Renewable Integration Market & Product Review- Phase 2

Day-of Market Design Framework

Stakeholder Meeting
July 11, 2011

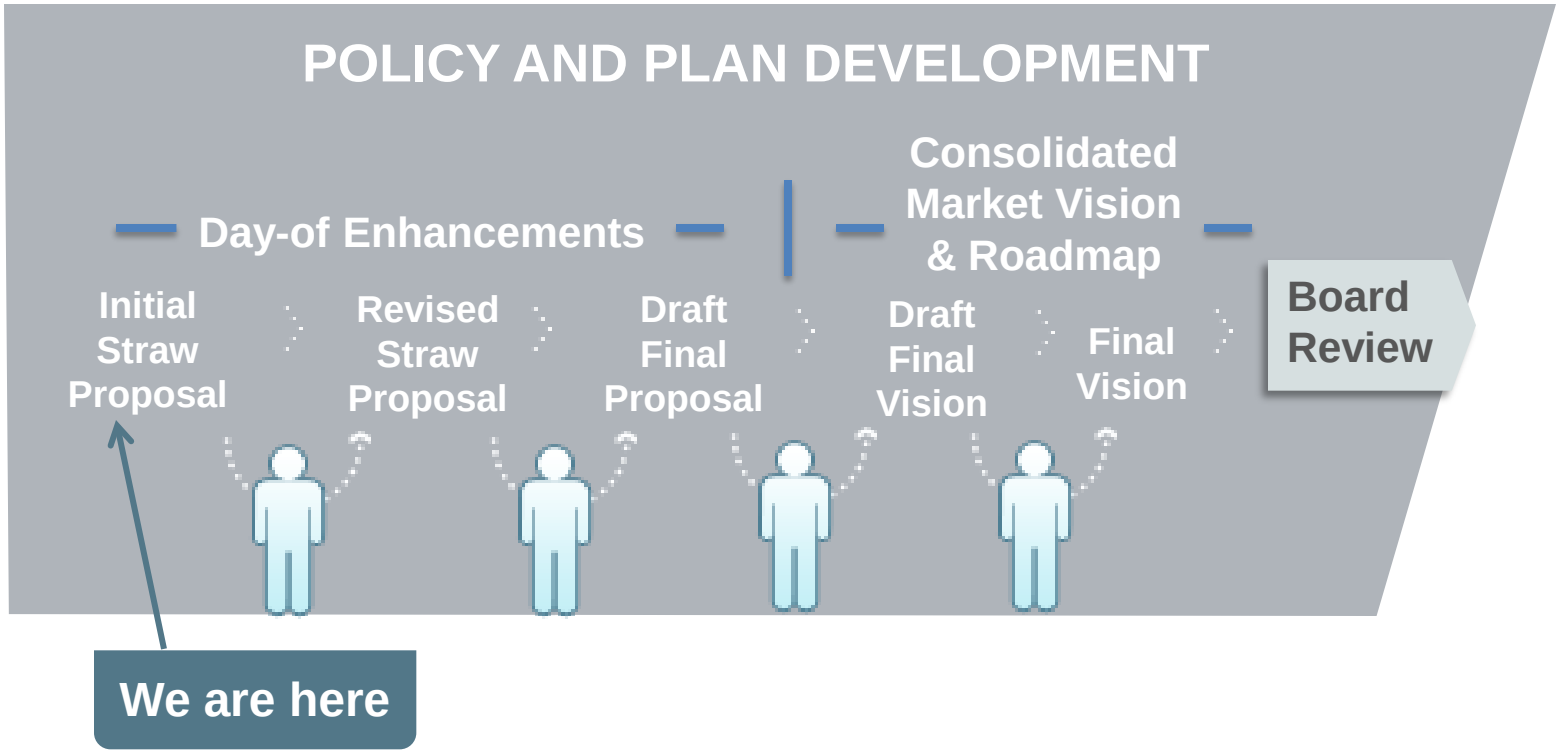
California ISO
250 Outcropping Way

Agenda

TIME	ITEM	PRESENTER
10:00-10:15	• Introduction	Chris Kirsten
10:15-10:25	• RI Phase 2 Overview	Eric Little
10:25-10:45	• Operational Challenges	Clyde Loutan
10:45-11:15	• Guiding Principles	Lorenzo Kristov
11:15-12:00	• Day-of Market Framework	Stephen Keehn
12:00-1:00	• Lunch Break	
1:00-2:30	• Day-of Market Framework	Stephen Keehn
2:30-2:45	• Break	
2:45-3:45	• Day-of Market Framework	Stephen Keehn
3:45-4:00	• Next Steps	Eric Little

ISO Policy Initiative Stakeholder Process

Day-of Market Stakeholder Input Opportunities



