WECC Toolkit Proposal

Steve Beuning, Xcel Energy
Chair WECC SIS
Discussion w. WestConnect 2/18/10

What's the problem?

- Not bad today
  - Very little WECC congestion but an increasing burden for balancing area resources
- Big in the future
  - High penetration of renewables will increase the balancing burden and will result in less predictable impacts on grid flows
- Proposed solution:
  - A toolkit that mitigates balancing obligations and manages congested power flows

Increasing flexibility requirement

- Each BA must set aside resources to provide balancing service
- As BA variability increases with added renewable penetration, the amount that must be set aside by each BA increases
- A regional imbalance energy pool reduces the need for set-aside

Increasing Renewable Penetration

- Western Wind and Solar Integration Study
  - Example: If the United States footprint of WECC is at 27% of 2017 load forecast from renewable energy supply, this would be an energy volume of 242,000 GWh per year!
  - The level of supply in this example could include 69,000 MW of wind resource and 13,000 MW of solar resource
- Regional planning collaborations are established to address power lines and interconnections, but not dispatch operations
- Question: *Who will own the operating solution?*

WECC background

- The WECC Seams Issues Subcommittee (SIS) assignment:
  - Propose an effective congestion management and imbalance mechanism
  - No Regional Transmission Organization (RTO) proposal
  - No full LMP-style market design

What is the WECC Opportunity?

- Capitalize on existing Reliability Coordinator assets and infrastructure
- Alternative #1: pursue full toolkit development
  - Develop both proposed tools (the seams tool and the imbalance/ congestion management tool) as part of a new division either within the RC or separately depending on funding rules
- Alternative #2: decline balancing tool option
  - Work with external parties to support their development of imbalance and congestion management tools; develop the seams coordination tool

Why a WECC opportunity?

- Capitalize on existing Reliability Coordinator assets and infrastructure
  - Achieve ability to perform efficient and equitable management of reliability concerns
  - Situational awareness helps the RC's anticipate potential degraded reliability situations; now the industry needs better tools to respond rapidly and efficiently to the operating conditions

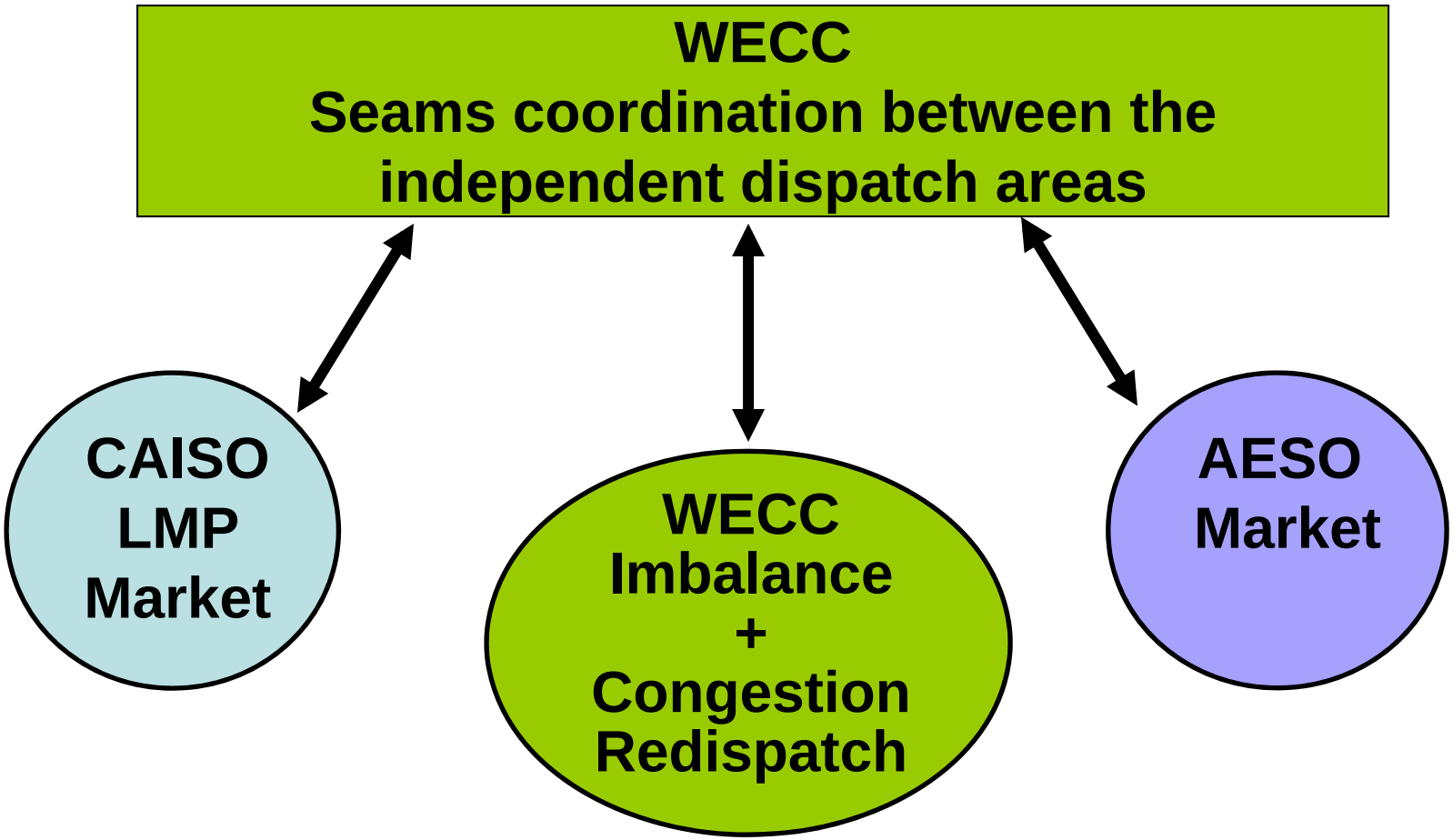
Background: WECC SIS activity

- The WECC SIS is preparing a high-level proposed design specification for "toolkit"
  - The EIS design is based on the SPP regional market
    - Energy imbalance and redispatch
  - Seams tool design coordinates across entire WECC
    - This is an augmented version of the webSAS tool used in the WECC
    - Cover CAISO/AESO/WECC EIS and non-participants

Toolkit components – two parts

- Seams coordination tool used throughout the WECC footprint
  - Likely accomplished through augmentation of the webSAS tool used by many parties in the WECC today
- Coordinated economic dispatch capability for congestion redispatch and energy imbalance service in participating parts of the WECC footprint

WECC toolkit development



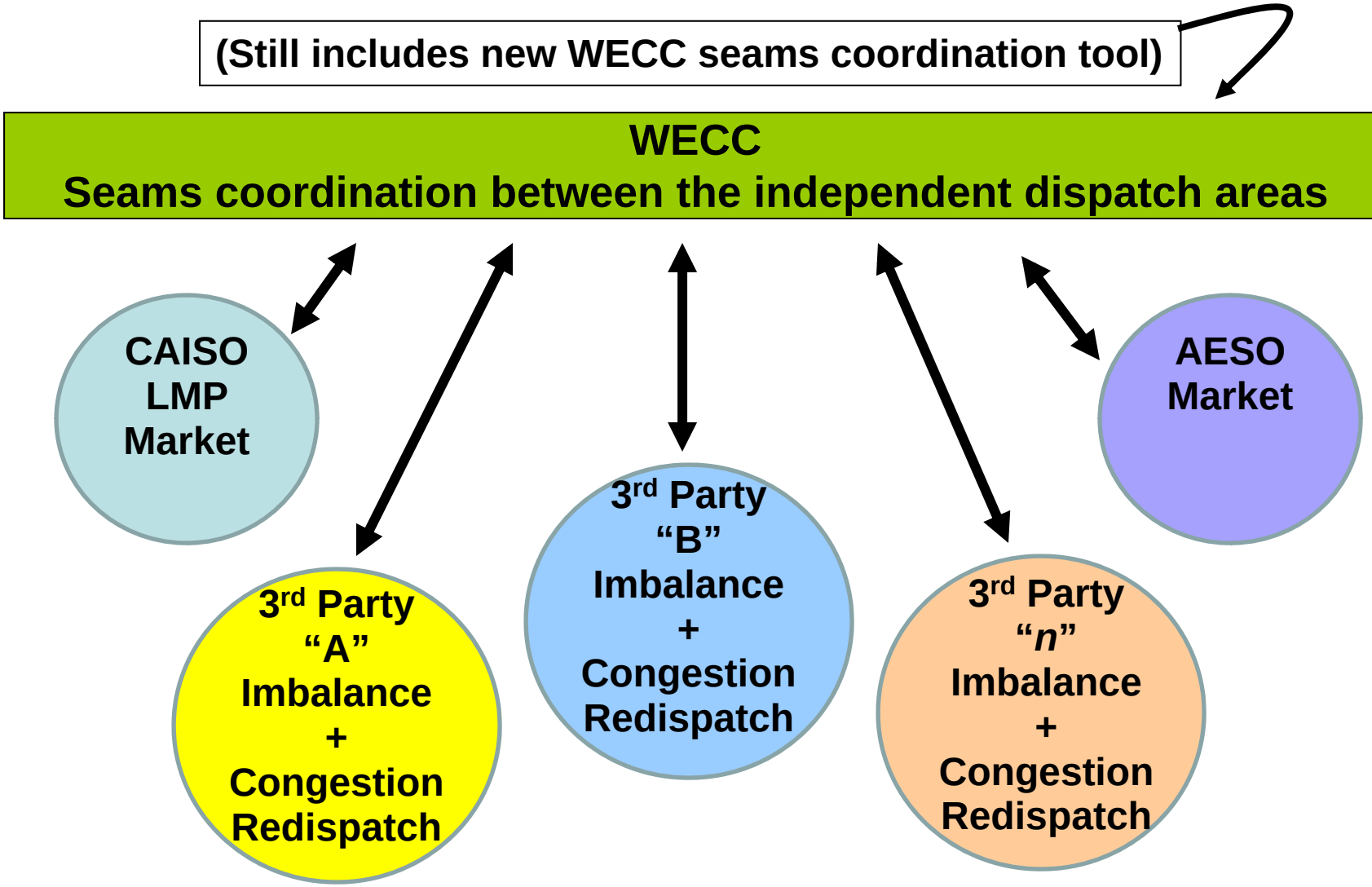
WECC toolkit development

Proposed WECC EIS Area

WECC Seams Coordination with CAISO and AESO

Note – this is not a Balancing Area consolidation. This is an area of coordinated dispatch operations.

