

New Tools for Integrating Variable Energy Generation Within the Western Interconnection

**A White Paper
Prepared by the Staff of the Western Interstate Energy Board**

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Executive Summary

Existing state renewable portfolio standards will result in a significant increase in the amount of variable generation on the electric grid of the Western Interconnection. Variable generation, in particular wind and solar generation, requires a high level of balancing flexibility on the grid, because both load and generation within the footprint of any given Balancing Authority must remain balanced in order to maintain system reliability. Therefore, as variable generation output increases over the next few years, other resources (generation or demand response) must be available in order to maintain that balance.

However, current energy balancing practices are insufficient to meet the challenges of integrating large amounts of variable generation. In order to address these challenges in a timely and cost-effective manner, the Seams Issues Subcommittee of the WECC, working over the past year with the Western Interstate Energy Board, has been developing a number of new tools, under the general rubric of an Efficient Dispatch Toolkit, to facilitate energy balancing within the Western Interconnection. The underlying principle that has guided the development of these tools is that the availability of diverse, flexible and dispatchable resources in the aggregate throughout the WECC can be used to assist balancing areas with variable generation.

There are two major proposed elements to the Efficient Dispatch Toolkit: (1) a seams coordination tool, called the Enhanced Curtailment Calculator (ECC), to manage power flow impacts across all seams between Balancing Authorities within the WECC footprint; and (2) an Energy Imbalance Market (EIM) that would supply energy imbalance and congestion management services for the portions of the WECC that are not within the footprint of the Alberta and California independent system operators.

The ECC will be used to coordinate curtailments for reliability throughout the WECC, including areas within the footprint of the Alberta and California independent system operators. The ECC will replace the existing rudimentary seams tool used in the WECC with an expanded comparable tool. In contrast to the current seams coordination tools, the ECC will be used to manage reliability on all WECC rated paths in the Western Interconnection, including areas within the footprint of the Alberta and California independent system operators. Although the ECC will provide several important building blocks necessary for the implementation of the proposed EIM, the ECC can be developed and implemented independently of the EIM.

The proposed EIM will allow BAs in the West to supply imbalance energy and to manage transmission constraints across BA borders, rather than only within BAs, as is the practice today. The EIM will not – and is not intended to – eliminate or undercut existing arrangements between BAs. Thus, transmission owners, generators, loads and other entities may continue current transmission service practices, e.g., reserving and contracting for long-term firm point-to-point and network transmission

service, after the EIM is established. The energy supplied by the EIM would fulfill the imbalance settlement requirements of resources and loads, which is currently addressed in Schedules 4 and 9 of the OATT. However, unlike full markets which make use of Locational Marginal Pricing, the EIM would not have a consolidated regional tariff, would be a real-time energy-only market, and would not include unit commitment.

The EIM would likely require an umbrella tariff that would guide the operations of a broad, multi-utility, energy balancing market. The participating transmission providers in the balancing market footprint would retain their own Open Access Transmission Tariffs (OATTs) for ongoing traditional activity with minor modifications to integrate their OATT service within the umbrella tariff of the EIM.

It should be noted that there are a number of important issues to be resolved before the EIM can be implemented. These issues include:

- How large the footprint of the EIM needs to be for it to be cost-effective;
- Who should operate the EIM, and what that entity's qualifications should be;
- The nature of the governance of the EIM;
- The scope of the EIM's tariff; and
- The collection, allocation and settlement of EIM revenues.

Introduction

State-level portfolio standards will increase Western Interconnection¹ installed renewable capacity to approximately 70,000 MW by 2020 from today's levels of approximately 13,000 MW. This change will challenge utility Balancing Authority Areas (BAs) to keep balance between load and generation; the balancing is needed to preserve grid reliability.

As variable generation output changes, other resources (dispatchable generation or controllable electric loads) must respond to BA instructions in order to maintain energy balance. Current energy balancing practices are inefficient for meeting future challenges for several reasons. For example, the bilateral nature of transmission and energy scheduling practices makes finding and dispatching available remote balancing resources difficult. Transmission and energy transactions based on bilateral schedules do not “net” scheduling errors into a single aggregate balancing requirement. Also the methods used by transmission providers to granting transmission service are conservative; new tools available to the industry and used in other regions have shown increased transmission utilization by granting balancing access based on actual operating conditions. With increasing variable generation in the Western Interconnection the reliability issue of keeping energy balance cannot be met while ignoring efficiency.

This paper will outline the issues relating to the need for more extensive energy balancing within the Western Interconnection and the possible establishment of an Efficient Dispatch Toolkit (EDT) within WECC to address this need. The paper will also serve as a guide to the various white papers and key documents addressing these issues that have been prepared to date.