Renewable Integration Phase 2

Day-of Market Framework

RI PHASE 2 OVERVIEW

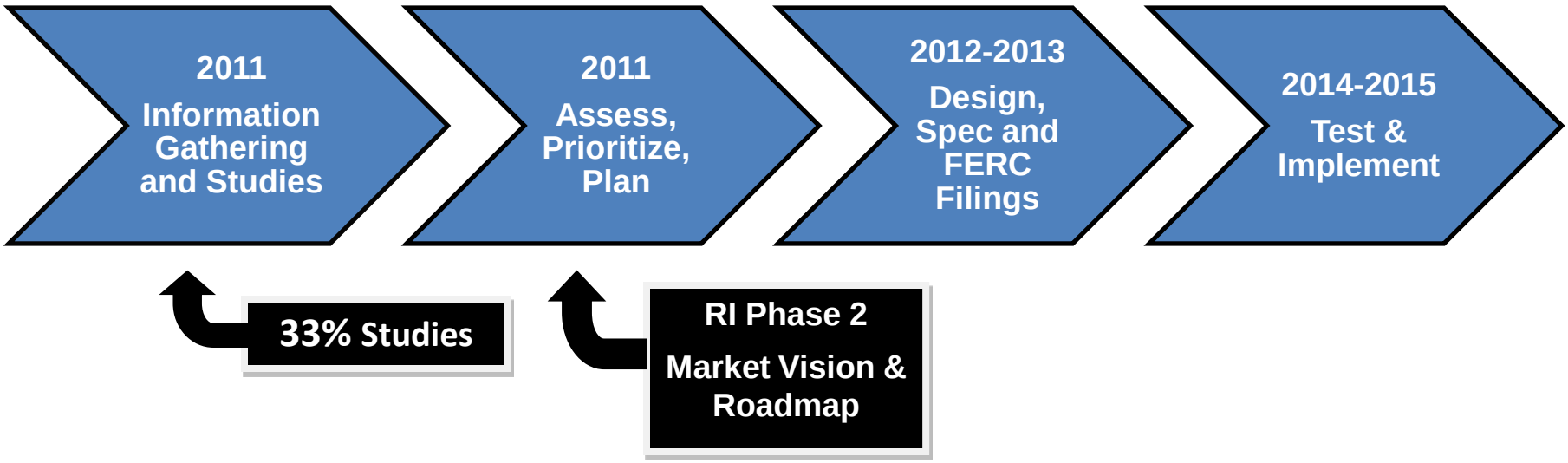
ERIC LITTLE

Statement of Purpose

With the increasing number of distributed and variable supply resources required to meet the 33% RPS, the ISO and its stakeholders must take a holistic view of the existing ISO market and propose comprehensive market design enhancements that will:

- Enable ISO operators to efficiently and reliably operate the grid with a more diverse and variable supply portfolio
- Accommodate changing energy policy goals and new resource types without requiring redesign
- Resolve known market and performance issues and minimize manual intervention