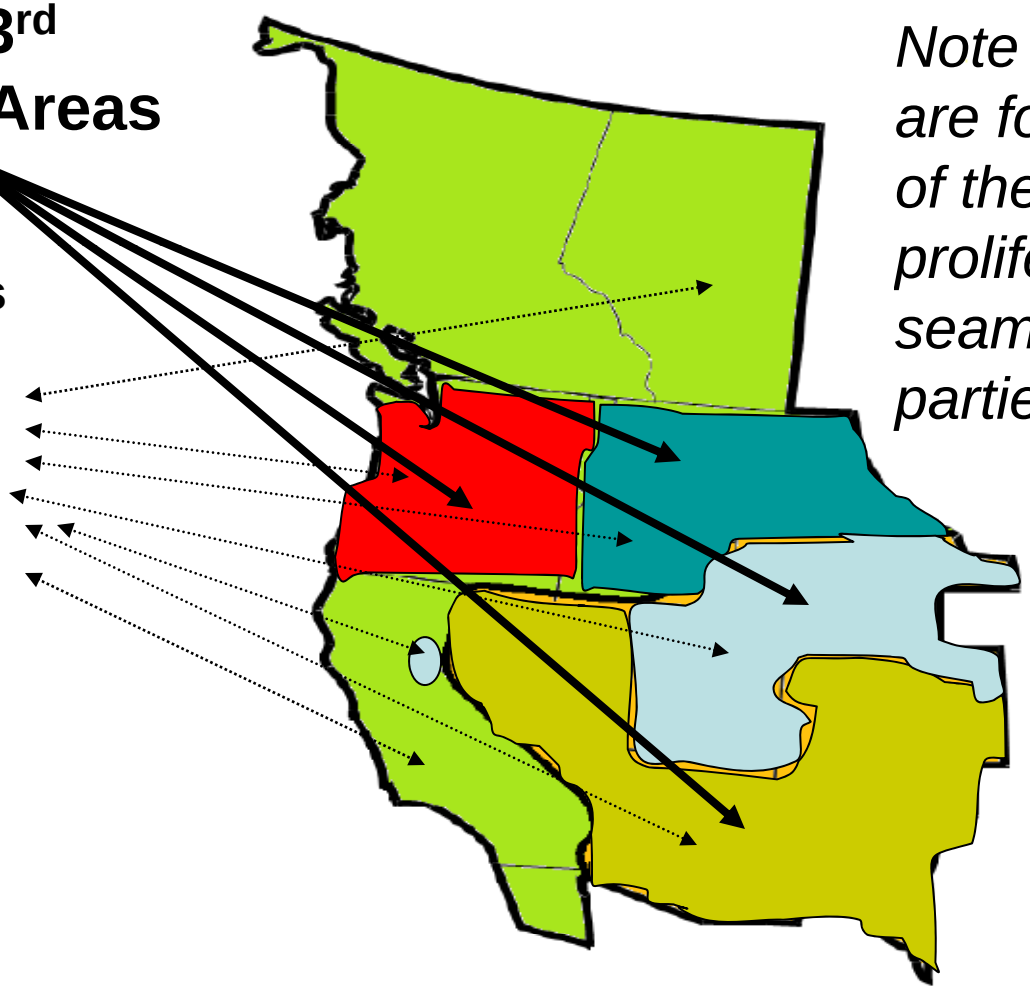
Alternative: Non-WECC imbalance



Alternative: Non-WECC Imbalance

Potential 3rd party EIS Areas

WECC Seams Coordination with CAISO and AESO and each 3rd-party EIS



Note – these areas are for illustration of the potential proliferation of seams coordinating parties.

Energy Imbalance & Redispatch

Toolkit Proposal & Comments

Toolkit Component 1

Congestion Management

Toolkit: Congestion management

- Today: Only six “Qualified Paths” in the entire WECC for congestion coordination
  - Assumptions used in today’s UFMP method could be improved:
    - System intact topology assumption is used
      - » During congestion, the “intact” assumption may be in error – line outages contribute to congestion!
    - Currently use a seasonal case assumption (two updates per year) and zonal approximations for source/sink
  - Future: Increase congestion coordination capability to all relevant grid components

Current congestion process

- What happens if the transmission owner or reliability coordinator sees a potential overload?
- Initiate the UFMP - *if the element is a WECC Qualified Path*
- Or – Transmission Owner manages the issue locally using their own accommodation or tariff curtailments

Current congestion process

- If the overload is “local”, there is no WECC method to ensure loop flow impacts of lower service priority are curtailed prior to curtailing the higher priority local uses
- And as we will see in an example, even if the element is a Qualified Path, there is no process to differentiate the priority of the external loop flow contributions

Example Discussion

Why we need to augment the existing WECC Unscheduled Flow Mitigation Procedure (UFMP)

UFMP curtailment: Example

Base assumptions

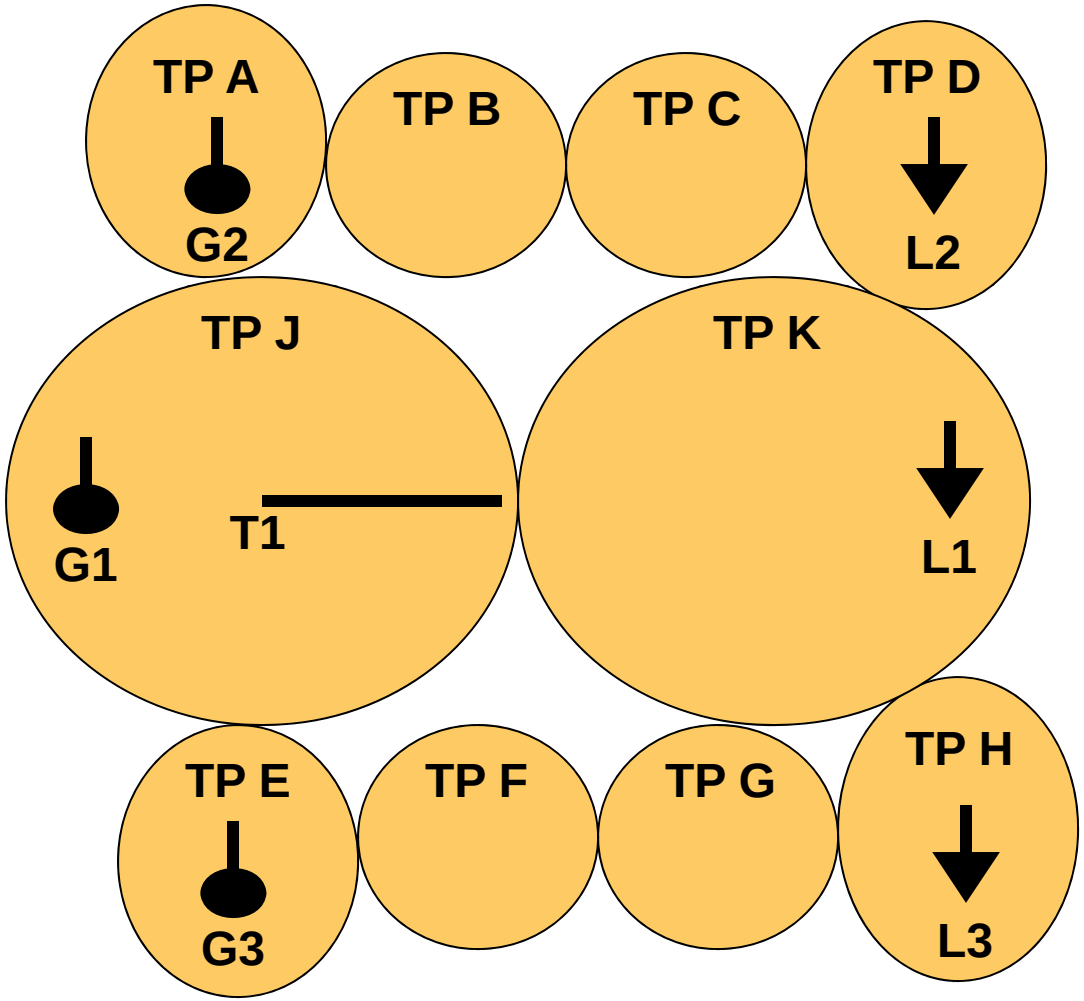


Diagram Key:

"TP 'n'" = Transmission Provider "n"

Line T1 in "TP J" is the limiting element in the Path.

Etag from G1-L1 uses TSR J-K

Etag from G2-L2 uses TSR A-D

Etag from G3-L3 uses TSR E-H

UFMP example: TSR assumptions

(TSR = Transmission Service Request)

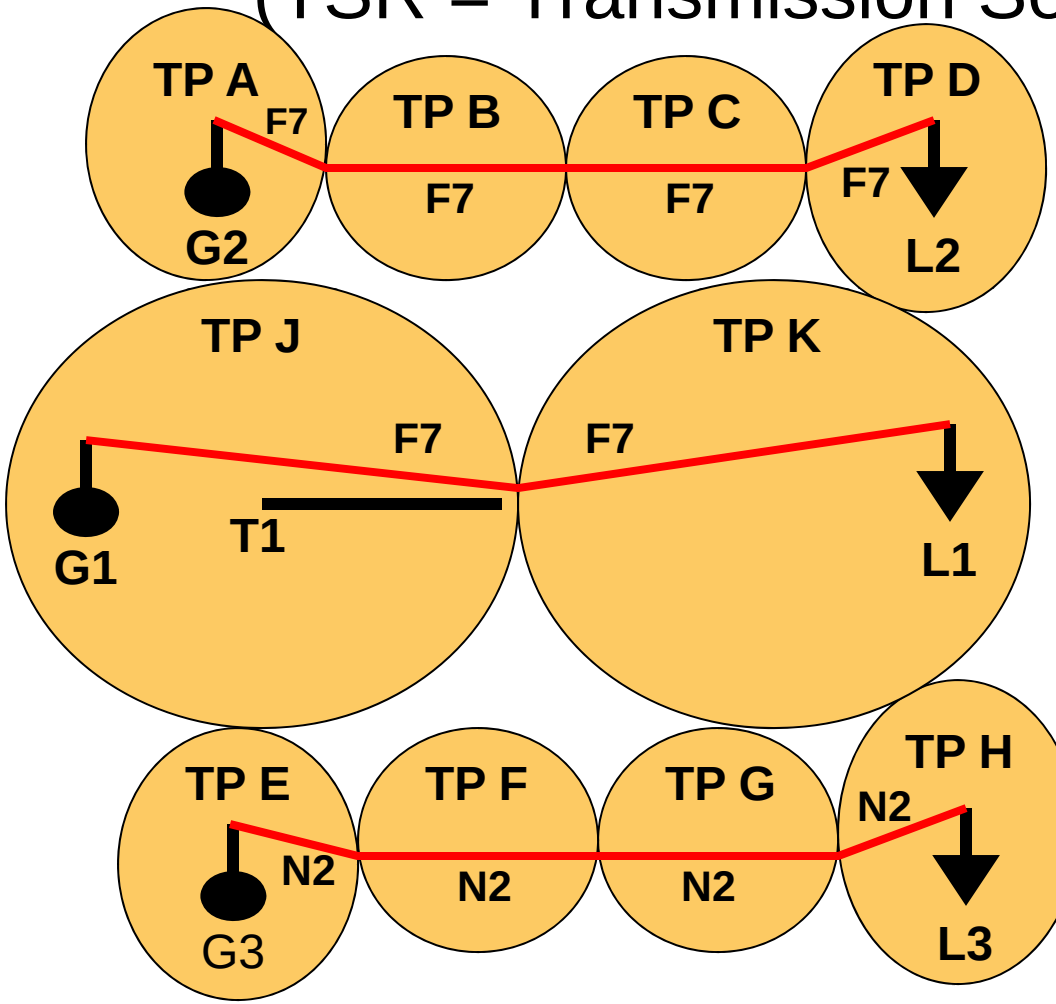


Diagram Key:

Etag from G1-L1 uses TSR J-K (Firm* service)

Etag from G2-L2 uses TSR A-D (Firm* service)

Etag from G3-L3 uses TSR E-H (Non-firm service)**

** Firm= Firm Curtailment Priority F7; **Non-firm= Non-firm Hourly Curtailment Priority N2*

UFMP example:

