time. While clearing congestion in the day-ahead market would generate revenue for ISO ratepayers (through either the CRR revenues allocated to load, or the reduction of the Transmission Access Charge), clearing congestion in real-time would generate a cost. As a result the approach used to evaluate the PVD2 project may understate the benefit of the PVD2 Project.

Without extensive additional analysis it would be difficult to determine if, or to what extent, this adjustment captures or exaggerates the true benefits of the upgrade for the CAISO rate payers. The true answer lies somewhere between the CAISO benefits computed with and without this adjustment.