CAISO Response to Request from PUC-EIM Task Force

March 29, 2012

1. Introduction

The Public Utilities Commissions Energy Imbalance Market (PUC-EIM) Task Force is leading an important endeavor as it considers an energy imbalance market deployed in its service areas. Broad participation in an imbalance market will bring important efficiency, reliability and financial gains to all parties. It also provides a valuable and important role in renewable integration, helping to balance variable resources.

The California Independent System Operator Corporation (ISO) provides this paper in response to the PUC-EIM as it considers this important initiative. This proposal results in a simple and economical way for participants to join an energy imbalance market. It uses existing features of the ISO real-time market and provides a scalable cost approach that allows entities to join when they are ready. It also preserves participants' autonomy. Participants continue to balance and provide ancillary services for their own balancing authority. This approach also provides participants flexibility to continue energy trading bilaterally, in the spot market, or both, depending on their preferences.

The ISO proposal provides all functionality sought in the straw proposal. In addition, the existing ISO markets readily allow for incremental functionality should participants choose to expand services in their area. Ultimately, we can construct a range of incremental functional options for participants, so their participation can best fit their preferences.

Designing a new market structure is a major endeavor. It is cost-intensive and resource-intensive both during market implementation and after initial market startup. It takes years to build a well-functioning market and to perfect market operation. The ISO markets have all the elements of the most advanced ISO markets in the United States, and as such the ISO does not have a need for a major risky market changes requiring significant highly skilled resources. Instead, the ISO's knowledgeable and highly skilled resources can focus on working with other parties in the west on establishing a well-functioning energy imbalance market, and those interested and prepared can join the market on a timeline that works for them. We encourage participants to take advantage of the maturity, market design stability and success of the ISO markets. Participants can use only the real-time market provisions, or they can choose to expand to other additional existing functional options that are mature, well-tested, and successfully operating since April of 2009.

This proposal by the ISO offers the benefit of an existing, stable platform that entities in the west can choose to avail themselves of at their own pace. In addition, those that choose to use these services eliminate many seams issues that take resources from all balancing authorities in the west. Rather than spending resources and time managing the complex seams issues, by engaging with the ISO in this endeavor the area benefits from the economies of scale that result from balancing together with the resources and loads in California, benefitting all participants through improved reliability, better forecasting and integration of renewables, and improved scheduling practices.

The ISO would like to be a partner in this development and believe the experience gained in operating its markets can provide important insights into a market structure that will benefit everyone. We recognize that the eventual approach and design will depend on further discussions with those balancing authorities and utilities that want to move forward with this market and look forward to the opportunity to explore possibilities with our neighbors.

2. Summary

The purpose of this effort is to provide the PUC-EIM Task Force with meaningful estimates of the costs of a real-time Energy Imbalance Market (EIM) and also to provide additional market insights for further consideration.[1] The cost estimate includes and distinguishes between one-time incremental costs for implementation and ongoing incremental costs for the operation of an EIM. It is assumed that participation in the EIM would likely be gradual, so cost estimates have been provided accordingly.

The ISO provides this cost estimate for the PUC-EIM Task Force as well as a description of the benefits of an EIM,[2] in order to perform a meaningful benefit-cost evaluation and allow task force members to develop recommendations as to whether an EIM should be further pursued.

For developing this cost estimate the ISO has focused on WECC's white paper (Energy Imbalance Market Functional Specification), and on the existing PUC-EIM straw proposal, which is based on the Southwest Power Pool (SPP) market design.[3] We are also aware that the Southwest Power Pool is in the process of developing a market similar to the ISO market and other ISOs in United States, which is expected to be completed in the next couple of years. The ISO has also identified some areas of the EIM design where there are alternatives to consider that could reduce costs, simplify the EIM design, or provide other improvements and provided cost estimates accordingly. The functionality described here and in the appendices takes advantage of optimization software already developed and proven in operation

Section 3 of this document is a brief summary the PUC-EIM straw proposal, and how it could be implemented in a simple and scalable approach using existing features of the ISO real-time market and dispatch.[4] Section 4 presents the ISO's estimates of the costs of this type of market. Section 5 lists

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1 The motivation for and objectives of an EIM are described in WECC's white paper, "Energy Imbalance Market Functional Specification" (available at http://www.wecc.biz/committees/BOD/09212011/Lists/Minutes/1/12a%20EIM%20Functional%20Specification.pdf), and along with a discussion of open issues, in a Western Interstate Energy Board white paper, "New Tools for Integrating Variable Energy Generation Within the Western Interconnection" (available at http://www.westgov.org/EIMcr/documents/eim-hli.pdf).

2 The benefits of an EIM are being studied and reported on through a separate effort, and are not the subject of this document. WECC's previous analysis of costs and benefits is available at http://www.wecc.biz/committees/EDT/EDT%20Results/EDT%20Cost%20Benefit%20Analysis%20Report%20-%20REVISED.pdf.

3 The straw proposal is available at http://www.westgov.org/PUCeim/documents/02-06-12EIMprot.doc.

4 Appendix 1 of this document expands this summary with more detailed descriptions of major functional areas that would comprise the EIM, comparing the existing PUC-EIM straw proposal to the market design that the ISO can offer.

several topics that the PUC-EIM Task Force may want to explore further as it considers the benefits of EIM implementation.

3. Description of the EIM design for which the ISO is providing cost estimates

The ISO believes that the essential elements of the PUC-EIM straw proposal could be implemented through limited adaptations of the ISO's real-time market functionality, without significant cost exposure to potential EIM participants. The ISO's recommended approach would be to utilize existing real-time optimization processes for the EIM that have been refined through experience running the existing ISO real-time energy market. This approach would most efficiently utilize all of the flexible resources available for managing changes in the region's balance of supply and demand, and would achieve the closest possible seams coordination between participating market areas and non-participating balancing authorities. It would also avoid the need to construct a new market platform, taking advantage of the resources spent to design and implement the ISO's new market and offering an opportunity for others in the west to use all the services contemplated in the EIM design.

The EIM would utilize only those design features of the existing ISO market functionality needed to accomplish the requirements of the EIM. Under the approach described below, EIM participants would:

- Maintain complete responsibility for serving their load with their own resources and bilateral purchases from other market participants, or with purchases from the EIM.
- Retain control of physical scheduling rights on their own transmission system. The current ISO market already includes features that recognize existing rights and respect curtailment priorities in case of infeasible operating conditions, which can be adapted to scheduling in the EIM footprint.
- Maintain responsibility for their own ancillary services procurement and deployment, without the ISO procuring ancillary services to meet requirements in the EIM footprint.
- Use existing internet-based bid submission system also used by ISO market participants to submit real-time economic energy bids (price-quantity curves) for self-committed resources, or self-scheduled output levels for self-committed resources whose output levels will not be subject to EIM dispatch.
- Receive dispatch instructions for those resources that submit economic energy bids (price-quantity curves) through the ISO's real-time market optimization.
- Utilize the ISO's settlement system for financial settlement of participating resources' real-time deviations from their schedules. For resources whose real-time deviations reflect their responses to EIM dispatch instructions, settlement would be at locational prices that are at least as favorable as their submitted offer prices. EIM energy and the associated settlement would be zero for resources whose actual energy deliveries equal their submitted schedules. In this way, resources operating in fulfillment of bilateral contracts, for example, would not impose imbalance energy requirements on the real-time market and therefore would not be subject to any real-time settlement.

- Benefit from established market monitoring and market power mitigation measures including mitigation of bid prices for resources that are necessary for relieving congestion and a "safety-net" cap and floor. The ISO performs these functions and relies on an independent Market Surveillance Committee to ensure an efficient market design.