Assume T1 is a qualified path

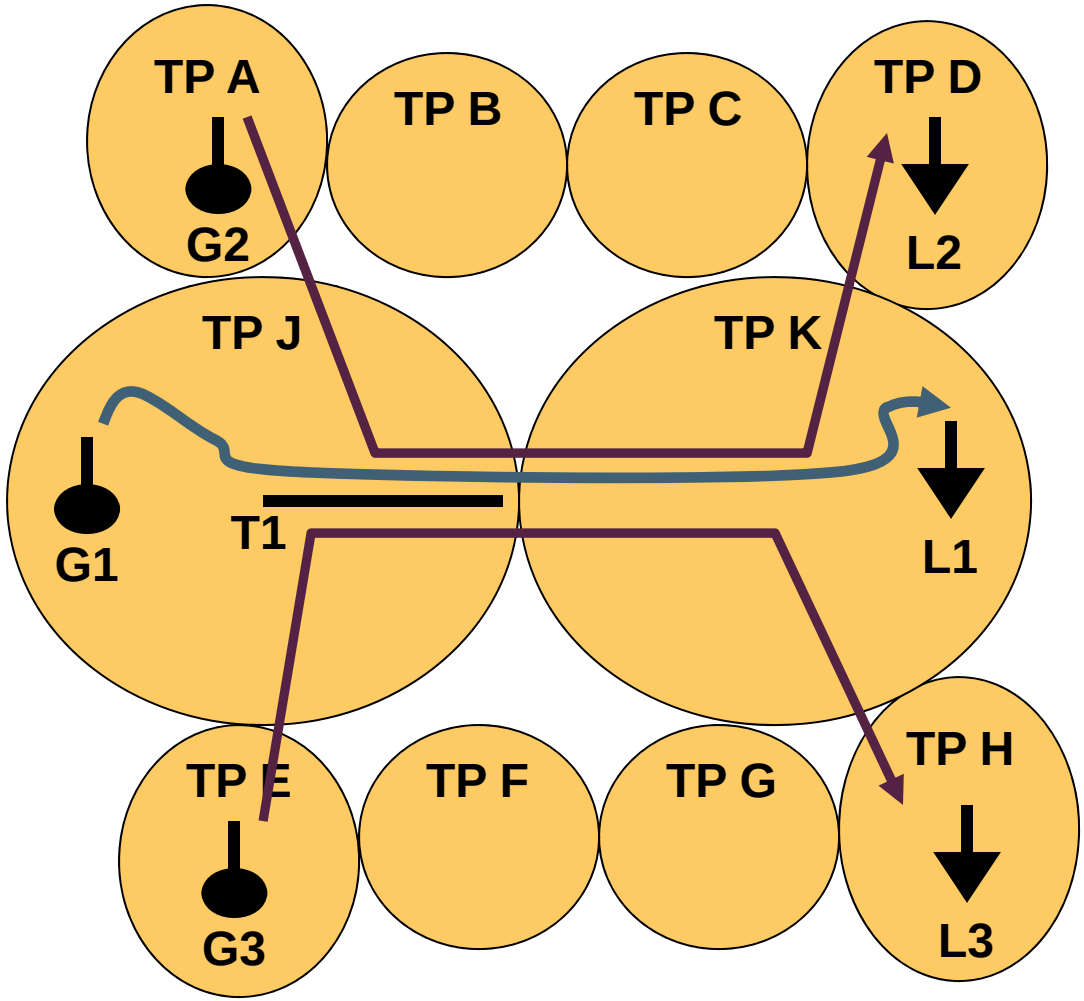


Diagram Key:

Etag from G1-L1 is a Scheduled Flow on T1

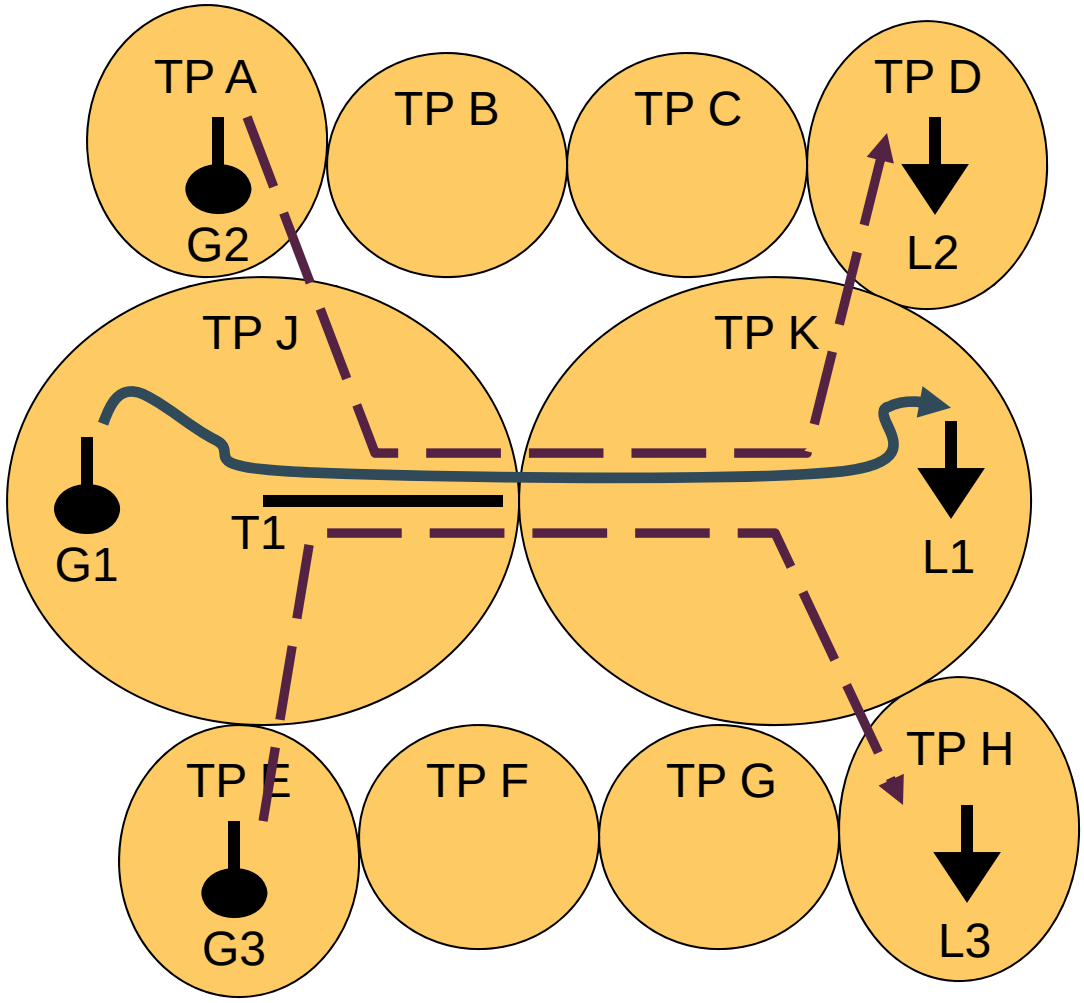
Etag from G2-L2 is an Unscheduled Flow on T1

Etag from G3-L3 is an Unscheduled Flow on T1

The purpose of the "flow" illustration is only to show impact on T1. Clearly the flow distributes throughout the grid based on physics.

UFMP example:

Assume TSR A-D and TSR E-H have same % TDF on Qualified Path T1



Discussion:

Under UFMP today, TSR A-D and TSR E-H would both be curtailed at the same step and by the same amount. Also TSR J-K would curtail (accommodate) to permit some continuation of TSR E-H.

In other words, the UFMP is not able to differentiate between the F7 external flow and the N2 external flow. And UFMP compels F7 Accommodation of N2.

The proposed EIS would instead curtail all N2 flow impacts on the limiting element prior to F7 cuts or F7 redispatch.

Toolkit Component 2

Energy Imbalance

Today’s energy imbalance

- Each BA must set aside resources to provide balancing service
- As BA variability increases, the amount of flexible reserve that must be set aside by each BA increases along with corresponding costs
- For variable resource transactions that cross balancing areas, present WECC interchange scheduling rules are inefficient

Toolkit proposal – Energy imbalance

- Real-time energy imbalance transactions occur on unused transmission capability
  - Regional balancing pool eliminates the artificial limitation of the balancing area boundary
  - Multi-party economic dispatch coordination with 5-minute setpoint adjustments
- Replaces OATT Schedules 4 and 9 on participating transmission provider systems

Energy Imbalance Service - EIS

- EIS creates a holistic solution
- For example: bilateral dynamic scheduling only moves the problem
- Bilateral dynamic scheduling does not capture the aggregate diversity benefit
    - It does establish infrastructure that could be used by an EIS
- EIS captures aggregate diversity benefit

Overview of EIS Concepts

Note the WECC EIS initial specification proposal is still in a drafting phase

EIS toolkit concepts

- An EIS-style tool retains the majority of grid delivery on the basis of traditional self-schedule or bilateral dispatch
  - For example: In the SPP EIS 90% of the energy delivery to load continues under these mechanisms
  - In SPP the remaining 10% EIS-based dispatch uses voluntary offers from generators to manage congestion and supply energy imbalance.
  - The EIS-style design provides for real-time dispatch operation only
  - “Schedules" against which imbalance service is calculated must be provided to the EIS Market Operator by a deadline prior to the operating hour

EIS toolkit concepts

- The EIS design leaves unit commit decisions with individual market participants
  - The option to offer resources for economic dispatch to the EIS remains with the generator owner. (This is not a must-offer requirement as exists in full-LMP-based RTO markets.)
  - Just like today, each load-serving entity must bring sufficient available resources to real-time operations to meet their load obligation

EIS toolkit concepts

- The EIS design does not require Balancing Area consolidation, as demonstrated by SPP's experience
  - ACE Diversity benefits are achieved under an EIS design with the added benefit of a security-constrained evaluation of the pseudo-tie transfers
    - Energy balances are settled financially rather than through adjustments to inadvertent

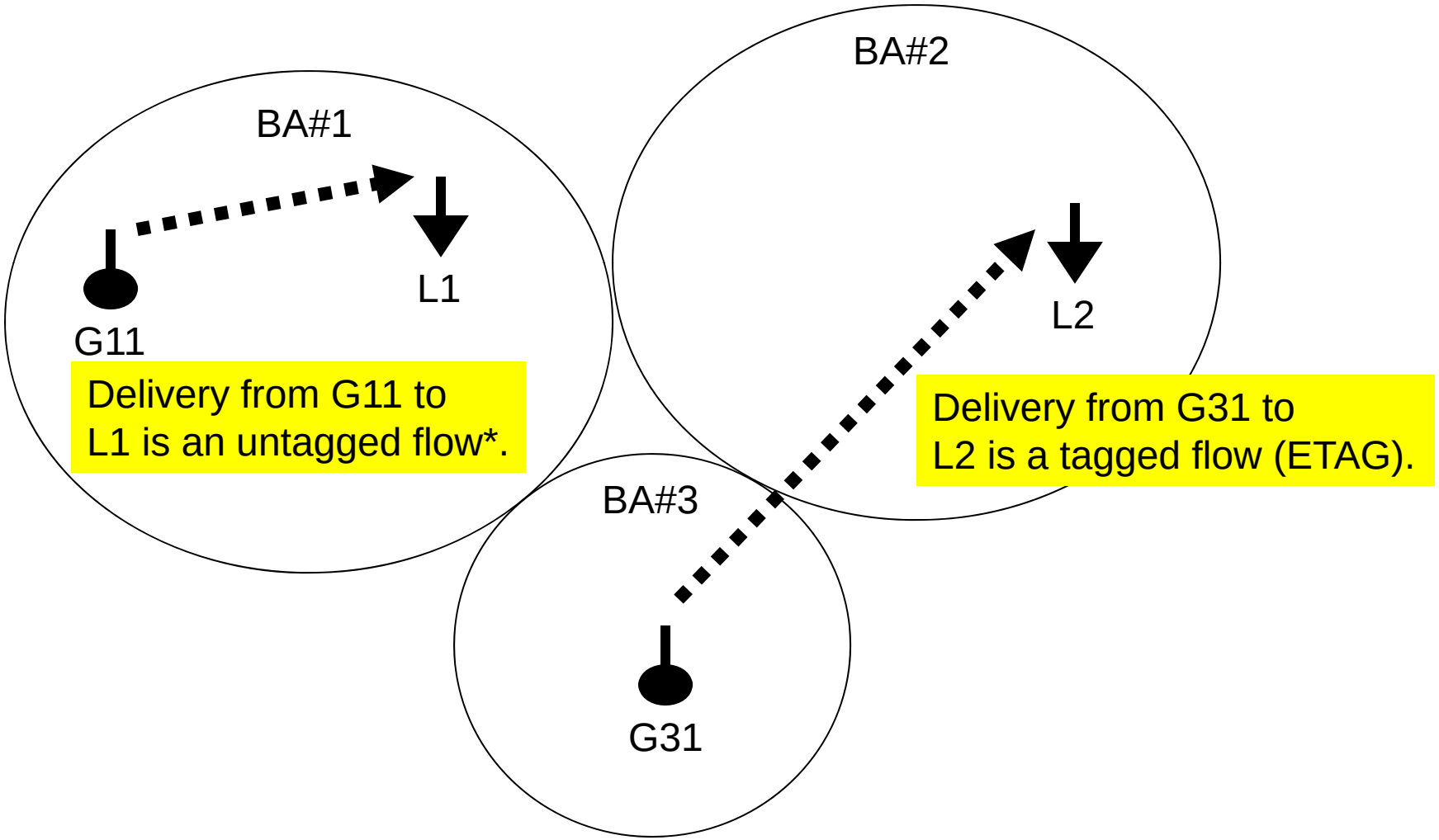
EIS toolkit concepts

- The WECC EIS design leverages the existing investment in WECC Reliability Coordinator Infrastructure
  - Makes use of existing State Estimator and Contingency Analysis software already in-use as well as WECC-owned (but currently unused) optimal power flow software