Process Timeline



Process Flow

Day-of Market Design Enhancements

Initial Straw	Revised Straw	Draft Final Proposal
Jul 6	Aug 3	Sep 8

Day-ahead & Forward Market Design Enhancements

Initial Straw	Revised Straw
Aug 3	Sep 8

Comprehensive Market Design & Roadmap

Draft Final Market Vision & Roadmap	Final Market Vision & Roadmap
Oct 13	Nov 4

Milestones

- Initial Straw Proposal- Day-of Market: July 6, 2011
- Revised Straw Proposal Day-of Market: August 3, 2011
- Initial Straw Proposal Day-ahead Market & Forward Procurement: August 3, 2011
- Draft Final Proposal- Day-of Market: September 8, 2011
- Revised Straw Proposal Day-ahead Market & Forward Procurement: September 8, 2011
- Draft Final Market Vision & Roadmap Published: October 13, 2011
- MSC Opinion Adopted: November 2, 2011
- Final Market Vision & Roadmap Published: November 4, 2011
- Board Review & Presentation: December 15, 2011

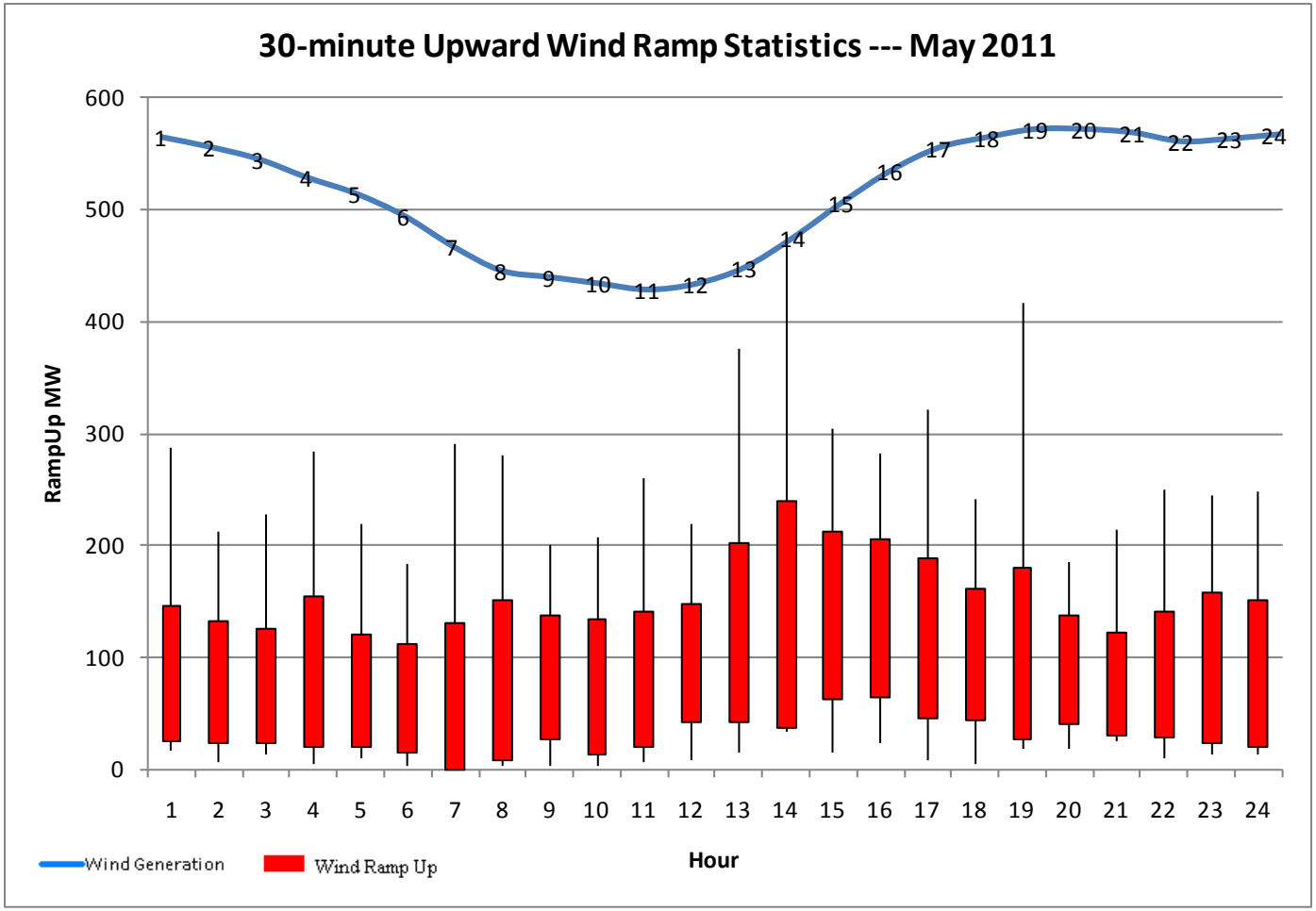
Renewable Integration Phase 2

Day-of Market Framework

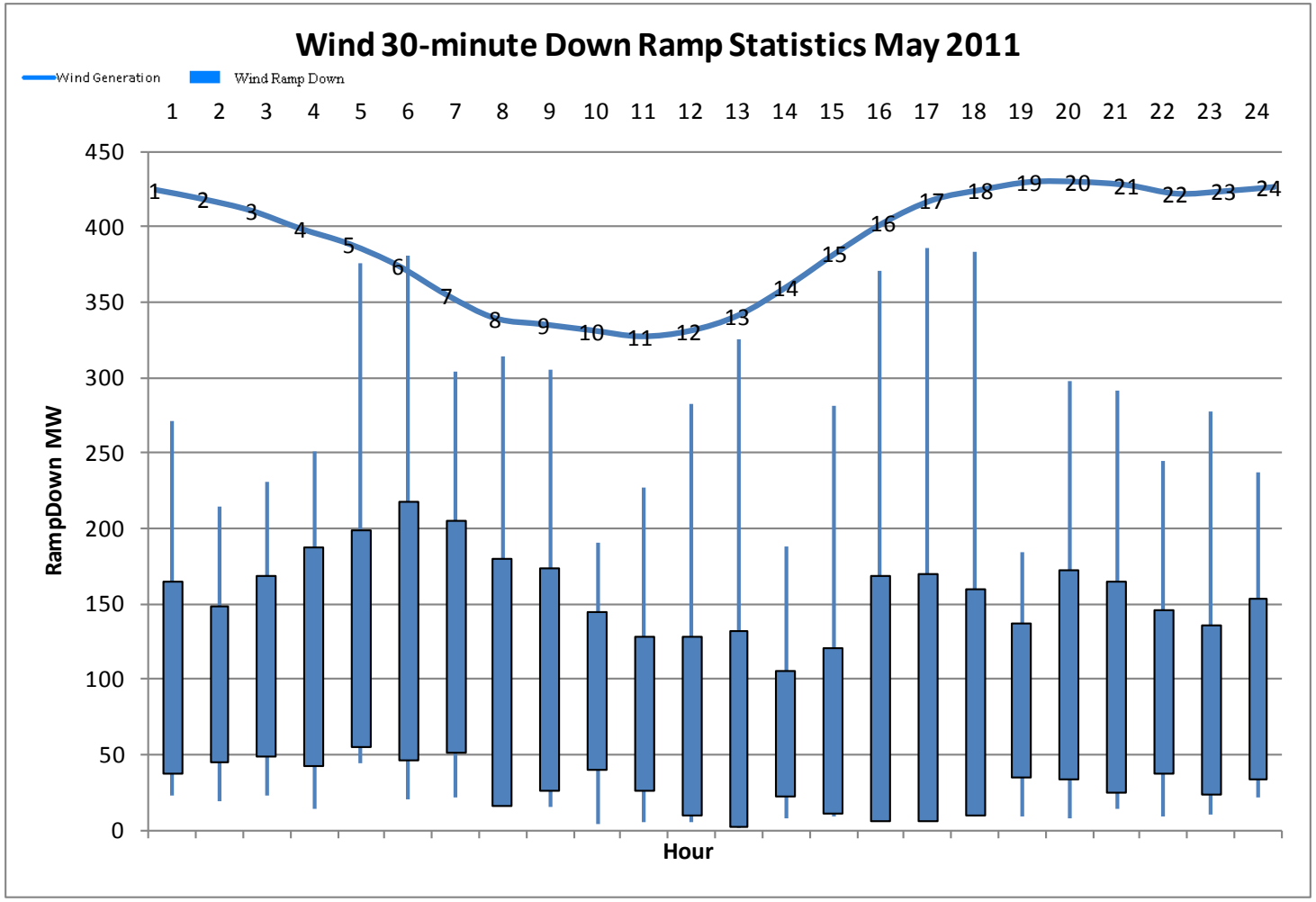
OPERATIONAL CHALLENGES

CLYDE LOUTAN

30-minute ramp up variability for May 2011