In the PUC-EIM straw proposal, transmission customers must replace losses owed to transmission owners, separately from the EIM settlement. The ISO can support this aspect of the PUC-EIM straw proposal even though the ISO market's locational prices and settlements typically include marginal losses instead of settlements for physical MW losses. The existing ISO market excludes losses when the losses are settled bilaterally, and in some situations, settles MW losses with transmission providers rather than including the marginal losses in market prices, due to contractual provisions. We can continue that approach for all EIM participants preferring it that way. Alternatively each EIM participant can opt to use existing ISO approach based on marginal losses and full AC representation of transmission network.

4. Cost estimate and description of cost components

The essential elements of the PUC-EIM straw proposal could be implemented through limited adaptations of the ISO's real-time market functionality, without significant cost exposure to potential EIM participants. The ISO's market functionality is established and adaptable and, in addition, the ISO's grid management charge is designed to allocate costs of participation based on principles of cost causation and ISO services utilization. Thus, the marginal costs that would be borne by participants in an EIM administered by the ISO would be attributable to the utilization only of applicable market services and system operations functionality. In other words, the per-MWh EIM rate would only include the initiation costs and the costs of services and functionality that are needed by EIM participants at this time.

In proceeding with this high-level cost estimate the ISO assumed that 10% of the total demand in the EIM footprint would participate. The rest would be self-scheduled or procured via bilateral contracts. These estimates include the net annual demand in the WECC region for 2009, excluding the ISO load, of about 615 Terawatt-hours (615 million Megawatt-hours). However, estimates below are constructed as incremental costs, which is to say that they are readily scalable based on the actual volumes of participation in the EIM. We can accommodate a phased approach in which an EIM could be launched with the participation of only a subset of WECC balancing authorities. In formulating the cost estimate for the ISO to establish and run an EIM for balancing authority areas in the Western Interconnection, the following additional assumptions were made:

- The ISO would leverage its existing market and dispatch systems to provide the EIM platform.
- The ISO's existing grid management charge structure would enable EIM participants to be charged a marginal rate based on services and functionality associated only with the EIM.[5]

[5] Details on the ISO GMC structure are available in Appendix F, Schedule 1 of the ISO Tariff which is available at the following link: http://www.caiso.com/Documents/08%20_AppendicesC-F_2011-12-01.pdf.

- Operating costs are estimated to increase and this increase is included in the revenue requirement and grid management charge rate calculations. Initial capital costs, extension of software licenses, and hardware costs are factored into the one-time charge noted below.

Based on the above assumptions, the ISO estimates that the following charges would be incurred by participants in a new EIM administered by the ISO. Each of these charges is based directly on the ISO's existing grid management charge structure and rates:

- The rate that reflects the EIM use of the ISO market services and operating systems are estimated to be $0.19 per MWh participating in the real-time EIM.
- Each scheduling coordinator in the EIM market would be assessed the same $1,000 per month borne by current ISO market participants.[6]
- As is the case for current ISO market participants, participants in the EIM would incur a charge of $0.005 per-bid segment.
- Telecommunications charges. These charges are payable directly by participants and vary between $3,000 and $100,000 for installation, and generally cost $500 per month on an ongoing basis.[7]

In addition to the charges described above which, as noted above, parallel those incurred by participants in the existing ISO market, the ISO would recommend a one-time charge to join the EIM. The ISO estimates this charge to be approximately $0.03 per MWh times the annual net energy for load reported to WECC for 2009.

In short, the ISO estimates that, after an initial fee to join the EIM, balancing authorities participating in an EIM administered by the ISO would pay a per-MWh grid management charge utilizing only elements of the existing functionality that are relevant to the EIM.

Furthermore, the ISO notes that growth in participation in the EIM would reduce this rate, not only for participants in the EIM itself, but also for participants in the ISO market as it exists today.

5. Additional EIM design considerations

In some areas, the PUC-EIM straw proposal's details differ from the market design that the ISO would recommend based on its experience as a market operator. The ISO's assumption in providing its cost estimate is that it would offer its services for the EIM footprint as outlined in the PUC-EIM straw proposal with the exception of several alternative optional design elements, described below, that offer a potentially more effective design for EIM's real-time energy market. Since these alternatives are based on the ISO's existing market functionality, their inclusion would not increase the costs of EIM implementation if used similarly to their function in the existing ISO market structure.[8]

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6 Existing CAISO market participants would not incur additional monthly scheduling coordinator charges.

7 Existing CAISO market participants would not incur additional telecommunications charges.

8 Although the EIM design is not currently anticipated to include a flexibility reserve or capacity market, the ISO has implemented a flexible ramping capacity constraint in the real-time market, and a current ISO stakeholder process is developing mechanisms for a flexible reserve market product.

These areas include:

- Improved congestion management process: In the PUC-EIM straw proposal, the market operator activates a transmission constraint to dispatch available resources when congestion occurs in real-time, and uses a curtailment and adjustment tool to curtail existing schedules, but the EIM market dispatch will not provide counter-flows to support curtailed schedules. The ISO's market software is able to automatically enforce constraints before they reach critical levels. This improves congestion management and would ensure that EIM's dispatch itself would not cause constraints to be violated, which would need to be followed by corrective action in future dispatch intervals. This approach would also allow the market dispatch to provide counter-flows when bilateral schedules would cause congestion, which can minimize the chance that the bilateral schedules would need to be curtailed. This process is known as "security-constrained economic dispatch."
- Managing schedule priorities, within reasonable pricing: In the event that available economic bids are not adequate to resolve congestion using security-constrained economic dispatch, the ISO's process enables automatic adjustments of self-schedules to achieve a feasible system dispatch, while maintaining relative curtailment priorities among the self-schedules. The adjustments alert operators to the possibility that they should initiate schedule adjustments. In the context of EIM, these schedule adjustments could be the trigger to implement the unscheduled flow mitigation plan or other adjustments through the enhanced curtailment calculator.
- Forward looking awareness of congestion: After execution of its day-ahead market, the ISO executes look-ahead evaluations of day-ahead market outcomes for the two following days, which among other things gives the ISO advance warning of anticipated conditions such as congestion that need analysis by operations engineers, particularly in the presence of current and planned outages. This forward-looking situational awareness exceeds what could be observed simply by comparing the balance of supply and demand through resource plans, as included in the PUC-EIM straw proposal. If market participants can be informed that congestion is anticipated, they would be able to adjust their final resource plan submissions before being exposed to the congestion.
- Coordination between market areas: The PUC-EIM straw proposal addresses seams coordination with other markets as part of the congestion management process after transmission loading has approached critical levels. The ISO would similarly be able to wait until congestion is imminent before acting to relieve the congestion through seams coordination, but including the dispatch of the EIM market in the same optimization as the ISO's own market dispatch would provide the closest possible interaction between these market areas.
- Forward-looking dispatch for smooth ramping: The PUC-EIM straw proposal limits its dispatch horizon to a single 5-minute dispatch interval. The ISO's security constrained economic dispatch in the real-time energy market optimizes five-minute intervals over a one-hour time horizon. The dispatch for the first 5-minute interval is binding, while the subsequent intervals produce advisory dispatches that enable the ISO to smoothly ramp resources to meet future system needs for energy balance and congestion management, and to avoid real-time price spikes. This approach is proven to work well in other ISOs throughout the United States and is planned for the new SPP market as well.