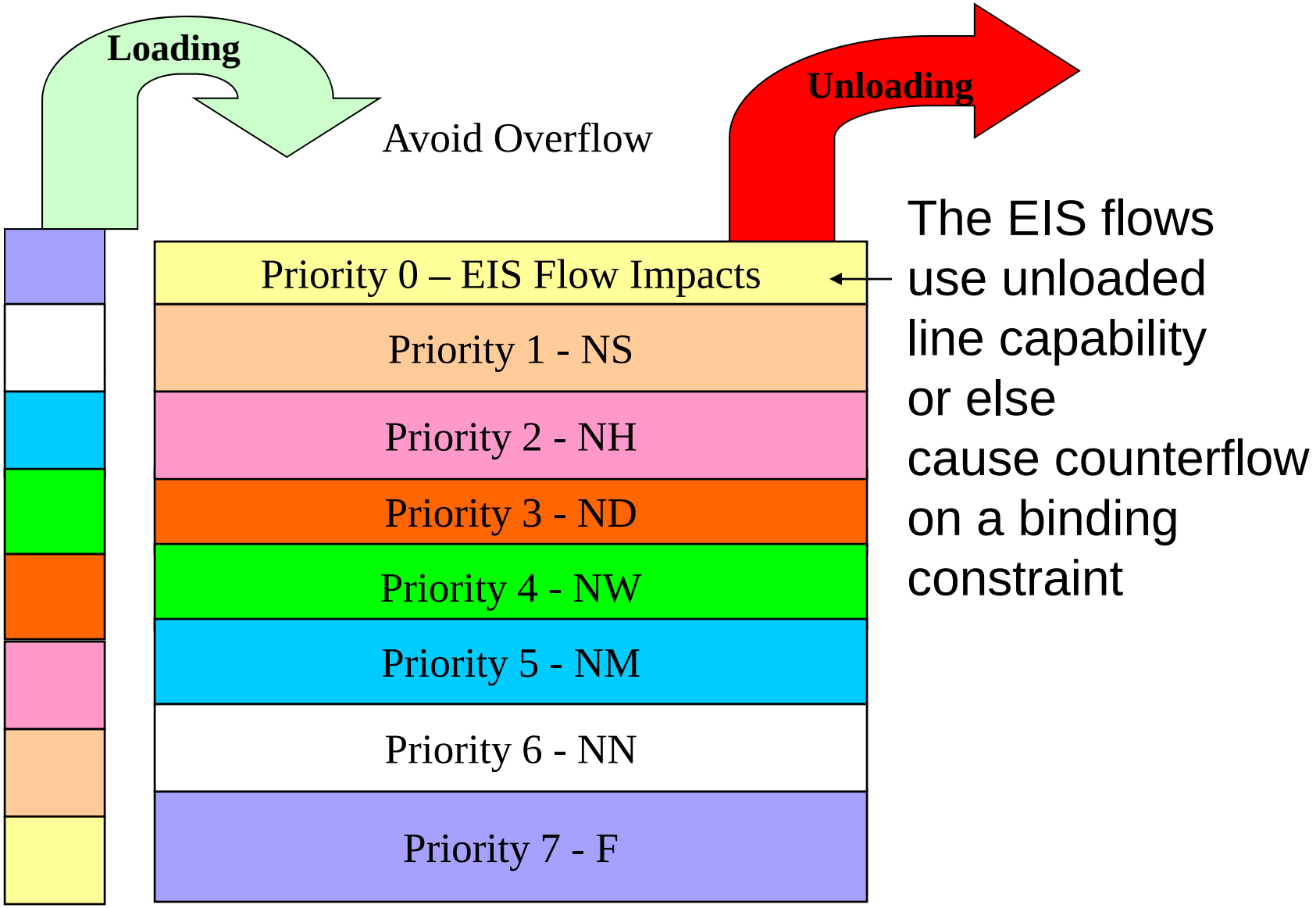
Priority of Toolkit Flows

- Proposal: the redispatch and energy imbalance flows will be evaluated with a curtailment priority of zero
  - In other words, toolkit flows are not allowed to cause curtailment of any tagged OASIS transactions or any firm network service flow

Flow “types”


BA#1
BA#2
BA#3
L1
L2
G11
G31
Delivery from G11 to
L1 is an untagged flow*.
Delivery from G31 to
L2 is a tagged flow (ETAG).

Curtailment priority coordination concept:

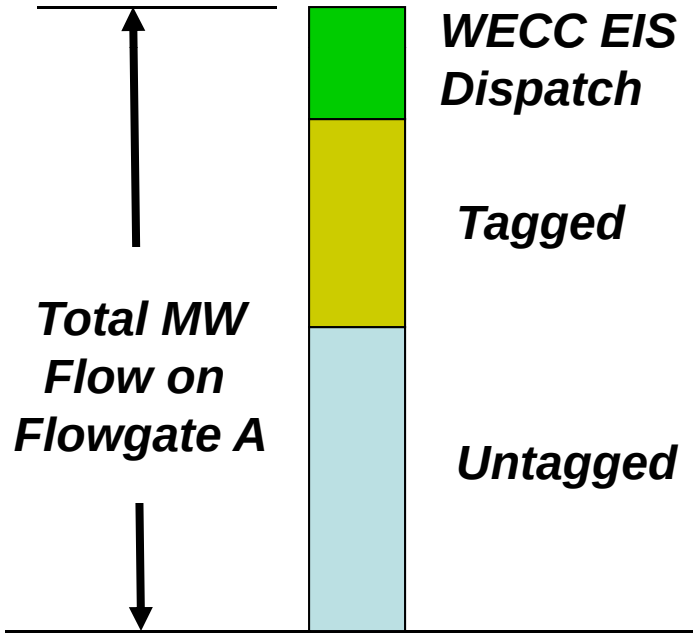


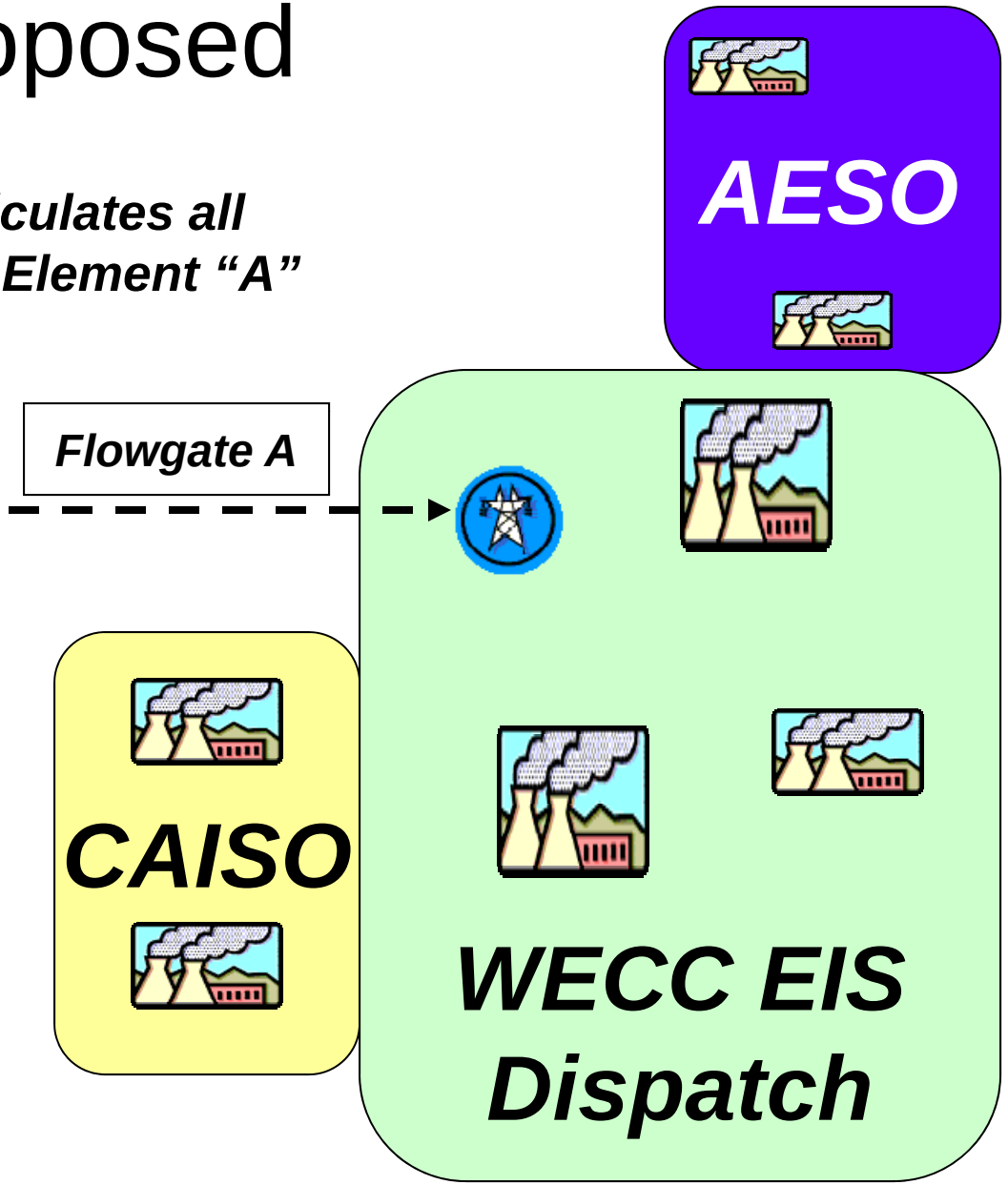
The EIS flows use unloaded line capability or else cause counterflow on a binding constraint

Notes: No displacement of same priority transactions except Firm. Firm curtails pro-rata.