30-minute ramp down variability for May 2011



Operational challenges

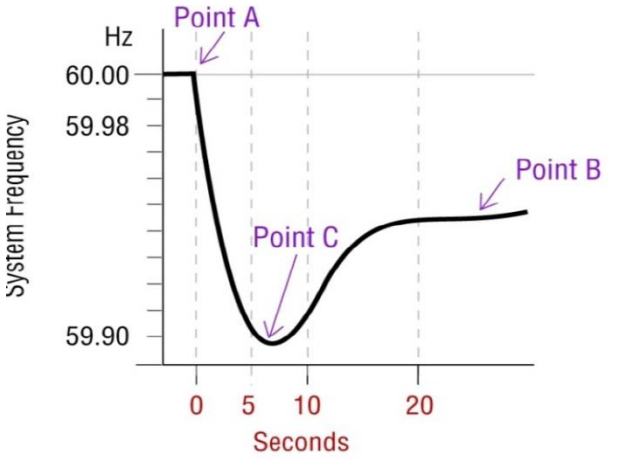
- Reliability with lower percentage of gas powered plants
  - Once Through Cooling Retirements/Repower
  - Characteristics of repowered/new resources
- Load-Following Requirements
  - Increase of intra-hour load following capacity, ramp rate and ramp duration
  - Unit commitment needs to cover energy needs plus variability needs
- Regulation Requirements
  - Increase of intra-hour regulation capacity, ramp rate and ramp duration

Operational challenges cont.

- Ramping Requirements
  - At times, insufficient ramping capability
  - Ties & Generation self schedules
  - Uncertainty and variability of wind/solar production
  - Should ramping needs be factored into unit commitment?
- Over-generation
  - Strategy to curtail resources
  - High hydro conditions
  - High wind/solar on a weekend
  - Not enough Ancillary Service (AS) [system control issues]
  - Low P_{min} (resource may not be able to provide AS or Frequency Responsive Reserve (FRR))
  - Storage can mitigate some over-generation

Operational challenges cont.

- Inertia and Frequency Response
  - NERC/WECC Standard Development
  - ISO/GE Ongoing Study
  - How do you meet FRR obligation?
  - Can load provide FRR?
  - How do you monitor FRR capability in real-time?
  - Should inertia be incorporated into unit commitment?
  - Can storage devices and flywheels provide FRR?
  - Incentive for wind resources to provide FRR?



Operational challenges cont.

- AGC Control
  - Increase in intra-hour regulation capacity, ramp rate and ramp duration
  - Renewable Energy Management
  - Fast Regulation
  - Need to allow Loads, PHEV, Storage Devices, Flywheels etc. to participate in Regulation
    - Traditional AGC may not be practical?
    - Frequency Control and Traditional Regulation?
    - Fast Regulation & Traditional Regulation?
    - Predictive AGC?

Operational challenges cont.

- Active Power Control
- Voltage Control
  - Solar PV ---- power factor requirement?
  - Predictive power flow studies based on forecast
  - Potential low voltages based on N-1?
- Low Voltage Ride-through Capability
  - Can MSSC be impacted?
- Curtailment Rules
  - Congestion
  - Incentive
- Fleet Flexibility

Operational challenges cont.