- Improved management of intermittent resources: The dispatch instructions sent by the ISO utilize the most recent schedule and dispatch as the instructed operating point. However, out of recognition that non-dispatchable, intermittent resources are often not able to operate at their scheduled levels, the ISO's market system automatically makes adjustments to project the output of intermittent resources that are deviating from their schedules and optimizes accordingly. This combination of dispatch instructions for resources to return to their schedules, and internal adjustments to reflect their projected actual output, improves the ISO's management of its system energy balance, and enhances the ISO's congestion management for future dispatch intervals. Given the high penetration of intermittent resources in the ISO balancing authority area, and the expected increase in the need to reliably integrate these resources in the future, the ISO continues to develop new forecasting and optimization techniques.
- Integration of WECC-wide state estimator with market dispatch: As in the PUC-EIM straw proposal, the real-time market includes the energy management system state estimator power flow solution as one source of inputs that provides a current solution to the market every minute. The ISO's existing state estimator covers the entire WECC region down to 220 kV (lower voltages in some areas, depending on available data). The ISO's state estimator exchanges real-time data with the WECC reliability coordinator, and is able to select which data source to utilize in different areas of the WECC grid, depending on each state estimator's quality of solution.
- Contingency dispatch to reduce manual dispatch: The PUC-EIM straw proposal includes manually issuing dispatches if necessary for reliability reasons to resolve conditions that security-constrained economic dispatch cannot resolve. In addition to its ability to manually issue "exceptional dispatches," the ISO's security-constrained economic dispatch has a contingency dispatch mode that can be used to quickly address emergency situations before the next 5-minute dispatch interval, while continuing to determine dispatches through market optimization.
- Improved incentives for response to dispatches: If desired by EIM market participants, the ISO would be able to use a hybrid approach, similar to the ISO's settlement of dynamic schedules. The ISO uses the hourly integrated MWh of energy from the dynamic schedule's final e-tag (updated shortly after the end of the operating hour), and distributes the hourly total to the 10-minute settlement intervals using telemetry data from the generator. This process could be adapted to use with hourly settlement intervals, in which each resource would have a resource-specific LIP that is a weighted average of its 5-minute dispatch interval prices, provided that market participants are aware that their response by dispatch interval will affect the LIP used in their settlements.
- Efficient design to reduce need for uninstructed deviation charges: The PUC-EIM straw proposal would assess uninstructed deviation charges to any resource that operates outside a tolerance band around its schedule or dispatch. The ISO tariff contains provisions for uninstructed deviation charges that could be activated if required to maintain reliable operations. However, the overall structure of the ISO market, including 10-minute settlement intervals for real-time energy, has supported reliable operations that have not required these provisions to be activated.
- Marginal losses for market efficiency and reduced cost: In the PUC-EIM straw proposal, security-constrained economic dispatch does not account for losses between resources and loads when calculating dispatch instructions, and transmission customers must replace losses owed to

transmission owners. The ISO could exclude losses from EIM operation if desired, but more efficient market operation can be achieved by including marginal losses in the market dispatch and pricing. Considering marginal losses in the market optimization would allow the market to minimize losses if this is supported by the available bids.

- Enhanced modeling of physical generation characteristics: Resource characteristics recognized in the PUC-EIM straw proposal are generally also recognized in the ISO's market systems. Additionally, the ISO's market systems recognize environmental factors using daily maximum energy limits, forbidden zones, and multiple operating configurations.

The ISO appreciates the opportunity to provide these inputs to the PUC-EIM energy imbalance market initiative, and remains poised to assist the Task Force and its members.

APPENDICES

Appendix 1: Comparison of Major EIM Functional Areas

Appendix 2: Sources of Additional Documentation

Appendix 1: Comparison of Major EIM Functional Areas

1. Overview of EIM design

The EIM is an imbalance energy-only market, and does not procure capacity or ancillary services (AS). When a balancing authority (BA) participates, all market participants with loads and/or resources in its BAA are eligible to submit offers to the market and are subject to real-time energy settlement. Each market participant remains responsible for serving its own load at all times, by operating self-scheduled resources, scheduling energy from third parties, and/or offering its resources to the market. BAs remain responsible for balancing load and resources within their areas. Daily and hourly processes notify market participants of their ancillary service (AS) obligations and hourly load forecast, and review load forecasts and resource plans to assess resource and AS adequacy throughout the market region. Market participants determine the availability of their resources, and EIM does not determine unit commitment.

Security constrained economic dispatch (SCED) determines the lowest cost of energy that can be delivered to each location considering the submitted offers, transmission limitations, and system topology; dispatches resources; and calculates locational incremental prices (LIPs). In the PUC-EIM straw proposal, the market operator activates a transmission constraint to dispatch available resources when congestion occurs in real-time, and uses a curtailment/adjustment tool to curtail existing schedules, but the EIM market dispatch will not provide counter-flows to support curtailed schedules. A BA may initiate operation of the WECC Unscheduled Flow Mitigation Procedure (UFMP) to curtail tags outside the market. The PUC-EIM straw proposal addresses seams coordination with other markets as part of this congestion management process. In the PUC-EIM straw proposal, SCED does not account for losses between resources and loads when calculating dispatch instructions, and transmission customers must replace losses owed to transmission owners.

Settlements are nodal for resources, but may be zonal or nodal for load. In the PUC-EIM straw proposal, the hourly LIP is the simple average from dispatch interval LIPs during the hour, and is available 15 minutes after the end of the hour. Imbalance energy is the difference between scheduled and actual MWh. When schedules equal actual deliveries, EIM energy and settlement are zero. In addition to the imbalance energy settlement, the PUC-EIM straw proposal would assess uninstructed deviation charges to any resource that operates outside a tolerance band around its schedule or dispatch. Intermittent resources whose actual output is difficult to predict would not be subject to uninstructed deviation charges.

Deployment of reserves would settle as bilateral transactions. A reserve sharing group may include members that do not participate in EIM. When bilateral schedules for reserve sharing cross the EIM boundary, the net scheduled interchange for the EIM area has a corresponding adjustment.

Market monitoring protects consumers and ensures an efficient market design. A cap limits prices for resources that can relieve a constraint when it is binding, and there is a "safety-net" cap and floor.

2. Details of EIM design

The following discussion and comparison table supplements the summary above by providing more detailed descriptions of major functional areas that would comprise the EIM, and comparing the PUC-EIM straw proposal to the market design that the ISO can offer. The ISO has tried to accurately

summarize the PUC-EIM straw proposal as prepared by SPP, but in case of errors in summarizing the straw proposal, that document in available on the PUC-EIM web site.

In presenting this comparison of design details, the ISO suggests that WECC's September 2011 white paper, titled "Energy Imbalance Market Functional Specification," is a useful foundation for describing the design principles for the EIM. This comparison summarizes WECC's EIM functional specification and the specific implementation illustrated in the PUC-EIM straw proposal, and then briefly describes the similarity of the ISO's functions. The comparison to the ISO's market functions focuses on the real-time energy market, as it could be available to EIM participants who do not use the remainder of the ISO market functions. The ISO market includes extensive functionality for other aspects of market operations, which are described in the ISO's Business Practice Manuals (listed in Appendix 2).

Certain functions that are described in WECC's Energy Imbalance Market Functional Specification are inherent to any market operator. Examples are:

- Coordinate, operate and administer market,
- Facilitate stakeholder discussions, including development of detailed market design and market rules, negotiation of detailed roles and responsibilities, development of appropriate business practice manuals, procurement/ operation/ maintenance of market software and financial settlement process,
- Develop and file contract and/or tariff,
- Maintain seams coordination, and
- Coordinate with reliability and market entities.

Business systems and processes that support these functions, which are not discussed in the PUC-EIM straw proposal in detail to allow comparison to the ISO's functions, include:

- Control Center and Operations: The market operator's control center and data center provides 24/7 market operations to accommodate the staff, systems, and infrastructure necessary to operate the market, provide visibility of market characteristics, and process and store all market data. Requirements include high availability, redundant power supply and data connections, security in compliance with Critical Infrastructure Protection standards, and business continuity and disaster recovery, including primary and backup control centers.

  The operations staff is responsible for operating the market, analyzing market results, making operational decisions, and coordinating with appropriate entities in real-time (24/7). EMS Engineers procure the EMS, develop displays, and maintain EMS in real-time. Market Engineers procure market software (including SCED), maintain it and the network and commercial models in real-time, and support the operations staff.

- Credit Management System: The credit management system monitors the credit worthiness of market participants (e.g., generator operators and load-serving entities) in accordance with market rules, identifies any credit issues that arise, and links to SCED to enforce any credit restrictions, as well as to settlement software and accounting software.