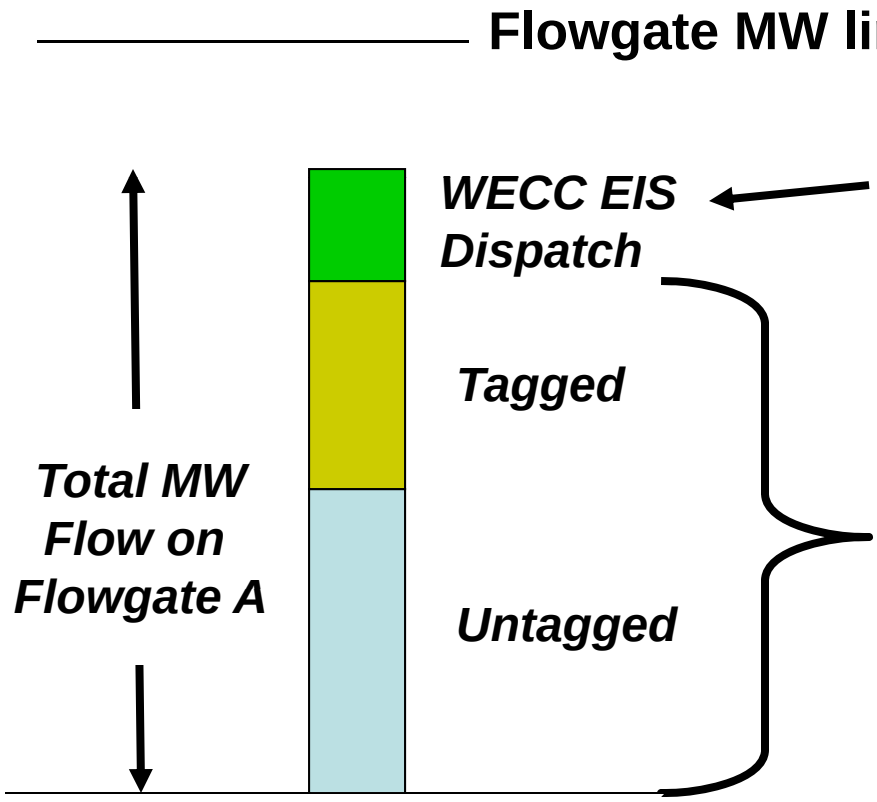
Determining source of flows - proposed

Seams coordination tool calculates all components of flow on grid Element "A"





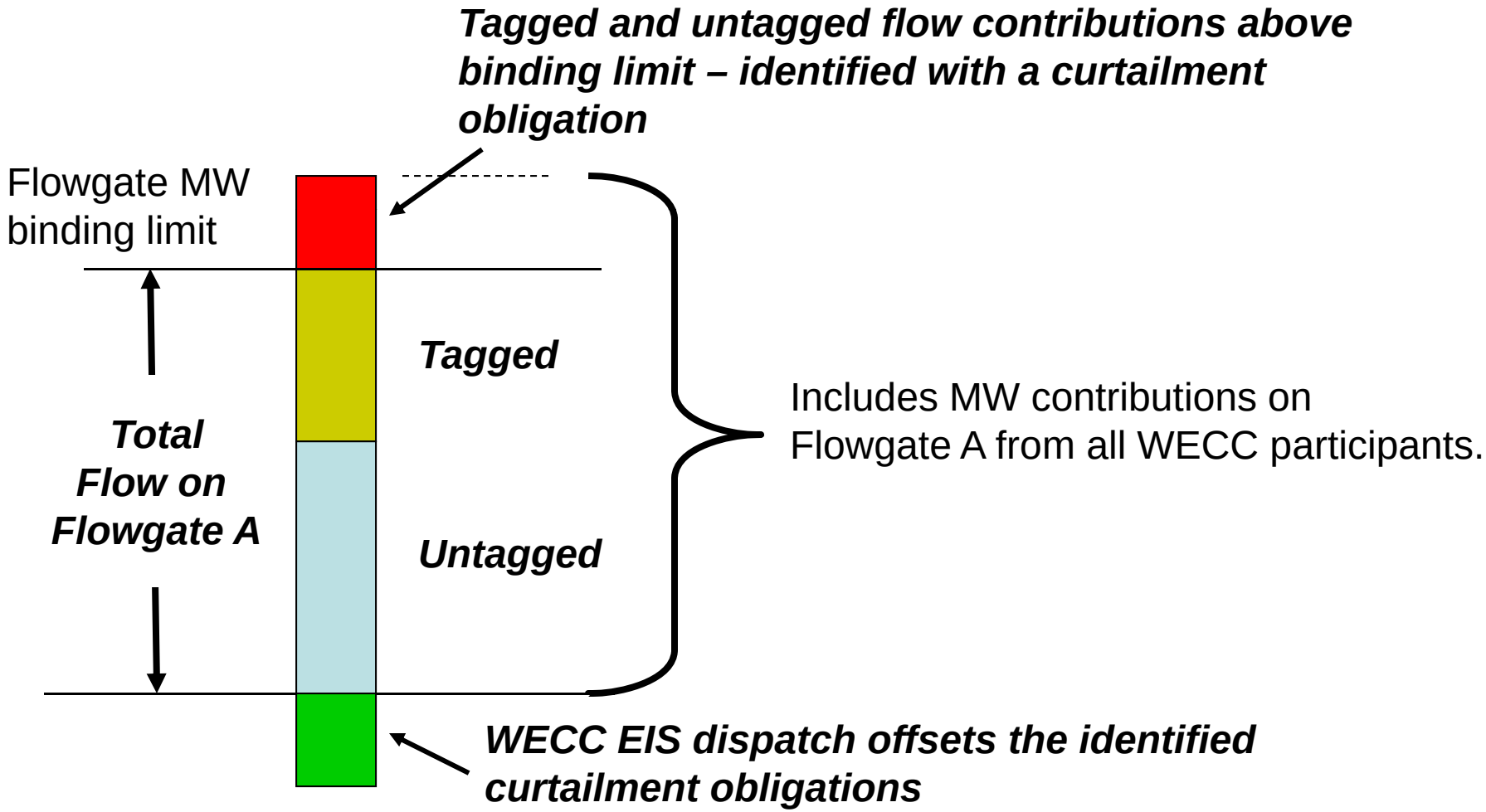
In this example EIS flows for imbalance are within the line loading limit



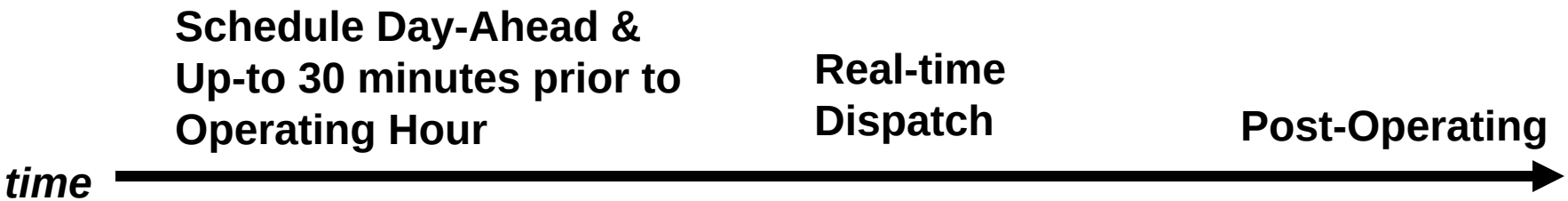
No need to limit the EIS MW amount since there is no congestion on Flowgate A.

Includes MW contributions on Flowgate A from all WECC participants.

In this example EIS flows offset the flow components that have a curtailment obligation



Operation Timeline and Activity for the WECC EIS Toolkit



Market Participant:

- ✓Forecast and unit Commit
- ✓Generators self-schedule
- ✓Generators voluntary submit offers
- ✓DSM resources voluntary submit offers
- ✓Prepare and finalize pre-dispatch schedules

WECC EIS Market Operator:

- ✓Perform security-constrained economic dispatch to keep balance
- ✓Provide redispatch if any congestion occurs
- ✓Send dispatch set points to generators
- ✓Coordinate any contingency reserve deployments With EIS dispatch

- ✓Gather meter data to support settlements
- ✓Provide settlement statement and invoices

Transmission Provider:

- ✓Provide meter data to support settlements

Summary and Next Steps

Busy spring…

Timeline and goals

- Stage 1: Benefits and costs analysis
  - Plan:
    - Three separate components to analysis activity
    - Begin in 2010, still need funding!
  - Duration: ~5-7 months
  - Result: Information for a go or no-go decision by WECC Stakeholders and Board of Directors for EIS development by April 2011

Timeline goals

- Stage 2: If “Go” = Project development activity
  - Prepare mid-level design specification(s)
  - Prepare regulatory, organizational and funding plans
  - Duration: 1 – 1.5 years
  - Result: Ready to arrange vendors and proceed to implementation of the EIS market and seams coordination tool

Timeline goals

- Stage 3: Project implementation activity
  - EIS software and settlements
  - Requisite tariff filings
  - Market testing pre-launch
  - Initiate EIS operations
  - Duration: TBD
  - Result: functioning regional toolkit for redispatch and energy imbalance services

Summary and next steps

- Presentation to WECC joint standing committees on 3/11/10
- Ballot by WECC MIC on benefit/cost plan
- Continue coordination of WECC SIS work with the Western Interstate Energy Board State & Provincial Work Group on Transmission Utilization
- Ballot by WECC board on study funding in April

Indicative Cost and Benefit Areas

Study scope and plan for analysis of Benefits and Costs…

Indicative cost and benefit areas

- Costs Analysis:
  - -Capital estimate
  - -Ongoing O&M estimate
- Benefit Analysis – two methods:
  - – Coordinated production cost modeling
  - – Impact on reduced flexible reserve requirements

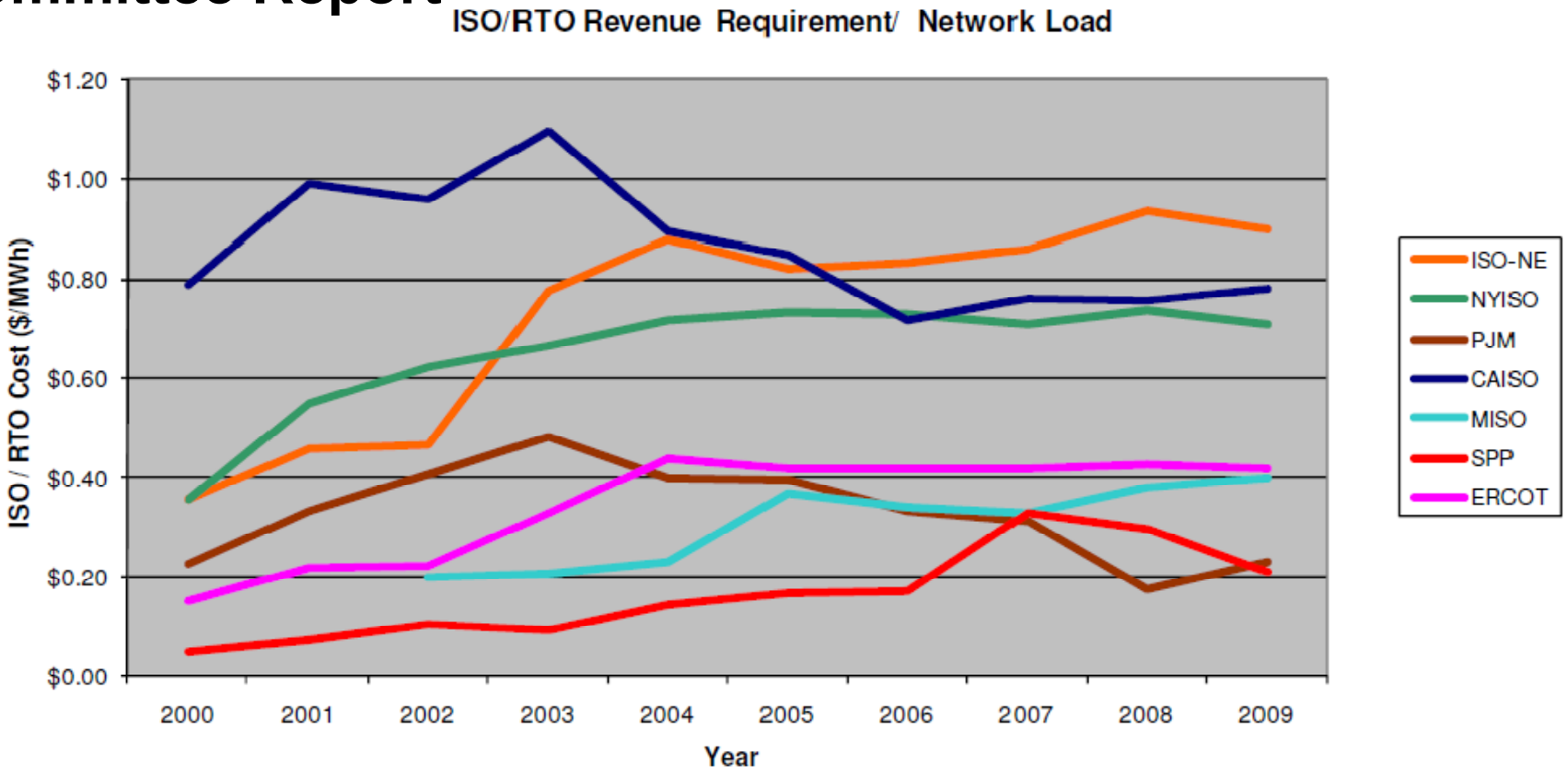
Policy of WGA Task Force

- WGA task force on grid utilization
  - DOE funding award of ~$12M
  - Policy promoting “technological and institutional improvements that minimize the cost of integrating variable renewable generation while maintaining system reliability”