- Forecast
  - Hour Ahead forecast is done 105 minutes ahead of the operating hour
    - More frequent and granular forecast
    - Reduce forecast errors
  - Assumptions for Distributed Energy Resources
  - Wind: is a persistence model good enough for real-time forecast?
  - Solar: persistent model is a challenge during sunrise/sunset
  - Need to incorporate DA, HA and RT forecast into market applications
  - Emerging technology/improve forecasting models
  - Assumptions for loss of telemetry

Challenges associated with distributed energy resources (DER)

- Ramping and Variability Impact
- Voltage Control
- Active Power Control
- Loss of DER following contingencies
  - FERC Order 661 A vs. IEEE 1547
- System Protection
- Visibility/Controllability
- Smart Grid --- Aggregation of DER to provide AS
  - Telemetry, visibility, controllability, timing, knowing what AS is available
- System Inertia and Frequency Response
- Power Quality

Renewable Integration Phase 2

Day-of Market Framework

GUIDING PRINCIPLES

LORENZO KRISTOV

Guiding Principles

- Technology Agnostic
- Transparent
- Durable & Sustainable
- Flexible & Scalable
- Deep & Liquid
- Cost-effective & Implementable

Guiding Principles

Technology Agnostic

Principle	The ISO market accommodates new resource types based on their performance capabilities, without preference for specific technologies.
Expected Outcomes	✓ Enables any technically capable resource, regardless of technology, to provide services on a level playing field based on performance ✓ Resource technologies are viable based on innovation and competition rather than on resource-specific market rules ✓ Integrates devices that can both produce and consume energy

Transparent

Principle	The ISO market relies on price signals to incent participant behaviors that align with ISO operating needs.
Expected Outcomes	✓ Products are competitively procured through transparent market mechanisms ✓ Procurement targets are transparent and tied to operational needs ✓ Operating constraints are reflected in price signals, minimizing non-market solutions ✓ Prices incent performance from supply and demand that supports operational needs and encourages mitigation of generation variability and congestion ✓ Pricing rules allow transparent allocation of renewables integration costs

Guiding Principles

Durable and Sustainable

Principle	The ISO market ensures an efficient mix of resources to maintain reliability and attracts new investment when and where needed.
Expected Outcomes	✓ Resources are commercially viable through a combination of ISO market revenues and forward contracts ✓ Resource fleet and mix enables the ISO to meet NERC and WECC reliability standards ✓ Resources are incented to enhance availability and performance ✓ Market products and rules are stable ✓ Known real-time market issues are addressed

Flexible and Scalable

Principle	The ISO market easily adapts to new and changing energy policy goals and resource mix.
Expected Outcomes	✓ Establish flexible market design that can accommodate reasonable changes in policies and technologies ✓ Recognize key linkages and coordinate with initiatives and proceedings of state agencies ✓ Compatible with high penetration levels of distributed energy resources

Guiding Principles

Deep and Liquid

Principle	The ISO market attracts robust resource participation.
Expected Outcomes	✓ More economic bids and less self-scheduling ✓ More price responsive demand ✓ Increased participation from resources in other balancing authorities through improved interchange scheduling ✓ Minimal seams issues with neighboring balancing authorities

Cost-effective and Implementable

Principle	The ISO market design leverages existing ISO infrastructure, industry experiences and lessons learned.
Expected Outcomes	✓ A market design that is cost-effective to implement for market participants and the ISO ✓ Build on existing functionality and market systems to extent possible ✓ Design leverages the experience of other ISOs/RTOs as to what works and what does not; do not re-invent

Renewables Integration Phase 2

Day-of Market Framework

DAY-OF MARKET DESIGN FRAMEWORK DISCUSSION

STEPHEN KEEHN

Structure of the Presentation

- I would like to go through a brief overview before taking questions
- Then I will launch into a detailed discussion

Structure of the Presentation, cont.