What is the EDT?

The EDT is primarily a real-time, voluntary energy balancing market with loop flow coordination capability. The proposed toolkit would permit increased use of transmission facilities resulting in lower costs for renewable integration and energy supply for balancing market participants.

The EDT has two parts: (1) a seams coordination tool, called the Enhanced Curtailment Calculator (ECC), to allocate curtailment responsibility when there is transmission congestion²; and (2) an Energy Imbalance Market (EIM) that would supply energy imbalance and congestion management services to transmission customers through participating BAs in the Western Interconnection³.

Enhanced Curtailment Calculator (ECC)

The ECC will be available across the interconnection to allocate responsibility for curtailments during transmission congestion. It will enable operators and reliability coordinators to see priority-sorted transmission service contributions to loading on selected grid elements. The ECC will be available to calculate coordinated allocations of curtailment responsibility on these selected elements throughout the western interconnection. The ECC will perform this calculation regardless of market or non-market status of the transmission owner facility.

¹ Nine of the 14 states in the Western Interconnection have RPS goals of 15% or higher (www.dsireusa.org).

² Most of the ECC functionality can be implemented with or without the EIM. Stakeholder activity in the WECC Seams Issues Subcommittee (SIS) and Unscheduled Flow Administrative Subcommittee (UFAS) is already evolving the existing WECC seams coordination tool. The only aspect of ECC functionality which is a part of the EDT is when additional ECC capability is developed to pass curtailment responsibility calculations to the EIM, as discussed later in this paper and in the ECC specification document.

³ The CAISO and the AESO are assumed not to participate in the EIM, since they already have established sub-regional energy balancing markets.

The ECC will replace the existing rudimentary seams tool used in the WECC. The enhancements provided by the ECC will also require new procedures for regional congestion management and reliability coordination. For example, the ECC will have the capability to differentiate transmission service curtailment priority for flows which start and stop outside the system of the Qualified Path owner⁴. In contrast to the current seams coordination tools and procedures, the ECC and associated new operating procedures will be available to manage reliability on any Western Interconnection transmission elements that benefit from coordinated curtailments. The ECC will be available at all times to provide output when schedule curtailments are necessary for congestion management. The ECC will ensure that the allocation of curtailment responsibility follows an objective, comparable process. The ECC process will include impact priority curtailment decisions (*i.e.*, curtailing non-firm schedules before firm schedules) and will also include real-time updates of transmission system circuit data to include actual outages⁵.

The ECC can be developed and implemented independently of the EIM. However, the ECC provides important information necessary for the EIM operation. Curtailment responsibility allocations calculated by the ECC would feed into the EIM as adjustments to scheduled delivery.

Issues relating to the ECC

- Need to establish the ECC and associated process for congestion management in the western interconnection.
- Need to describe the added functions of the ECC which would support the EIM.

Energy Imbalance Market (EIM)

The second part of the toolkit, the EIM, will use regional security-constrained economic dispatch (SCED) to supply imbalance energy and to manage transmission constraints. The EIM will allow the West to settle energy imbalance and redispatch transactions across BA borders, rather than only within BAs as is the practice today. Transmission owners, generators, loads and other entities may continue current transmission service practices and would still be able to reserve and contract for long-term firm point-to-point and network transmission service.

The EIM would operate based on voluntary offers from participating resource providers to deliver least-cost energy supply. The energy supplied by the EIM would fulfill the imbalance settlement requirements of resources and loads which are not operating at their Scheduled Delivery⁶ levels. The EIM would use information provided by the ECC to perform settlement of energy imbalances when there have been curtailments of Scheduled Deliveries due to congestion on the grid.

Energy Imbalance Service would not be provided pursuant to an OASIS-based tariff reservation. Moreover, EIM dispatch would not be reliant upon the traditional methods used by transmission providers to perform Available Transfer Capability (ATC) calculations. Instead the EIM SCED and ECC tools ensure that the regional energy dispatch process does not result in reliability impacts due to the balancing market dispatch.

The EIM would consist of a sub-hourly, real-time energy market providing centralized, automated generation dispatch and prices for each 5-minute interval, covering participating BA areas in

⁴ Today's WECC Unscheduled Flow Mitigation Procedure does not differentiate between firm and non-firm transmission service impacts on the constrained Path if those transactions source and sink outside of the transmission provider system. So firm service with a loop-flow impact on the Qualified Path may be cut prior to non-firm loop flow impacts on the same path. Also the accommodation (curtailment) by local on-path uses in some cases involves curtailment of firm use when non-firm loop flow impacts may be contributing to the overload.