- Customer Relationship Management Software: This software provides customer contact information, customer contact history, and customer issue management, through a portal for stakeholders to submit and follow-up on issues, concerns, and questions regarding market results, settlement results, or other concerns.

- Office Functions: The market operator includes several office functions, including regulatory administration, market analysis, settlements, accounting, credit management, customer support, information technology, and training.

These are established functions within the ISO, and would be available for running the EIM market.

In addition, market operation includes user interfaces and data links with market participants, and interface with other tools. The market operator and other entities (Enhanced Curtailment Calculator (ECC), reserve-sharing groups, balancing authorities, other market operators, etc.) exchange and transfer data, and user interfaces and data links provide user-specific validation and security to ensure that only authorized users could submit data and offers, or download confidential data. These ISO systems would also be available for running the EIM market, and are documented in detail in the Business Practice Manuals listed in Appendix 2.

Comparison of Major EIM Functional Areas

WECC White Paper	PUC-EIM Straw Proposal version 0.d, prepared by SPP	Comparison to ISO market functions
Energy Imbalance Market: EIM performs centralized, automated, region-wide, sub-hourly, real-time generation dispatch. EIM optimizes dispatch subject to real-time generation capabilities and transmission constraints based on actual flows, and produce prices. It does not replace the current bilateral energy market, become a transmission provider, or implement an ISO/RTO with consolidated regional tariff. EIM relies on ECC for curtailment responsibility for scheduled use, and will receive schedule changes from ECC that EIM must account for in its dispatch and settlements.	This is an imbalance energy-only market and does not supersede any market participant's obligations with respect to any other capacity or ancillary service (AS). The responsibilities in regards to capacity adequacy, reserves, and other reliability-based concerns do not change as a result of this market. All market participants with loads and/or resources will be subject to EIM under this market. All participants must register with the market. Entities wishing to provide imbalance energy will submit offers to the market. Each market participant must provide sufficient energy to serve its obligations at all times, by scheduling energy from third parties, operating its self-scheduled resources at scheduled MW levels, and/or offering its resources to the market with sufficient dispatchable operating range that they can serve its obligations at all times. Market participants must satisfy their AS obligations by submitting a plan demonstrating their requirements are being met.	Although the ISO's full market design includes functionality going significantly beyond the real-time energy market, market participants in the EIM market would participate similarly to the straw proposal: • Submit self-schedules, bilateral trades, and/or real-time energy bids for self-committed resources, • Receive dispatches through SCED's market optimization, at LIPs that are at least as favorable as the submitted offers, • Maintain responsibility for serving their load with their own resources and/or bilateral purchases from other market participants or purchases from the overall market (assuming they have met obligations to schedule or bid into the market as the straw proposal requires), and • Maintain responsibility for AS procurement and deployment, without the ISO procuring AS to meet requirements in the EIM footprint.
Scheduling: Schedules made prior to real-time include both bilateral interchange schedule and intra-BA native load schedules. Similarly, intra-hour schedules may be transacted bilaterally. Bilateral scheduling	All loads and resources are located at registered settlement locations. A day-ahead process notifies market participants of the next day's AS obligations	Scheduling in the ISO real-time energy market would be similar to the straw proposal. The ISO presents demand forecasts, and receives schedules and bids, from its day-ahead market participants up to 7 days in advance. This

prior to real-time will continue to be processed the same way as it is without the EIM, subject to tagging requirements for inter-BA schedules. The WECC Interchange Tool (WIT) contains all tagged schedules and may be able to provide data to or perform duties of the EIM scheduling system, but the WIT does not currently include all intra-BA native load schedules. The scheduling system includes a mechanism to receive tagged schedules, a mechanism for market participants to enter native load schedules, and a data link to SCED, settlements software, and ECC. Resource plans submitted to the market operator will include tagged schedules, native load schedules, unit commitment, and a showing of sufficient resources to cover load and reserve obligations (including contingency, regulating, and flexibility reserves). These resources must be either scheduled or offered into the market by the party with load responsibility. The timing requirements for submission of resource plans, and types of data and format, will be addressed during detailed market design.	and hourly load forecast for the next 7 days. Market participants then submit 7-day load forecasts, resource plans, and AS plans, the market operator informs market participants of imbalances or mismatches, and updates are submitted and reviewed. The resource plan enables the market operator to assess resource and AS adequacy for the EIM region, each BAA in the EIM footprint, and each market participant. Schedules do not have to include all load for which the market participant is responsible, but the energy withdrawn and the energy received must match for each hour. However, market participants will not be paid (due to under-scheduling) for providing counterflow when serving their firm energy obligations, and market participants will not be allowed to profit from submitting schedules in excess of their firm energy obligations. Market participants that do not schedule load accurately may be subject to disgorgement of profits through a process described in the straw proposal. Balancing authorities remain responsible for the balance of load and resources within their areas. Offer curves and energy schedules may be submitted between 7 days and 45 minutes before the start of an operating hour. Tagged schedules are submitted at least 30 minutes before the start of the schedule and approved at least 20 minutes prior. Native load	general process could receive the data described in the straw proposal's day-ahead process. In addition, after execution of its day-ahead market, the ISO executes look-ahead evaluations of day-ahead market outcomes for the two following days, which among other things gives the ISO advance warning of anticipated conditions that need analysis by operations engineers. This forward-looking situational awareness exceeds what could be observed simply by comparing the balance of supply and demand. The ISO market as a whole contains several incentives for accurate scheduling in advance of the operating day. The ISO recommends that appropriate incentives for accurate scheduling before the operating day, in the context of the EIM market, should be a topic of EIM stakeholder discussion. Disgorgement of profits from inaccurate scheduling is one workable approach, but is not the only possibility.

	schedules are between resources and loads registered by the same transmission customer in the same BAA, are submitted at least 20 minutes before the start of the schedules, and automatically approved subject to rules listed in the straw proposal.	
Energy Imbalance: Difference between Scheduled Energy (tagged and native load schedules) and Actual Energy (based on metered data). EIM responds to traditional causes of Energy Imbalance (forced outages or derates, changes in variable generation output, and load forecast error), and redispatches the system to take advantage of efficiencies available on the system. EIM would dispatch a generator to a value other than its Scheduled Energy only if: (1) the generator operator submits an offer to the market, making the generator available for dispatch, and (2) market conditions support the dispatch (dispatched up if LIP is greater than the offer price, or down if LIP is less than the offer price).	Energy schedules are classified, depending on the status submitted in the resource plan, as a self-scheduled resource (physical schedule) or offer into the market for dispatch (market schedule), or a settlement location for load. If a resource has both a schedule and an offer, the dispatch system will calculate a dispatch instruction based on the offer price and resource plan. In this case the energy schedule will be considered a market schedule for market settlement, and the dispatch will be driven by its offer. A self-scheduled resource (physical schedule) will be expected to physically operate to its schedule.	As described in the straw proposal, a resource may have a self-schedule, submit economic bids to supply real-time imbalance energy, or both (a self-schedule with additional capacity offered for economic dispatch). The ISO's real-time economic dispatch optimally responds to changes in the system energy balance, within complex combinations of transmission constraints (thermal MVAr limits, MW flows on transmission corridors, nomograms, and constraints resulting from contingency power flow analyses), while recognizing the physical limitations of supply resources.
Security Constrained Economic Dispatch (SCED): SCED uses a linear programming optimization model to develop the dispatch and price solution by minimizing total production cost, based on available bids, subject to several constraints including maintaining system energy balance and staying within generation and transmission limits.	SCED determines the lowest cost increment of energy that can be delivered to each location considering the submitted offers, transmission limitations and system topology. EIM dispatch instructions will be calculated for dispatchable resources, and LIPs will be calculated for each settlement location on the system. Before the start of a dispatch interval, SCED sends dispatch instructions to every resource	The SCED optimization as described in WECC's Energy Imbalance Market Functional Specification is a common function among market operators. The ISO's SCED produces dispatches and prices every 5 minutes by minimizing total production cost, based on available bids, subject to several constraints including maintaining system energy balance and

The SCED algorithm produces dispatch and price every 5 minutes, based on energy needs, generator characteristics, transmission characteristics, and market rules. Considering all of these system characteristics, the SCED would develop the least cost, most feasible, and deliverable dispatch of the system to meet energy needs.