- Brief Overview
  - 2 Options
- Detailed Discussion
  - Common Elements to Both Options
  - Differences Between the Options
- Benefits of the ISO Proposed Structure
  - Pros and Cons of the Options

BRIEF OVERVIEW

ISO's Proposal for Modifications to the Day-Of Market Structure

- Retain the current two-settlement market system
- Simplify the existing Hour Ahead Scheduling Process (HASP) for clearing and settling intertie bids
- Introduce a new ancillary service product called Real Time Imbalance Service (RTIS)
  - More granular dispatch than today's 5-minute Real Time Economic Dispatch (RTED),
  - Less granular than regulation
  - Market for providing ramping/balancing

Two Real Time Dispatch Options

- Option A
  - RTED occurs every 15 minutes
  - Prices would be set every 15 minutes
  - Energy, Ancillary Services, and Short Term Unit Commitment would all be co-optimized every 15 minutes
  - RTIS provides more granular energy dispatch to maintain system balance
- Option B
  - RTED occurs every 5 minutes
  - Prices would be set every 5 minutes
  - Energy and Ancillary Services are co-optimized in the 5 minute RTED
  - Some form of Short Term Unit Commitment process would continue to run every 15 minutes
  - RTIS provides more granular energy dispatch to maintain system balance

What are the big open questions?

- Need for additional AS products, e.g.
    - Inertia
    - Frequency control
- On-demand Residual Unit Commitment
- Simplified Hourly Inter-tie scheduling procedure

DETAILED DESCRIPTION

Retain two-settlement design: Day-ahead and Real-time Markets

- The ISO believes the complications of adding a third settlement would create significant issues without providing any clear benefits
  - Full third settlement
  - Convergence Bidding
- The ISO believes that inter-tie scheduling issues can be effectively dealt with by simpler methods that avoid the complexities of a three settlement system

Replace Hour-Ahead Scheduling Process (HASP) with simpler process

- The ISO believes that there are simpler methods to accommodate hourly inter-tie scheduling than having a HASP
  - Market issues related to price disparities between inter-ties committed based on the HASP price and internal generation committed based on the 5-minute interval price
- FERC is considering 15 minute scheduling
- WECC members are beginning to consider intra-hour scheduling

Ancillary Services Markets under both options

- Co-optimized with Energy in RTED
  - Non-Contingent Reserves not needed for the next period can be used for energy
- New Product: Real Time Imbalance Service(RTIS)
  - Used to balance the system between RTED runs
  - Dispatched on 1 minute basis
    - Is that the right interval?
- Regulation
  - Only to balance until RTIS is dispatched
  - Consider single bidirectional product
  - Procured as MW/min
  - Payment includes capacity, mileage and accuracy
    - No net energy since bidirectional

Real Time Imbalance Service

- Similar to regulation, but dispatched every minute
- Procurement will explicitly consider ramping capability
  - Provides a market-based product
- Procurement will be based on MW and ramping capabilities.
  - The amount procured will be sufficient to balance the system until the next RTED run is implemented

Real Time Imbalance Service cont.

- Will be co-optimized with energy and other ancillary services
  - Units will likely have an energy schedule (at P-min or some “optimal” level) and then some amount in the Real Time Imbalance Service
- Procurement may not be symmetrical up and down, and will vary over each day as needed
- Payment will consist of:
  - Capacity payment
  - Mileage payment
  - Net energy payment – at the 15-minute price
    - the ISO is considering a floor of $0 for upward movements
  - Accuracy adjustment

Bidding and Dispatch of RTIS

- Some resources will prefer to be used for balancing often
  - Want the mileage compensation
- Some resources could move but would prefer not to
  - Want to receive the capacity payment
- Some resources cannot move, so do not bid to provide RTIS
- Two possible methods for dispatching RTIS:
  - Units put a flag in their bid to indicate their willingness to have their resource moved, and are dispatched on technological basis
    - similar to the “contingency only” flag for reserves
  - Resources submit a mileage bid which would then be used to dispatch the units
    - Use bid only for dispatch, with mileage paid at some administratively determined rate
    - Mileage paid at an as bid rate
    - Mileage paid at a market clearing mileage rate