⁵ Currently, the seams tool grid model to calculate flow impacts is only updated twice annually.

⁶ Deviations from Scheduled Delivery will become the basis for settlement in the EIM.

the WECC region except for CAISO and Alberta, which already have more mature market dispatch functions.⁷ The EIM proposal closely resembles the Energy Imbalance Service in the Southwest Power Pool (SPP).⁸

Participation in the EIM would be voluntary on a BA or transmission service provider basis. The EIM SCED would incorporate real-time generation capabilities, transmission constraints, and pricing. Generators may elect to offer their output into the market or self-schedule. Loads would self-schedule their deliveries (matched to generation) or would be settled at the market clearing price for energy. The EIM operator would dispatch the generation to balance supply and demand and manage congestion, to the extent it is offered, available, and deliverable, rather than using bilateral trading between buyers and sellers. Existing contingency reserve sharing groups are accommodated by the EIM. Contingency reserves and regulating reserve requirements will remain the responsibility of the BA. Participating transmission customers can continue to schedule bilaterally, including bilateral and self-schedules.

While the market design has many similarities to those administered by ISOs and RTOs, this proposal does not include implementing an RTO for the EIM. The EIM could utilize tools and algorithms that have been successfully implemented in other centralized markets, but an EIM would not include a consolidated regional tariff for basic transmission service (*e.g.*, network or point-to-point). However, the EIM would use a coordination tariff to address provision of generator and load energy imbalance, replacing some Ancillary Service Schedules of participating transmission provider tariffs.

Two reference papers related to open issues in the EIM design are summarized below. One paper was developed by the Crossroads committee and describes the options for the EIM footprint, governance, market operator, start-up and exiting. The second paper was developed by the WECC Seams Issues Subcommittee and describes tariff considerations and tariff design alternatives.

The options paper covers:

Open Issues Relating to the EIM: Footprint

Participation in the EIM could manifest in many combinations of BAs and transmission providers. Thus, further discussion of an EIM must take into account several possibilities for footprints. In addition, questions must be addressed relating to the critical mass of BAs that would be necessary for an EIM to be cost-effective, the extent to which the BAs participating in the EIM must be contiguous, and transmission rights for non-participants in the EIM.

An effort is underway by the EIM Crossroads Meeting Committee⁹ (Crossroads Committee) to identify potential likely configurations of an EIM that result in a critical mass sufficient to justify the cost of an EIM, and the economies of scale resulting from alternative footprints. The size and makeup of the EIM footprint will affect cost considerations (including start up and operating costs) and the ability to create a sufficient pool of economic dispatch benefits.

The Crossroads Committee is drafting an options white paper that discusses the pros and cons of several possible EIM footprints.¹⁰

Open Issues Relating to the EIM: Market Operator

⁷ Extensive descriptions of the CAISO market are available at www.caiso.com.

⁸ For information on the SPP EIS Market, visit http://www.spp.org/publications/EIS_Market_Fact_Sheet.pdf. Also see,

⁹ Link to website when available

¹⁰ Link to white paper when issued

A Market Operator needs to run the EIM, meet any legal requirements established by FERC and provide accurate and timely market settlements. There have been several open issues identified for the Market Operator role. Key among these issues is what agent should operate the EIM and whether previous experience in operating a market is a critical selection criterion for the agent.

A Market Operator would:

- Operate a sub-hourly, real-time energy market providing centralized, automated generation dispatch and prices for each 5-minute interval;
- Dispatch the generation to balance supply and demand and manage congestion
- Interact with the WECC Reliability Coordinator in the support of reliable grid operations;
- Perform a balancing market settlement function (billing, collections, credit issues to participants, etc.) for each balancing market operating hour; and
- Have a Market Monitor role, either in-house or via a contractor, to monitor any potential gaming of the system and implement rules regarding the disgorgement of profits from violations of market rules.

In addition, the Market Operator will be responsible for compliance with certain FERC-adopted mandatory reliability standards pursuant to a standards compliance delegation agreement, to be established.¹¹ The Market Operator will need to file a tariff with FERC which will govern market operations.

The Crossroads Committee addresses options for Market Operators in its options white paper.

Open *Issues Relating to the EIM: Governance*

There are several issues surrounding the governance of an EIM in the West. These include:

- FERC approval;
- Role of market participants or regulators;
- Methods of oversight of market operator; and
- Jurisdictional issues.

The Crossroads Committee is addressing these issues in its options white paper.