Hypothetical allocation of development costs

- Seams coordination tool costs could likely be allocated over entire WECC footprint
  - All interconnected systems coordinate impacts with neighbors
- Energy imbalance/congestion tool costs could be allocated to participating entities over the non-CAISO and non-AESO parts of the region (Canadian and Mexican aspects to be determined)

Source: December 2009 MISO Board of Directors Finance Committee Report



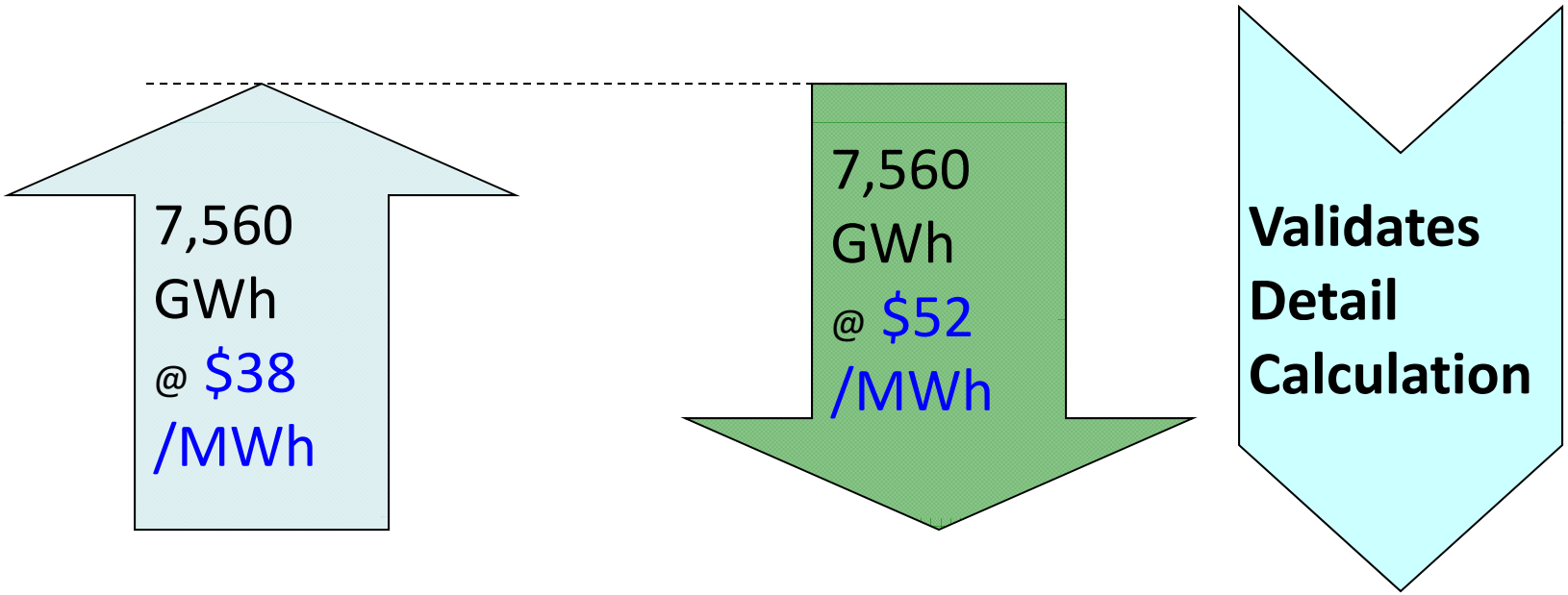
WECC will need to establish a cost allocation for the development of the toolkit. This slide compares the cost per MWH of end-use load for some of the ISO/RTOs in North America. The WECC already has some foundational work complete.

SPP costs

- Capital estimate
  - Initial investment over 6 years
  - Continued investment
- Ongoing O&M estimate
- Benefit areas:
  - Economic dispatch benefits (next slide)
  - Renewable integration benefits (EDE example)
  - Congestion redispatch benefits (handouts)
  - Enhanced reliability benefits

Actual 2007 SPP Results

Incurred	**Avoided**	**Trade Benefit**
$286 Million	- $ 393 Million	= $ **107 Million**



Detail Transactional Calculation = $103 Million

SPP EIS Market Overview

Basis for WECC toolkit design proposal…

SPP Evolution to Today

- 1997 – Reliability Coordination
- Transmission Tariff Administration
  - 1998 – Non-Firm and Short-Term Firm Point to Point
  - 1999 – Added Long-Term Firm Point to Point
  - 1999 – Added Network Service
- 2001 – Electronic Scheduling
- Charles Rivers Associates (CRA) B/C study 2004-05
  - Involved extensive simulation modeling, benchmarking & overall study process
  - Estd an overall 10 Yr saving of $1.1 Billion
  - Estd year 2007 saving $80 Million within market
- 2007 – EIS Market

Benefits of the SPP EIS Market

- Increased use of transmission capacity for economic exchange of energy
- Transparent and economic congestion relief
- Asset owners benefit from pooling their resources and gaining access to lower, more transparent pricing.
  - **GenCos benefit by having the option of reducing their generation and buying lower cost energy from the SPP market to serve their load, and by offering their generation into the marketplace for exposure to an increased customer base.**
  - **GenCos are also able to more closely operate to their economical efficiency point.**
  - **LSEs benefit from more efficient competition among suppliers (generators) which lowers spot energy prices.**

SPP EIS Market Highlights

- Spot Balancing energy market
- Locational Imbalance Pricing (nodal)
- Voluntary Offers on Resources
- Charges
  - Imbalance Energy
  - Uninstructed Deviation Charge
- Hourly Settlement – Weekly Invoicing
- Physical Transmission Rights – Built on Existing Transmission Reservations and Scheduling
- Self-commitment of Resources by Owners

SPP EIS Market Highlights

- The financial impact on both resources and load is within the “control” of the participants through the use of energy schedules and status of resources.
- Load and resources are subject to financial settlement of Imbalance Energy.
- Participants with both load and resources have the hourly imbalance settlement for both load and resources netted prior to invoicing.

EI = Actual - Scheduled

SPP EIS Market Highlights

- The EIS market is not, by its nature, thick or thin.
  - The participation by resources in selling energy into the market and setting price is based upon each participant's evaluation of the benefits of selling energy to the market, and submitting offers accordingly.
- Resources may either offer and sell into the market (Available status) or Self-dispatched and serve scheduled transactions and/or native load.

EI = Actual - Scheduled

SPP EIS Market Highlights

- Dispatch is regional and is calculated using a security constrained, offer-based economic dispatch (SCED) every 5 minutes.
- If a resource is Self-dispatched, it is still subject to imbalance settlement if actual output does not match scheduled output.
- Any resource that is offered into the market has the entire asset subject to dispatch (within the offered "Dispatchable Range").

EI = Actual - Scheduled

“Market” Comparison

MISO PJM	**SPP**
• Real-time Energy Market	• Real-time Energy Market
• Locational Pricing	• Locational Pricing
• Day-Ahead Energy Market	• No Day-Ahead Market (Bilateral Market Used)
• Financial Transmission Rights	• Physical Transmission Rights
• Security Constrained Unit Commitment	• Unit Commitment by Owner
• Mandatory Offers	• Voluntary Offers
• Energy Schedules without reservations	• Energy Schedules using reservations
• Consolidated BAs	• No BA consolidation

Energy Imbalance Service (EIS)

What is “Imbalance Energy”?

- Imbalance energy (or Energy Imbalance) is the difference between what actually happens for each generator and load location, and what they prearranged through schedules.

Energy Imbalance = Actual Production/Usage – Scheduled Production/Usage

EI = A - S

- Asset owners instructed to move their generation output based on offer curves while maintaining reliability and balance (matching generation to load).
- The amount of increase or decrease in generation is paid for by the asset owner needing the energy.

What is the “Energy Imbalance Service”?

- EIS is the dollar amount associated with the imbalance energy.
- EIS is calculated by taking the amount of Energy Imbalance and multiplying by the price at a specific point on the energy grid.

Energy Imbalance Service = Imbalance Energy x Locational Imbalance Price (LIP)

EIS = EI x LIP

What is the “SPP Energy Imbalance Service” Market?

- Provides asset owners the infrastructure to offer resources into a marketplace for providing Energy Imbalance.
- SPP is responsible for accounting and financially settling all EIS amounts.
  - SPP remains revenue neutral
- Does not supersede any MP’s obligations with respect to any other capacity or ancillary service obligations.
  - Control Areas (CA) and asset owners will continue to use the same procedures used today to manage capacity adequacy, reserves, and other reliability-based concerns.
- All asset owners must register with the SPP EIS market.

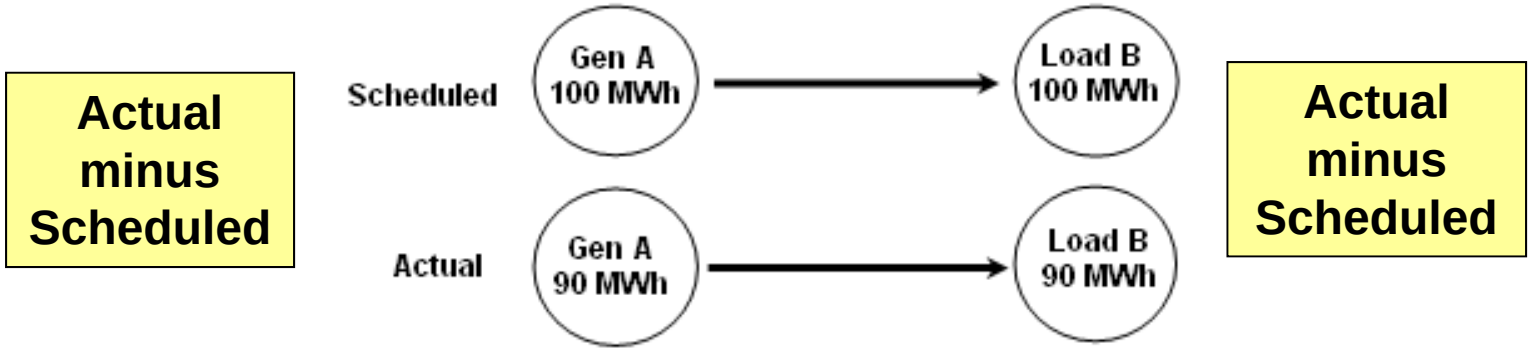
Imbalance Energy Example

Imbalance (Gen A) = (-90 MWh Actual) – (-100 MWh Scheduled)

Imbalance (Gen A) = 10 MWh

Imbalance (Load B) = (90 MWh Actual) – (100 MWh Scheduled)

Imbalance (Load B) = -10MWh



Notice that even though the *system* was in balance (generation matched load), by definition there was an imbalance at each location. Actual and Scheduled were not equal.

Note: Generation Injections are (-) and Load Withdrawals are (+) as viewed from an SPP settlement reference frame for EIS.