SCED includes a short-term load forecast and mechanism for estimating non-dispatchable resource outputs. The system energy need is the difference between 1) the load forecast and 2) the sum of the non-dispatchable resource outputs, self-scheduled resource outputs, and net scheduled system-wide import for the five-minute dispatch interval.

Generator characteristics include current output, physical considerations, market rules, and economic offers. SCED only dispatches to an output that is achievable in the 5-minute dispatch interval. If no economic offer was made, the generator is self-scheduled.

The main transmission characteristic is actual physical availability, from EMS, calculated with each solution taking into account changes in transmission topology and actual generation dispatch and load.

SCED will also consider market rules (such as seams coordination) or reserve sharing in determining feasibility of dispatch.

SCED will produce a LIP for every generator in the market footprint for every interval, as the MW set point to be reached at the end of the dispatch interval. (The straw proposal prepared by SPP uses its terminology, "deployment interval". This comparison uses the synonymous term "dispatch interval" for consistency with WECC's white paper.) The components of dispatch instructions are resource name, resource type, date, interval ending time, dispatch type (EIM or other), MW set-point, and price. For jointly owned resources, the dispatch instruction is an aggregate representing the total of all co-owners' dispatches, consisting of resource name per each co-owner's registration, and MW set-point.

Balancing authorities receive their net scheduled interchange every 4 seconds.

LIPs for each operating hour are available 15 minutes after the end of the operating hour.

Except in emergency conditions, the market operator will initiate a Congestion Management Event (CME) when a constraint is observed in real-time, to activate the constraint. The CME will cause dispatchable resources to be deployed to provide appropriate reduction in flows to relieve the constraint. In conjunction with the constraint activation, the market operator's Curtailment Adjustment Tool (CAT) will manage curtailments of energy schedules. During a CME, EIM impacts in a particular priority will

staying within generation and transmission limits. Key inputs include a short-term load forecast and mechanism for estimating non-dispatchable resource outputs, as well as available energy supply bids and self-schedules. Other key inputs in the ISO's SCED include real-time updates of transmission and generation outages (as well as expected outages in future dispatch intervals), and the detailed status of grid conditions from EMS state estimator solutions that are transferred every minute to the real-time market system. The ISO's market system recognizes that non-dispatchable resources will not necessarily operate at their scheduled levels, and automatically makes internal adjustments to project the output of resources that are deviating from their schedules as well as variable resources that are unable to maintain specific schedules. The dispatch instructions sent by the ISO continue, though, to show the most recent schedule and dispatch as the instructed operating point. This combination of dispatch instructions and internal adjustments to projected output improves the ISO's management of its system energy balance.

The ISO's SCED publishes locational prices for imbalance energy 2.5 minutes before the start of each dispatch interval, along with the dispatch operating targets at the middle of the next 5-minute interval. (The ISO's

node and every load zone, and dispatch signal for each generator node, every five minutes. SCED's functions are described in further detail in section 6.2 of WECC's 9/8/2011 EIM Functional Specification.	be removed before curtailing any existing schedules with higher priority. Since the current market operator market structure provides no mechanism to directly assign the cost associated with relieving congestion to the schedules impacting a particular constrained flowgate, the CAT curtails or adjusts schedules to achieve a relieving impact equal to the amount of energy imbalance supporting scheduled flows. The result of such curtailment procedure will be that flows resulting from the EIM market dispatch will not provide counter-flows to support schedule flows that are to be curtailed as described earlier. A BA will initiate operation of the WECC Unscheduled Flow Mitigation Procedure (UFMP) if applicable. The UFMP will prescribe curtailments of those tags that are not included in market flows. The market operator will prescribe curtailment of market flows, and activate or continue activation of the constraint in the market system. CAT will receive the market flow relief obligation from the market operator and curtail/adjust those schedules included in EIM market flow. LIPs will not be updated after a schedule curtailment until those curtailments are recognized in the market dispatch. Schedule adjustments would be affected by a Congestion Management Process (CMP) prescribed by a Joint Operating Agreement, by	terminology is "locational marginal price", or LMP. This document uses the synonymous term "LIP" for consistency with WECC's white paper.) In addition to including the cost of congestion, the ISO's LIPs include the impact of marginal losses on the overall system, so that the cost of losses is considered in the market optimization. The ISO's SCED has the capability of leaving transmission constraints unenforced until an actual flow reaches critical levels, at which time a constraint can be activated. There are rare examples of using this mechanism, in cases where constraints are significantly affected by sources and sinks outside the ISO grid that cannot be modeled due to lack of real-time data. However, the ISO achieves better management of transmission constraints by allowing its market software to automatically activate constraints when modeled flows reach critical levels, with no need to initiate a "congestion management event". Thus, available resources are automatically dispatched to manage congestion. LIPs include congestion costs, which increase LIPs on the importing side of a constraint (typically dominated by net demand) and the exporting side (typically dominated by net supply). Market settlements using these LIPs ensure that there is an adequate source of revenue to pay for the re-dispatch that is necessary to manage

	which the market operator will determine its market flows on Coordinated Flowgates (CFs) and Reciprocal Coordinated Flowgates (RCFs), which are flowgates identified as being impacted by activities within EIM and one or more entities operating under the requirements similar to those of the CMP. The market operator would establish firm flow limits and schedule priorities of its market flows. At least every 15 minutes, the market operator will send market flow values for all CFs and RCFs to the BA in the appropriate priority levels for the current hour and next hour. During a Congestion Management Event, the UFMP will use this information to prescribe appropriate reductions in market flows and curtailments of tags whose impacts are not reflected in market flows. Market operator systems will identify market flows that must be curtailed to achieve any obligation assigned by the UFMP by binding of the constraint in SCED. Additional details concerning this process are described in the straw proposal. SCED's optimization is limited by the system conditions determined by the state estimator program, resource parameters provided in resource and AS plans, energy offer curves, and activated transmission constraints. In certain situations, enforcing all such limiting factors may not result in a feasible solution, and the market operator applies a Violation	congestion. Thus, the market's dispatch is generally able to provide counterflow if self-schedules by themselves would cause congestion and adequate economic bids are available. This market design minimizes the curtailments of bilateral schedules and other self-schedules that could otherwise be necessary. In the event that available economic bids are not adequate to resolve congestion using the ISO's SCED, BAs would be able to use WECC's UFMP as they would in the straw proposal. This document assumes that WECC's ECC tool will be available at the time the EIM is implemented, which would be responsible for determining schedule curtailments when EIM does not have adequate economic bids to manage congestion. If this were not to occur, the ISO's SCED assigns "uneconomic bid" prices to self-schedules based on their level of scheduling priority. The ISO SCED's use of "uneconomic bids" determines any necessary adjustments to self-schedules in a "scheduling run" to achieve a feasible system dispatch, and then freezes the adjusted schedules and moderates the "uneconomic bid" prices to produce reasonable final market prices. The use of "uneconomic bid" prices that maintain relative priorities among self-schedules is coordinated with violation relaxation limits (VRLs) similar to those described in the straw proposal, but with