Open *Issues Relating to the EIM: Start-Up Costs*

The issue of EIM start-up costs is being explored by the Crossroads Committee in its options white paper. The paper outlines the issues relating to start-up costs and provides options. Among the issues relating to start-up costs that must be considered are:

- Financing the start-up of an EIM;
- Controlling risk and possible incentives for early opt in;
- Efficient and timely start-up of an EIM; and

¹¹ For example, other regional market organizations have established agreements with participating balancing areas that define roles and responsibilities for standards compliance. The most similar design in operation to the proposed EIM function is the SPP regional market. Their standards compliance delegation agreement is filed with FERC in Docket ER06-451-000.

- Encouragement of participation.

The Seams Issues Subcommittee paper covers:

Open Issues Relating to the EIM: Tariff

Unlike Regional Transmission Organizations, the EIM would not have a consolidated regional tariff for full transmission service. The EIM would be a real-time energy-only market, and would not include unit commitment or ancillary services. The EIM would require an umbrella tariff that would guide the operations of the energy balancing market for the participating utility systems. The participating transmission providers in the balancing market footprint would retain their own Open Access Transmission Tariffs (OATTs) for ongoing traditional activity with minor modifications to integrate their OATT service within the umbrella tariff of the EIM.

In order to establish the new tariff, Schedules 4 (Load Imbalance) and 9 (Generator Imbalance) of the existing OATTs of the BAs participating in the EIM would be replaced. Today each BA, on behalf of itself and any embedded third-party transmission service providers, provides an ancillary service to balance generation and demand on an ongoing basis. The cost recovery for provision of these services is invoiced to the transmission customer under Schedule 4 for load-side imbalances and Schedule 9 for generator-side imbalances. Most non-RTO balancing-area transmission providers have a provision in their tariffs for settling the imbalance accounts, by either charging or paying for the imbalance energy (depending on the direction of the imbalance error). In addition, common practice is to reduce the per-unit value of payments or increase the per-unit cost of charges as the imbalance error increases, as an incentive to accurate scheduling practices by the transmission customer. The EIM would replace these provisions with a market-based settlement for balancing energy.

The WECC Seams Issues Subcommittee (SIS) is addressing the tariff issue in its Tariff White Paper.¹² That paper outlines several options for tariffs and supplies additional information on the nature of the issues related to the tariff.

Open Issues Relating to the EIM: Revenue Collection

With the deployment of the EIM, there are new general revenue collection issues. First is the recovery of administrative costs (staff and equipment) for deployment of the Market Operator and Market Tools. The second issue is recovery of transmission service provider lost revenues due to potential substitution of energy balancing transmission service for traditional forms of transmission service¹³. The collection and payments process would be administered through EIM market settlements.

Issues Relating to the EIM: Non-Participating Transmission Providers

¹² Link to paper when available

¹³ The concept for addressing this revenue collection issue is as follows: based on the availability of an EIM, some market participants may reduce their purchases of conventional OATT-based transmission service (most likely of non-firm service priority, since firm uses are still required for adherence to certain reliability criteria). This could result in a reduction of transmission revenues to Transmission Providers.¹³ Therefore participating transmission providers (and their firm delivery customers) may potentially be impacted by a reduction in revenue from third-party transmission customers which is credited against their embedded system rates. The EIM discussions thus far have included consideration of this issue and several alternatives have been identified in the SIS tariff paper.

Some Transmission Providers have indicated that if they are not EIM participants they may seek to recover transmission service charges from the EIM participants due to parallel flow or loop flow impacts on their systems. This issue is not yet resolved although the SIS Tariff White Paper does discuss various options and scenarios.

Issues Relating to the EIM: Market Monitoring

Market monitoring is a critical function in the operation of an Energy Imbalance Market. A market monitoring role will be required as part of the EIM proposal. There are several issues related to market monitoring that must be addressed:

- Market Monitor establishment and role;
- Disgorgement rules for counter-flow scheduling abuse; and
- Market Power Mitigation Procedures.

The EIM settlement calculations create the opportunity for an entity with resources serving demand across a congested transmission interface to game the balancing market. This issue must be addressed in the tariff in a specific market-monitoring and margin disgorgement rules to mitigate such conditions. Although gaming can potentially occur in any rule-based system, this specific aspect is unique to an energy imbalance-style market design where there is no settlement for the Scheduled Delivery portion of grid use. The Southwest Power Pool has been using an energy imbalance-style market for several years and has successfully used its disgorgement rules to prevent abuse.

Details about market monitoring of the EIM are included in the SIS Tariff White Paper.