Settling an Imbalance Financially

Suppose the following:

LIP @ (Gen A) = $30/MWh

LIP @ (Load B) = $40/MWh

The resulting charges would be:

EIS (Gen A) = $30/MWh x 10 MWh = $300 (MP pays SPP)

EIS (Load B) = $40/MWh x -10 MWh = -$400 (SPP pays MP)

NOTE: **A (+) EIS indicates that SPP will receive payment from the Participant (a charge)**
A (-) EIS indicates that SPP will pay out to the Participant (a credit)

- **The net imbalance is zero (generation equaled load), but there is a net payment of $100 ($300+(-$400)) to Load B because of different prices at different points in the system.**

EIS Tariff Activity

Impact on transmission revenues

- An additional aspect to the WECC development option is the need to protect transmission revenues
- Participating transmission owners could provide inputs into a rate design for the EIS adder
- Possible rate design goals
  - Hold harmless from present revenue levels, with annual true-up mechanism
  - Establish potential for increased revenues based on successful utilization of the EIS toolkit
  - Note – transmission providers retain their own tariffs

Umbrella tariff proposed

- Service only for real-time imbalance and redispatch
- Replace some service sold under current OASIS
  - Replace Schedules 4 and 9 (imbalance service) for all participating transmission providers
  - Recover the EIS market development and administration costs through a fee levied against only the EIS settlement volumes
  - Recover revenues for Member Transmission Providers to replace their lost sale of Hourly non-firm (priority 2) transmission service, which would be largely replaced by deliveries under the EIS

Initial tariff cost recovery assumptions

- Tariff must do the following:
  - Recover WECC EIS administrative costs
  - Provide true-up to participating transmission providers for lost hourly non-firm revenues
    - Transmission Revenue Recovery Fee
  - Replace OATT Schedule 4 and Schedule 9 for participating transmission providers

Rough Estimate of EIS Cost

- SPP EIS market clears 10% of the demand in the region
- The SPP EIS all-in cost recovery is $0.20/MWH
- Estimate of WECC EIS cost is under development
- Similar costs and volumes for US-WECC footprint excluding CAISO would yield ***very roughly estimated*** $0.50/MWH of EIS settlement volume (i.e. applied to both purchase MWH and sales MWH)
  - Assume WECC US-non-California annual energy volume of 543,200,000 MWH/yr (from WWSIS 2017 fcst)
  - Assume 50,000,000 MWH EIS Demand Cleared/yr
  - The $50M/yr revenue would fund an operation far larger than SPP, and WECC already has sunk costs that would contribute to the EIS operation

Rough Estimate of TRRF

- The tariff proposal would recoup lost revenue through an EIS Transmission Revenue Recovery Fee that would be distributed to participating transmission providers
- Estimate of fee in development, but the flat “hurdle rate” could be build into the SCED more simply than a path-based transmission cost recovery method

WECC Toolkit Funding

- Seams coordination tool: cost to all entities in WECC footprint
  - A Reliability Coordinator tool with traditional WECC funding
    - Costs to support EIS role are allocated to EIS
- Energy Imbalance Service (EIS) tool: cost to participating transmission owner's network and point-to-point customers
  - Tool development and operation costs recovered from EIS participants

Future Tariff Group Contract Issue:

Example: SPP Contract w. Balancing Areas
Transfers compliance responsibility

- *Scheduled and Actual Interchange:*
  - *INT-002, -003 and -004; BAL-006*
- *EIS Market:*
  - *IRO-006; BAL-006; INT-002, -003*
- *Dynamic Scheduling and Inadvertent Interchange:*
  - *BAL-005, -006*
- *Balancing Authority Area Control and Performance:*
  - *BAL-001, -002, 003; TOP-002; EOP-001*
- *Data Exchange:*
  - *TOP-002, -005*
- *Ancillary Services:*
  - *Section 3 of Open Access Tariff*
- *Emergency Operations:*
  - *EOP-002, -003, -008*

Some open design issues…

Full development after benefit/cost study indicates results would be worthwhile

Retain the UFMP Pyramid?

- Should the UFMP pyramid method be retained once there is an option to purchase redispatch at any level of curtailment obligation?
- SIS consensus is to propose pro-rata curtailment responsibility allocations, once there is an EIS toolkit to manage the redispatch cost allocation (improved liquidity)

Losses in EIS Dispatch

- SIS proposes to use marginal loss evaluation in the SCED calculations to manage imbalance and redispatch

COPS/UFMP

- SIS proposes to discuss with the UFAS group the potential design for integrated operations
  - Phase-Shifting Transformers (PSTs)
  - Congestion management process steps
  - Recourse to UFMP command and control if EIS response is not available or sufficient

Extra stuff – Bonus technical info

Flow impact evaluation

• Self-scheduled (NLS) →	System POR	System POD
• ETAG →	Tariff POR	Tariff POD
• EIS Gen setpoint →	Gen node MW	Aggregate load
• EIS Demand value →	Aggregate gen	System POD

Definitions:

System POR – all dispatchable generation resources scaled in balancing area
System POD – all LSE load served in balancing area
Tariff POR – Specific generator source points identified in OASIS
Tariff POD – Specific load interconnection or system POD delivery points in OASIS
Gen node – specific generator modeled by EIS state estimator
Aggregate load – all load eligible for EIS settlement
Aggregate gen – all generation eligible for EIS settlement

WECC-Funded CRAT

- Curtailment Responsibility Allocation Tool
  - The UFAS recently passed a recommendation to the OC that WECC take on this tool responsibility (currently self-provided through webSAS)
    - The UFAS did not include any details as to tool capability
    - UFAS concern is that if FERC approves the proposed IRO-006-WECC-1 standard, subscribers will drop their webSAS subscription, causing the cost to go up significantly to anyone retaining the program until support is either dropped or the cost of the service is picked up by the region
    - The UFAS Task Force working on refining the existing UFMP process and will continue to propose
      - As changes are agreed to by WECC, OATI would be given change orders (in a process similar to the IDC change process at NERC) and the tool would be modified as directed.
  - The WECC OC will have to approve it and send the recommendation on to the Board to see if the Board is willing to enter into a contract for the tool. Since this will impact the budget that must be approved by FERC, we are hoping that it could be included in the 2011 budget that the Board will be discussing in April

Can't be done without balancing area cooperation – WWSIS Study

Summary Statistics for 10-Minute Delta
Zone -> Wyoming -> Footprint -> WECC
Local Priority Scenario

	BEPCWA	BHPLA	WYCENA	WYNWA	WYSWA	TRSTWYOA	WACMA	WY	In FootPrint	WECC
Sigma (MW)										
Load-alone	2	2	2	3	3	1	2	15	239	731
Baseline (Existing)	2	2	8	3	17	2	2	23	240	734
10% In FP Scenario	2	2	15	4	17	3	14	31	245	718
20% In FP Scenario	2	2	33	8	17	18	27	56	260	718
30% In FP Scenario	2	2	47	9	18	53	36	93	286	728
Max Neg Delta (MW)										
Load-alone	-7	-8	-10	-10	-11	-3	-8	-53	-708	-2239
Baseline (Existing)	-7	-8	-91	-10	-335	-29	-8	-334	-810	-2279
10% In FP Scenario	-7	-8	-162	-56	-335	-35	-369	-340	-867	-3734
20% In FP Scenario	-7	-8	-409	-170	-335	-439	-860	-962	-1216	-3672
30% In FP Scenario	-7	-8	-590	-170	-308	-809	-1128	-1476	-1641	-4270
Max Pos Delta (MW)										
Load-alone	11	13	16	17	19	6	7	84	612	1786
Baseline (Existing)	11	13	90	17	227	27	7	228	710	1865
10% In FP Scenario	11	13	168	50	227	31	264	290	873	2093
20% In FP Scenario	11	13	443	134	227	276	548	630	1075	2172
30% In FP Scenario	11	13	618	134	227	620	716	994	1416	2681