Other Potential AS Products: Market for Automatic Unit Response

- Ensure that sufficient units are online to provide immediate response to frequency deviations without any ISO direct control
- Potentially, this could consist of two separate products
  - Inertia: to ensure sufficient spinning mass to damp frequency excursions
  - Frequency Response: to ensure sufficient governor response to arrest frequency excursions prior to AGC response

Other Potential Products:
On-Demand Residual Unit Commitment or Short-Term Unit Commitment

- Designed to allow commitment of resources with longer start times
- The look-out time would be 8-10 hours, allowing consideration of more units
- The operator could run the on-demand RUC whenever demand forecasts, renewable forecasts or resource availability change
- The on-demand RUC would run during the next RTED or RTPD
- The ISO is considering what rules would be required for on-Demand RUC to limit up-lift costs

Real Time Market under Option A

- The Real-Time Economic Dispatch every 15-minutes establishes:
  - Real time prices
  - Binding schedules
- Will co-optimize real-time energy, ancillary services and unit commitment decisions
- Will look forward up to 8-10 hours

Real Time Market under Option A

- Bids may be submitted each hour up to half an hour before the hour
  - this may initially have to be 45-minutes to accommodate existing tagging timelines, but the ISO will work to shorten this time to 30 minutes or less
- Scheduling coordinators for variable energy resources could submit revised schedules every 15-minutes
  - Bids are still hourly
- Dispatch instructions will be issued to all units between 12.5 and 15-minutes before the start of the operating interval
- The ISO is considering having a 10 minute ramp period
  - From 5-minutes before to 5-minutes into the subject 15-minute interval
  - ISO specifically seeks comments on this

Real Time Market under Option B

- The Real-Time Economic Dispatch every 5-minutes establishes
  - Real time prices
  - Binding schedules
- Will co-optimize real-time energy and ancillary services
- Would retain some form of today's Real Time Preliminary Dispatch
  - Short Term Unit Commitment (STUC) run every 15 minutes
  - This market will look forward up to 8-10 hours
  - STUC would not be co-optimized with the energy and AS markets,
  - STUC will recognize the abilities of the generator to provide ramping
  - STUC will commit sufficient resources to meet all reliability and ramping needs
    - This may involve the use of some form of flexi-ramping constraints

Real Time Market under Option B

- Bids may be submitted each hour up to half an hour before the hour
  - this may initially have to be 45-minutes to accommodate existing tagging timelines, but the ISO will work to shorten this time to 30 minutes or less
- An open question:
  - How often can scheduling coordinators for variable energy resources submit revised schedules?
    - 5 minutes
    - 15 minutes
    - some other period
- Dispatch instructions will continue to be issued at 5 minutes before the operating interval

BENEFITS
Pros and Cons of Options

Discussion

- Real Time Imbalance Service
- 5 Minute vs.15 Minute RTED

Renewables Integration Phase 2

Day-of Market Framework

NEXT STEPS

ERIC LITTLE

Upcoming Milestones

Revised Straw Proposal Day-of Market:
August 3, 2011

Initial Straw Proposal Day-ahead Market & Forward Procurement:
August 3, 2011

Draft Final Proposal- Day-of Market:
September 8, 2011

Revised Straw Proposal Day-ahead Market & Forward Procurement: September 8, 2011

Draft Final Market Vision & Roadmap Published:
October 13, 2011

Upcoming Stakeholder Process

Jul 22	• Comments due on day-of market initial straw proposal
Aug 10-11	• SH meeting to discuss day-of and day-ahead/forward procurement enhancements
Aug 25	• Comments due on day-of market revised straw proposal and day-ahead/forward market initial straw proposal
Sep 15	• Second SH meeting to discuss day-of and day-ahead/forward procurement enhancements
Sep 29	• Comments due on day-of market draft final proposal and day-ahead/forward market revised straw proposal
Oct 20	• SH call to review draft final market vision and roadmap
Oct 27	• Comments due on draft final market vision and roadmap

*Submit comments to phase2ri@caiso.com

Submit Comments to:
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