	Relaxation Limit (VRL) to obtain a feasible solution and limit the binding constraint's shadow price. The VRL value indicates the relative priority for a type of constraint, such as relaxing flowgate constraints before ramp rate constraints. VRLs include operational constraints (flowgate constraints, etc.), resource ramp rate limits, market balance (generation to load), and maximum/minimum resource capacity. When a limit is reached but not exceeded, it is referred to as "binding", and in this state, VRLs are not applicable. The market operator, in coordination with a BA, may dispatch any resource through manual processes when necessary to resolve emergency conditions that the EIM market cannot resolve through SCED.	refinements that coordinate the relaxation of transmission constraints with self-schedule adjustments in the "scheduling run", and then moderating the pricing results resulting from the "pricing run". The ISO has previously discussed a straw proposal for seams coordination[1] at the 11/15/2010 WECC Seams Issues Subcommittee meeting and 3/7-8/2011 EIM Crossroads meeting. This paper identified distinctions between SPP's Congestion Management Process and needs for seams coordination in the western interconnection, and proposed mechanisms that may be more suitable. The ISO remains open to further discussion of its straw proposal, but notes here that even closer coordination between could be achieved if the real-time dispatch of EIM and the existing ISO real-time market were determined in the same optimization process. If necessary for reliability reasons to resolve conditions that SCED cannot resolve, the ISO has the ability to manually issue "exceptional dispatches". In addition, SCED has a contingency dispatch mode that can be used to quickly address emergency situations while continuing to determine dispatches through

[1] Available at http://www.wecc.biz/committees/StandingCommittees/MIC/SIS/SIS111510/Lists/Exhibits/1/WECC_SIS_EIM_MarketCoordination_20101109_final.doc

		market optimization.
Physical Considerations: Market design must include a description of the physical characteristics that must be submitted with offers of availability of generation, including economic and emergency minimum and maximum loadings, and ramp rates. These loadings and ramp rates do not necessarily need to reflect the operational limits on the generation, but rather the limits that should be imposed within the market, such as forbidden zones (e.g., mill points), duct burning zones, combined cycle characteristics, or environmental constraints (such as for hydropower units). Additional physical characteristics may also be necessary for demand response resources. As market design continues, it must be noted that while adding these additional characteristics may make the market dispatch more accurate and more accessible to non-thermal resources, they also make the algorithm more complicated, customized, and costly.	The resource plan submitted by market participants for each resource for each hour of the 7-day horizon includes resource type, planned MW, minimum operating limit, minimum economic operating limit, minimum emergency operating limit, maximum operating limit, maximum economic operating limit, maximum emergency operating limit, and ramp rate (up to 10 segments). The sum of schedules from a self-scheduled resource shall not exceed its capacity submitted in the resource plan for any settlement interval.	The types of resource characteristics recognized in the straw proposal are generally also recognized in the ISO's market systems. The ISO's market systems also recognize additional physical constraints that are listed in the WECC's EIM Functional Specification, including environmental factors using daily maximum energy limits, and forbidden zones in which a resource cannot maintain a stable dispatch operating point but through which the resource can pass to reach a different feasible operating range. The ISO's design for the real-time market also includes modeling of multi-state generation, such as combined-cycle generator, which optimizes the transition between feasible operating states (e.g., one combustion turbine plus a steam turbine, transitioning to two combustion turbines plus the steam turbine) and recognizes each configuration's physical characteristics and different operating costs (which translate into bid prices).
Economic Offers: Economic offers of generation are optional, are offered on an hourly basis, and include at least two parameters: offer status for market dispatch, and price. Status types may include: • Available: able to be dispatched by the market, within defined limits, based on economic prices. • Self-schedule: dispatched solely from its	EIM offers are submitted for each resource participating in the EIM market. These offers are tied to the settlement location at which the resource is located. The resource plan submitted by market participants for each resource for each hour of the 7-day horizon includes the resource status: available, available quick start (off line, available, capable of reaching the dispatch	Like the straw proposal, bids are submitted in the ISO for each resource at its own location, for each hour of the operating day. Resources are considered self-committed in a particular hour if they submit a self-schedule for energy greater than zero. To the extent that resources have characteristics that do not vary from day to day (e.g., being quick-start, being variable energy resources that cannot

bilateral and native load schedules, not deviating based on price. • Offline: unavailable to the market, resulting in a dispatch of zero. • Manual: dispatched as an echo of the current loading, for generators that are in start-up or maintenance or for variable generation or dynamically scheduled generation. • Supplemental: offline but quick-start capable. Special offer parameters and statuses may be necessary for non-conventional resources such as hydro, demand response, or variable generation. Offer prices ($/megawatt-hour) may identify an offer curve with multiple MW-Price pairs, or simple INC and DEC offer prices, depending on developing the detailed market design. Certain rules may be necessary to simplify dispatch calculations, such as the price per MWh not decreasing as the MW value increases.	instruction), unavailable, supplemental (offline, available for supplemental reserve requirement, not dispatched by EIM), self-scheduled, intermittent (uncontrollable output), startup/shutdown (online, unable to follow dispatch due to changing status), testing (online, unable to follow dispatch due to testing), qualified cogeneration (online, unable to follow dispatch due to PURPA obligations), exigent conditions (online, unable to follow dispatch due to changes in resource conditions, available only via market operator override). Market participants must keep the data current during the operating day. The market operator will utilize the planned MW to assist with determining whether a resource is in start-up or shut-down mode. If a resource is on and unavailable to the market, it is considered a self-scheduled resource, dispatched only in a system emergency through an "out of merit energy" dispatch instruction. The offer curve allows resources to offer up to 10 monotonically increasing pairs of MW points and prices. Prices may be positive or negative, and are subject to an offer cap and floor. The set of price points are the beginning and ending values for calculating a linear slope for each set of beginning and ending values. Each MW between two price points has a different price due to the	be dispatched, or serving cogeneration), the ISO records these characteristics in its master file, and it is not necessary to submit these characteristics in market bids. If a resource is unavailable due to an outage or derates, the ISO's outage tracking system provides more detailed information than could be provided in market bids. A difference between the straw proposal and the ISO's existing market design is that bid curves consist of 10 segments with a constant bid price within each segment, rather than linear slopes between bid points. If it is important in the EIM design to use linear slopes between bid points, this bid characteristic can be explored.

	interpolation of the submitted price points. The first price point corresponds to the zero MW loading level regardless of whether the unit can operate at that level. The last price point on the offer curve is used between that point and the maximum capacity.	
Special Considerations: Other considerations that may play a part in calculating dispatch include seams coordination, consideration of credit, scarcity pricing, and price caps. Seams coordination may include special considerations in the SCED that allow for the coordination of pricing and flow assumptions between the EIM footprint and other organized markets (ISO and AESO), as well as coordination of schedules and flows with non-market areas. Credit considerations may be important in rare cases to prevent the market from forcing participants into transactions exceeding their available credit, and to maintain market integrity. Scarcity pricing can deal with cases where the does not have sufficient liquidity, either locally or footprint-wide. If resources are insufficient, the scarcity price would be considered in calculation of the LIP, and the market operator would coordinate with the Reliability Coordinator to take appropriate actions to maintain reliability. If a flexibility reserve or capacity market is developed outside of the EIM, market rules	Day-ahead and by the top of every operating hour, the market operator will provide a supply adequacy analysis for the next operating hour, based on load forecast, resource and AS plans, and schedules received from market participants, via the OASIS website or API Notification. If a market participant has insufficient or too much energy supply, the market participant is deemed to have inadequate supply. If the aggregation of the market participants' resource plans and schedules in a BAA within the EIM footprint, compared to the market operator's load forecast and AS requirements for the BAA, indicates that a BAA has inadequate supply, the market operator will notify the market participants and host BA. If a market participant does not resolve the issue and it contributes to a real-time reliability problem, the BA and WECC will take actions including interruption of load or resources, curtailment of schedules, or manual deployment of resources, if deemed necessary. The straw proposal addresses seams coordination as part of its Congestion	The ISO would be able to perform a supply adequacy analysis as described in the straw proposal, and to notify market participants, the host BA, and WECC of mismatches or reliability issues, as appropriate. The details of this process should be determined through EIM stakeholder discussions. The ISO's daily market operation includes verification of market participants' credit adequacy as described in the WECC EIM Functional Specification. The ISO market includes a scarcity pricing mechanism that is based on adequacy of ancillary services. However, this may not be applicable to the EIM design since EIM does not procure ancillary services. Although the EIM design is not currently anticipated to include a flexibility reserve or capacity market, the ISO has implemented a flexible ramping capacity constraint in the real-time market, and a current ISO stakeholder process is developing mechanisms for a flexible reserve market product. Seams coordination is described above in the "Security Constrained Economic Dispatch"