Corrected for 2/3 Data

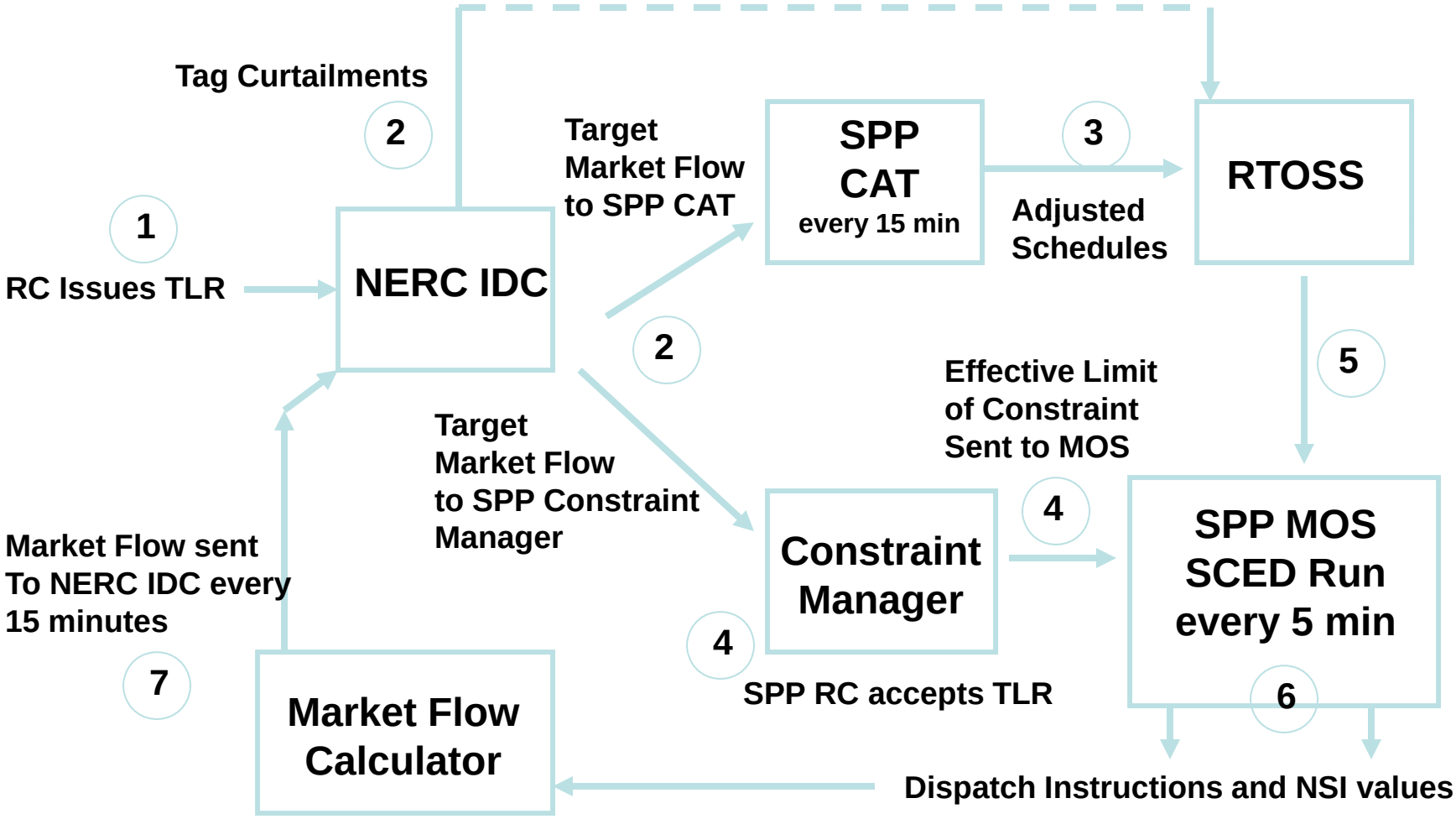
WestConnect WWSIS Analysis Results

	Ariz			CO-E			CO-W			NM			NV			WY			In Foot Print			WECC		
	IA	LP	MP	IA	LP	MP	IA	LP	MP	IA	LP	MP	IA	LP	MP	IA	LP	MP	IA	LP	MP	IA	LP	MP
Sigma (MW)																								
Load-alone	97	97	97	61	61	61	6	6	6	25	25	25	52	52	52	15	15	15	239	239	239	731	731	731
Baseline (Existing)	97	97	97	65	65	65	6	6	6	31	31	31	52	52	52	23	23	23	240	240	240	734	734	734
10% In FP Scenario	107	105	97	69	69	69	11	10	7	33	36	43	57	56	53	24	31	49	243	245	246	717	718	719
20% In FP Scenario	128	116	100	80	81	71	19	16	7	43	46	54	68	63	55	34	56	108	259	260	268	716	718	722
30% In FP Scenario	146	128	106	98	89	72	25	20	10	54	56	70	79	69	57	46	93	157	284	286	301	728	728	734
Max Neg Delta (MW)																								
Load-alone	-348	-348	-348	-223	-223	-223	-20	-20	-20	-86	-86	-86	-200	-200	-200	-53	-53	-53	-708	-708	-708	-2239	-2239	-2239
Baseline (Existing)	-352	-352	-352	-412	-412	-412	-20	-20	-20	-260	-260	-260	-200	-200	-200	-334	-334	-334	-810	-810	-810	-2279	-2279	-2279
10% In FP Scenario	-901	-772	-406	-412	-420	-409	-134	-109	-41	-252	-240	-354	-367	-340	-250	-327	-340	-903	-843	-867	-991	-3744	-3734	-3706
20% In FP Scenario	-1367	-1052	-367	-825	-829	-490	-234	-205	-60	-394	-408	-532	-568	-565	-305	-401	-962	-1725	-1360	-1216	-1821	-3656	-3672	-3713
30% In FP Scenario	-1616	-1169	-418	-1082	-956	-559	-288	-239	-91	-516	-565	-708	-767	-633	-386	-501	-1476	-2274	-1576	-1641	-2325	-4266	-4270	-4308
Max Pos Delta (MW)																								
Load-alone	267	267	267	195	195	195	22	22	22	106	106	106	206	206	206	84	84	84	612	612	612	1786	1786	1786
Baseline (Existing)	269	269	269	306	306	306	22	22	22	147	147	147	207	207	207	228	228	228	710	710	710	1865	1865	1865
10% In FP Scenario	711	590	289	334	336	364	160	93	30	166	201	320	319	311	209	233	290	567	899	873	770	2084	2093	2118
20% In FP Scenario	917	784	887	548	555	360	211	197	51	323	358	448	455	449	233	459	630	1069	1193	1075	1219	2211	2172	2203
30% In FP Scenario	1169	1041	1207	1010	804	426	296	221	93	462	466	543	582	519	293	649	994	1805	1430	1416	1542	2728	2681	2677
No. Drops > 3* Ld Sigma																								
Load-alone	18	18	18	36	36	36	90	90	90	45	45	45	54	54	54	45	45	45	0	0	0	9	9	9
Baseline (Existing)	18	18	18	155	155	155	90	90	90	617	617	617	54	54	54	1458	1458	1458	12	12	12	9	9	9
10% In FP Scenario	203	158	21	296	323	302	2163	1367	294	822	1121	1938	219	185	59	1649	2979	6399	44	42	62	6	6	11
20% In FP Scenario	672	350	47	669	687	362	5426	4298	476	1977	2262	3188	680	464	117	3638	7836	12968	125	140	224	6	5	11
30% In FP Scenario	1172	632	159	1388	995	344	7884	6074	1415	3156	3452	5262	1317	684	156	5993	12185	15905	240	284	468	17	17	42
No. Rises > 3* Ld Sigma																								
Load-alone	0	0	0	36	36	36	72	72	72	107	107	107	27	27	27	405	405	405	0	0	0	0	0	0
Baseline (Existing)	0	0	0	66	66	66	72	72	72	449	449	449	35	35	35	1563	1563	1563	0	0	0	0	0	0
10% In FP Scenario	165	123	0	194	236	204	1956	1194	236	636	951	1940	198	138	45	1779	3144	6681	15	15	12	0	0	0
20% In FP Scenario	722	419	132	738	764	303	5663	4521	386	2043	2367	3611	714	468	74	3801	8039	13319	203	171	212	2	0	2
30% In FP Scenario	1284	782	357	1656	1209	435	7983	6146	1908	3497	3864	5850	1350	824	191	6288	12513	16353	521	476	599	63	48	50

SPP Congestion Management Tools

SPP Congestion Management Tools:

Interaction of Congestion Management Tools



Inventory

- **Interchange Distribution Calculator (IDC)**
  - **NERC tool used by Eastern Interconnection RCs to manage parallel flows.**
  - **Calculates impact of tagged transactions and Network/Native Load (NNL) on flowgates.**
  - **Prescribes equitable curtailment of tags, NNL, and market flow.**
- **Market Flow Calculator**
  - **Used to calculate impacts of SPP market dispatched generation and native load schedules on flowgates.**
  - **Market flow in appropriate priorities are calculated for current hour and next hour and submitted to IDC every 15 minutes.**

Inventory

- **Curtailment/Adjustment Tool (CAT)**
  - **Administers curtailments and/or adjustments of schedules not curtailed by the IDC when internal flow reduction is required.**
  - **“Curtailments” describes reductions of schedules from self-dispatched resources.**
  - **“Adjustments” describes reductions of schedules from market-offered resources.**

Functional Description

- **Constraint Manager**
  - **Used by the Reliability Coordinator as an interface to MOS and IDC.**
  - **Displays pertinent constraint data and allows for data input necessary to facilitate constraint management.**
- **Market Operations System**
  - **Employs Security Constrained Economic Dispatch (SCED) logic to calculate a dispatch solution that attempts to maintain flow at or below the effective limit of any activated constraints.**

Curtailment / Adjustment Functions

- **NERC IDC**
  - **Tagged Interchange Transactions that leave or enter SPP Market footprint**
  - **Tagged Interchange Transactions from Self-Dispatched units**
  - **Other Tagged Transactions external to SPP**
  - **Network and Native Load (NNL) external to SPP market footprint**
  - **Market Flow**

Curtailment / Adjustment Functions

- **SPP CAT**
  - **Tagged Interchange Transactions from units that are not Self-Dispatched**
  - **Intra-BA Schedules from Market-Dispatched units (NLS or Tagged)**
  - **Intra-BA Schedules from Self-Dispatched units (NLS or Tagged)**

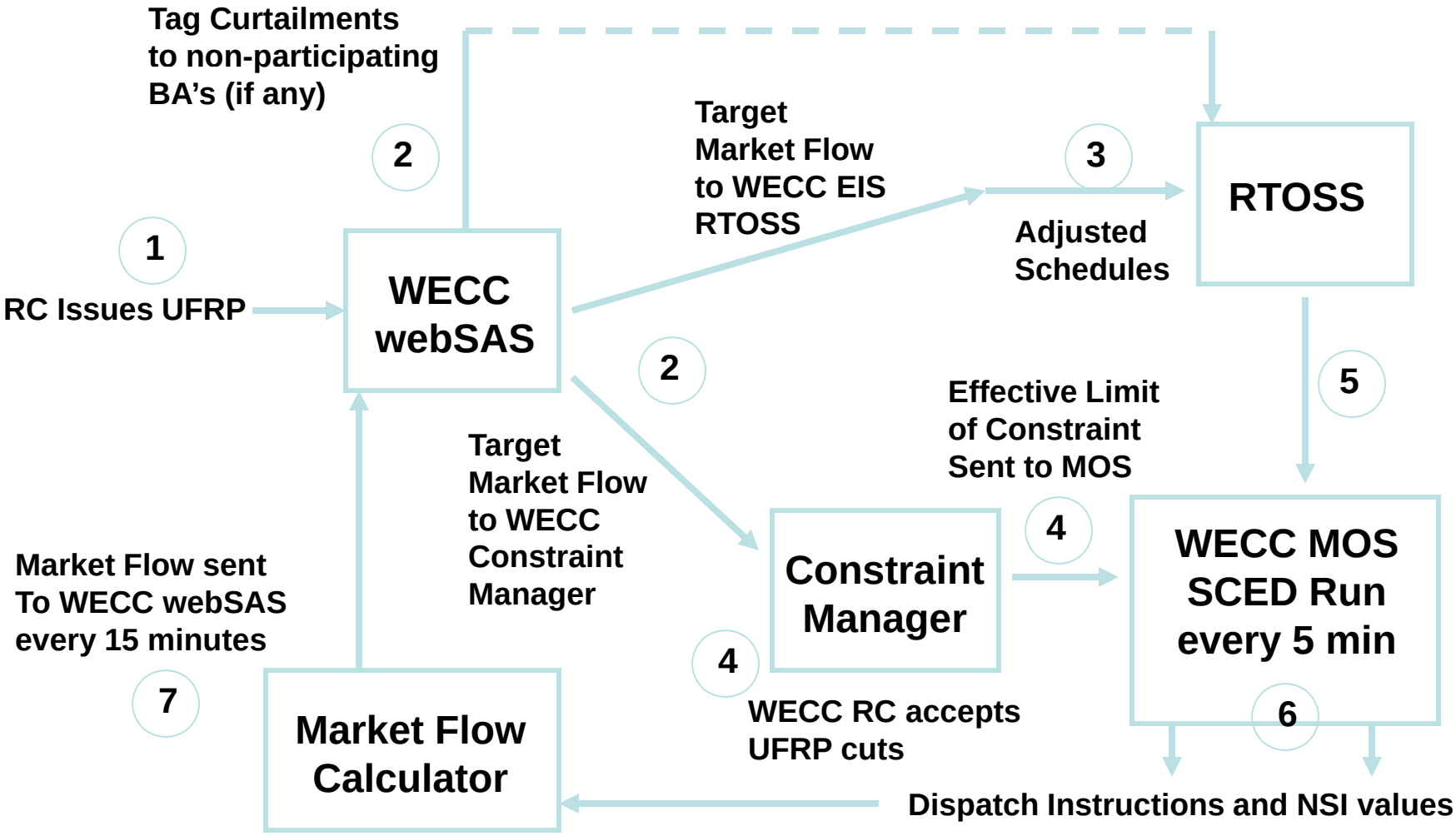
EIS Tools in WECC

Discussion in WECC Context

- The SPP design required two tools to deal with bilateral scheduled transactions (tagged flows)
  - The SPP CAT and also the NERC IDC
  - This was due to the multiple sub-interconnection footprints and the development of the SPP scheduling tools after the IDC was established
- Starting from scratch, WECC can likely develop a single tool (e.g. augmented webSAS capability) rather than two.
  - Less technical overhead!
  - Built-in integration with imbalance/redispatch market

Draft – Potential WECC Congestion Management Tools Process:

Interaction of WECC Congestion Management Tools



Comparing SPP to WECC

Key differences remain…

Comparing SPP to WECC

- Different starting points
  - MIC gave SIS direction to explore development without proposing an RTO; the toolkit is not an RTO proposal
  - An EIS-style toolkit could be specified without the full RTO characteristics, but would still require increased regional cooperation
- Toolkit implementation would include market-to-market seams coordination between CAISO and AESO with the rest of WECC
- Non-RTO transmission service considerations
  - Transmission service rate
  - Imbalance/redispatch service priority

Comparing SPP to WECC

- Differences:
  - SPP was all-in, WECC is not
  - WECC is talking about a phased development
  - They had a single transmission tariff, we do not
    - The WestConnect tariff experiment concept shows potential for use with adaptations by the WECC EIS
- Similarities:
  - They had 13 BAs, we have 37
  - SPP region had seams agreements with MAPP and MISO, we have CAISO and AESO to consider and coordinate

Comparing SPP to WECC

- SPP EIS market was initiated when the Eastern Interconnection had already established the Interchange Distribution Calculator, a tool analogous to an enhanced webSAS in the WECC
- Either WECC toolkit alternative will require augmenting the capabilities provided by the webSAS tool today

WestConnect Discussion Items

Considerations for the group

ColumbiaGrid Activity

- ColumbiaGrid (Jon Kaake and Paul Arnold) are visiting CG members promoting their “Achieving the ColumbiaGrid Vision: Single System Operation” (Feb 2010 draft).
- Three options (with annual operating costs):
  - Balancing and Reliability Redispatch Services (Assistance with Balancing Functions) $1.5M
  - Single Balancing Authority with Balancing Zones (Partial Consolidation of Balancing Functions) $10.2M
  - Independent Grid Operator, with Balancing Area, Transmission, and Market Facilitation Services (Full Consolidation plus Additional Service) $50M-$91M
- CG reports they are trying to gain consensus from the CEOs and top execs of the ColumbiaGrid members

WC Alternatives to WECC EIS

- Potential for an expansion of the SPP EIS market westward, across the DC ties to include the WestConnect footprint
  - Alternatives could include WECC or SPP as the Reliability Coordinator / Regional Entity

Contingency Reserve Sharing

- RMRG is in early talks with NWPP on a contingency reserve group consolidation
- Any prospects for WC participants to provide similar benefits?
- Any interest/possibility for WC to consolidate at same time or in a coordinated way?

END