would coordinate such a capacity market with the EIM.	Management Procedure, which is summarized in the "Security Constrained Economic Dispatch" section of this table.	section of this table.
Energy Management System (EMS): The EMS monitors the real-time system state and provides necessary information as the starting point for each SCED solution, using real-time data from Balancing Authorities, generators, loads, transmission operators, and Reliability Coordinators. The state estimator estimates current loadings, flows, and voltages throughout the system. EMS may also facilitate data transfer to other entities, including generator dispatch signals or Balancing Authorities' net scheduled interchange.	The scheduling, pricing, and dispatch program uses the system conditions described by the most recent EMS state estimator power flow solution, along with resource parameters provided in resource and AS plans, energy offer curves, and activated transmission constraints, as inputs to SCED. In this set of inputs, the latest generation values are collected from WECC's EMS AGC (fed from ICCP).	As in the straw proposal, the ISO's real-time market includes the EMS state estimator power flow solution as one source of inputs. To ensure that the market's 5-minute dispatch process has the most current situational awareness, the ISO's state estimator provides a current solution to the market every minute. The ISO's existing state estimator covers the entire WECC region down to 220 kV (lower voltages in some areas, depending on available data). The ISO's state estimator exchanges real-time data with the WECC reliability coordinator, and is able to select which of these data sources to utilize in different areas of the WECC grid, depending on each state estimator's quality of solution.
Locational Imbalance Price (LIP): Calculated nodally for generators and zonally for loads, based on a marginal clearing price. Marginal congestion is location-specific compared to a reference node. Losses may also be incorporated into the price.	The LIP is the offer price for SCED to meet the next MW. SCED's objective is to minimize the total cost of energy while honoring the constraints, and results in dispatch instructions to deploy EIM resources and in calculated LIPs. In the straw proposal, SCED does not account for differences in losses between resources when calculating dispatch instructions. The LIP for a settlement location is the numerical average of its LIPs across the 5 minute dispatch intervals, and is calculated for each hourly settlement interval. Settlement locations may be zonal (load weighted average of nodal LIPs) or nodal for	As in the straw proposal, the LIP is the result of market optimization to most economically serve the next MW at each location in the market area. In the ISO market, SCED is able to account for differences in losses between resources when calculating dispatches and these differences become market prices for each 5-minute dispatch interval. However, if it were preferred for the EIM market, SCED would be able to exclude marginal losses from LIPs. LIPs are available no later than 2.5 minutes before the start of each dispatch interval.

	load, but are only nodal for resources. The pricing data includes date, time, settlement location, and price ($/MWh). A resource that is not free to change output to move along its offer curve in response to dispatch instructions will not set prices. In general, a resource sets price when it is under market dispatch and is not limited in its ability to change output to comply with economic dispatch of EIM energy. Limitations may include the resource operating at the minimum or maximum of its dispatchable range, ramp rate limitations, other resource operating limitations, transmission constraints, etc. The market operator, with assistance of the market monitor, monitors for possible errors in the EIM market. Errors can result from flaws in software design or implementation or from the data inputs, resulting in incorrect LIPs. If errors are identified, specified corrective measures remedy such errors as soon as possible. If recalculated LIPs would result in a resource being paid less than its offered price for the actual dispatched output, a compensatory payment makes up the difference between the recalculated LIP and the offered price. If recalculated LIPs result in a market participant being charged more for purchased imbalance energy as a direct result being dispatched incorrectly, a make-whole payment reflects the difference between the	The ability of resources to set market prices is similar to the straw proposal. LIPs in the ISO's existing market are for each resource location for supply resources, and for "default load aggregation point" zones for most loads. The ISO market also uses nodal LIPs for "custom load aggregation points" in certain specific situations, as a policy outcome of ISO stakeholder processes. As in the straw proposal, the ISO reviews all market price results, and makes price corrections on the occasions when this is needed. Bid cost recovery and make-whole payments apply in situations that have been determined through stakeholder processes.

	recalculated LIP and the offer and the difference between the adjusted and the actual dispatch.	
Settlements: Settlement software provides necessary inputs to invoicing, accounting, and credit management, based on market rules, and provides data to market participants. It receives data from SCED, the scheduling system, ECC, and the Credit Management System, and has a secure user interface to receive meter data and to send billing data. Two options for the granularity of energy settlement are 5-minute settlement (matching EIM's dispatch intervals) or hourly integrated settlement. The 5-minute settlement produces less exposure to price volatility, as dispatches match changes in price, but causes more administrative burden for processing meter data, calculating settlements, and market participants' shadow settlements and verification. Hourly settlement integrates meter data and averages the 5-minute LIPs over the hour, then settling the hourly meter data at the hourly LIP. This is simpler to calculate, track, and verify, but can spread dispatch price volatility over the entire hour. Seams coordination with adjacent market and non-market areas may need to be accounted for in the settlement of flows entering or leaving the EIM footprint. Mechanisms for transmission service settlement will need to be addressed in	Resources will be settled based on the LIP associated with their settlement location during the settlement interval, which is a one-hour period. Resources are only settled nodally, at the numerical average of locational prices for the hourly settlement interval (sum of dispatch interval LIPs divided by the number of dispatch intervals per settlement interval). Load may choose to be settled either zonally as the load-weighted average of nodes within its zone, or nodally. The LIPs are based on the resource offers and are locational. The MWh of imbalance energy is calculated by subtracting scheduled MWh from actual MWh. Settlement will be the quantity of EIM energy times the LIP at that settlement location for a given operating hour. When scheduled quantities equal actual quantities, EIM energy and settlement are zero. The data used in market settlement must be submitted by settlement location (node or zone). Transmission customers must replace transmission loss energy owed to transmission owners on a real time basis. Market participants must notify the market operator of their registered settlement locations to be used for receiving self-provided losses. The credit reflected in the EIM settlement for the	In the straw proposal, the hourly LIP is the simple average from dispatch interval LIPs during the hour, and is available 15 minutes after the end of the hour. The ISO would be able to use averaged prices for the EIM footprint, but the ISO's experience during the initial years of its operation was that uninstructed deviations were difficult to control with this system. Generators responded to hourly average prices rather than dispatch interval prices, and produced as much as possible when the hourly average price would be high (ignoring dispatch instructions to decrease their output), or under-produced when the average would be low. The ISO then implemented 10-minute settlement intervals, for which LMPs for instructed energy are now dispatch-weighted averages of their 5-minute dispatch interval prices, and the ISO has been able to maintain good system performance without uninstructed deviation penalties. Uninstructed energy is simply settled at the simple average for the 10-minute settlement intervals. If desired by EIM market participants, the ISO would be able to use a hybrid approach, similar to the ISO's settlement of dynamic schedules. The ISO uses the hourly integrated

detailed market design.	identified loss settlement location will be offset exactly by the amount of the loss charge on each settlement statement. Meter data for loads, resources, and interconnections are received 4 days after the operating day. The market operator publishes preliminary settlement statements 5 days after the operating day and final settlement statements 45 days after the operating day. Resettlement statements may be produced on later dates using corrected settlement data due to resolution of disputes, or correction of data errors. This market will be facilitated such that the market operator maintains revenue neutrality. Any difference between charges for EIM and payments will be uplifted.	MWh of energy from the dynamic schedule's final e-tag (updated shortly after the end of the operating hour), and distributes the hourly total to the 10-minute settlement intervals using telemetry data from the generator. This process could be extended to hourly settlement intervals, provided that market participants are aware that their response by dispatch interval will affect their LIP used in settlements. In the straw proposal, transmission customers must replace losses owed to transmission owners, separately from the EIM settlement. The ISO's market currently models transmission systems outside its footprint, and does not account for losses in the external areas when computing its LIPs. These market prices include the ISO's intertie scheduling points, some of which are significant distances from the ISO BAA, e.g., Celilo, Four Corners, Mona, IPP, etc. The ISO market's settlements exclude losses when the losses are settled bilaterally, due to contractual provisions. There are also certain situations where the ISO settles MW losses with transmission providers rather than including the marginal losses in LIPs.
Market Penalties: To maintain proper dispatch and price signals, and to encourage dispatchable generation to submit offers and provide the market operator with appropriate cost data, market penalties will be used for	Uninstructed deviation is the difference in a resource's dispatch instruction and real time operating level. A resource operating tolerance based on acceptable dispatching error adjusted for regulation services allows	The ISO tariff contains provisions for uninstructed deviation charges that are similar in concept to the straw proposal. These provisions could be activated if required to maintain reliable operations, but the

failure to follow dispatch. The design of these penalties includes value, deadband, and exceptions. Market rules and potential associated market penalties may also need to address the ability of market participants to arbitrage across their own system.	the market operator to maintain efficient dispatch and provide financial incentives for resources to perform within an acceptable range. In addition to the settlement for EIM, uninstructed deviation charges will be assessed to any resource that operates outside the defined resource operating tolerance. A resource operating outside the tolerance will incur a charge based on the amount the resource is outside the operating tolerance and a percentage of the LIP for the applicable hour, with the charge increasing with the amount of uninstructed deviation. For intermittent resources, whose actual output is difficult to predict and ability to respond to dispatches is limited, dispatch instructions consistent will equal its operating level at the time of the dispatch calculations, and the resource will not be subject to uninstructed deviation charges. Uninstructed deviation charges also do not apply in several conditions that are outlined in the straw proposal.	development and potential activation of these provisions have been controversial among ISO stakeholders. The overall structure of the ISO's real-time market has supported reliable operations without activating these provisions.
Modeling and Registration System: This system maintains model information for physical assets in the market and identifies relationships between the physical assets and commercial owners or responsible parties, for validation that the assets meet market qualifications.	Market participants may participate in the market as any combination of resource entities, load serving entities, meter agents, and/or power marketers. All loads, and all resources excluding behind-the-meter generation less than 10 MW, must register. Each market participant has a legal relationship with the market operator, and is required to execute specific service	The functions described by the straw proposal are within the ISO's existing capability.

	agreements. Registration identifies each load and/or resource to settlement locations, the entity submitting settlement meter data, and settlement responsibilities. The market participant is also responsible for insuring that the BA also receives settlement data from the meter agent.	
Excluded Products: The following products are not included in the EIM: • Contingency Reserves • Regulating Reserves • Capacity • Transmission Service To the extent that bilateral or external centralized markets exist for these products, there will need to be coordination between those markets and the EIM. The EIM will not procure or deploy reserves, but will need to recognize capacity maintained to supply the reserves and accommodate deployment of such reserves. The Market Operator will work with the Reliability Coordinator and Market Participants to remedy any potential deficiencies in available capacity to protect the liquidity of the market and address reliability concerns. Transmission compensation for EIM flows will need to be defined.	NERC policy will continue to dictate reserve sharing deployment by BAs and reserve sharing groups. The energy schedules implemented through deploying reserve sharing will continue to be settled as bilateral transactions. These bilateral transactions for reserve sharing are treated as "market schedules", which ensure that self-scheduled resources are sent consistent instructions. Market participants may provide such schedules by entering resource specific schedules and/or supplying a default distribution prior to real-time, to automatically generate reserve-sharing schedules. Following a contingency, resources should return to following dispatch instructions within 20 minutes. As with all bilateral transactions in the EIM market, any deviation between the schedules and actual meter values will be subject to settlement through EIM at the appropriate LIP. Uninstructed resource deviation penalties will not apply to the units carrying contingency reserves for the full duration of the reserve sharing event, but resources that are not designated as carrying contingency reserves in	The existing ISO market supports self-provision of ancillary services, and this capability would be able to support the reservation of AS capacity for resources in the EIM market. In particular, the ISO market supports metered sub-systems (generally, municipal utilities and other governmental entities) and aggregations of metered sub-systems that have jointly-owned resources that provide AS. Although the existing ISO market dispatches these self-provided AS resources for overall system reserve requirements, the associated functionality can be adapted as described in the straw proposal and in WECC's EIM Functional Specification. As recognized in WECC's EIM Functional Specification, transmission compensation for EIM flows will need to be defined through an EIM stakeholder process. A regional transmission access charge has not been anticipated as part of the EIM design.

	the AS plan continue to follow dispatch instructions. A reserve sharing group may include members that do not directly participate in the EIM market. Nothing prohibits these entities from continuing to participate in the reserve sharing group, or subjects them to changes in their internal business practices. When bilateral schedules for reserve sharing cross the EIM boundary, the net scheduled interchange for the EIM area has a corresponding adjustment.	
Market Monitoring: • Evaluate market and identify attempts to exercise market power • Identify violations of market rules and gaps in market rules • Monitor both market participants and Market Operator • Certify whether the market is competitive Resource offers will be required to follow several rules to prevent or mitigate market power or market manipulation, such as limits on offer prices, arbitrage rules, rules associated with other energy or ancillary services markets, and rules to mitigate local market power. Price caps and floors could identify the highest and lowest allowable value that prices could reach.	Market monitoring protects consumers against abuse of horizontal and vertical market power and ensures that the design and implementation of markets and services is as efficient as possible, so that consumers may obtain the best deal based on price, risk and reliability. A market monitor independently evaluates the market operator's market, recommends proposed changes, reviews market performance, and refers possible cases of market power to FERC. Internal employees would staff the market monitor. Two principles for mitigating economic withholding are: (1) in a context where the electricity marketplace is workably competitive, absent transmission constraints, mitigation will be applied only at the time of, and in places with, transmission constraints, and (2) mitigate would not cap prices below	As in the straw proposal, market monitoring functions are performed by staff within the ISO's organization that acts independently of the ISO's other functions. The market software performs local market power mitigation as part of the normal market execution, and a "safety net" cap and floor further protect consumers.

	the long run marginal cost of new investment. When any transmission constraint is binding in the EIM market, offer curves for resources on the importing side of each constraint, with generator-to-load distribution factors of at least 5% have an effective offer no higher than the offer cap for each resource. The offer cap is calculated daily, equal to the sum of the estimated annual fixed cost, an adder for non-fuel variable O&M cost, and fuel cost, of a new, natural gas-fired, combustion turbine peaking generator. A "safety-net" offer cap and floor is $1000/MWh and $-1000/MWh.	

Appendix 2: Sources of Additional Documentation

The ISO provides extensive documentation of its market functions in its Business Practice Manuals (BPMs), which are available on ISO's web site. BPMs provide detailed rules, procedures, and examples for the ISO's administration, operation, planning, and accounting processes through which the ISO and market participants conduct business in accordance with the tariff. Changes to the ISO market are developed through a rigorous stakeholder process to ensure that all stakeholder viewpoints are considered, and a systematic and publicly transparent change management process ensures the consideration of all relevant information when modifying the BPMs. The BPMs are available at http://www.ISO.com/rules/Pages/BusinessPracticeManuals/Default.aspx

The ISO anticipates that BPMs would similarly be developed for the EIM market.

The primary sources that are pertinent to the existing real-time energy market include the following:

- Business Practice Manual for Change Management
- Business Practice Manual for Compliance Monitoring
- Business Practice Manual for Credit Management
- Business Practice Manual for Direct Telemetry
- Business Practice Manual for Managing Full Network Model
- Business Practice Manual for Market Instruments
- Business Practice Manual for Market Operations
- Business Practice Manual for Metering
- Business Practice Manual for Outage Management
- Business Practice Manual for Rules of Conduct Administration
- Business Practice Manual for Scheduling Coordinator Certification and Termination
- Business Practice Manual for Settlements and Billing