Proposal for EIM

Issues Related to Joining

And

Exploration of Participation Model

March 2019

Version 2.0

Version History

Version	Description	Date
0.0	Created document	11/29/2018
1.0	Updated through January bilateral meeting with CAISO and BPA	1/22/2019
2.0	Updated through March bilateral meeting with CAISO and BPA	3/15/2019

Table of Contents

Executive Summary: Proposal for EIM 5

Purpose of Documentation 6

- Purpose 6
- Organization of the Document 6

EIM Process Mapping 7

- Parties' Understanding of the Issue and Intended Resolution 7
- Bilateral Discussions of the Issue 7
- Questions remaining to be addressed 8

EIM Agreements 9

- Parties' Understanding of the Issue and Intended Resolution 9
- Bilateral Discussions of the Issue 9
- Questions remaining to be addressed 9

Governance 11

- Parties' Understanding of the Issue and Intended Resolution 11
- Bilateral Discussions of the Issue 11
- Questions remaining to be addressed 11

EIM Settlements 13

- Parties' Understanding of the Issue and Intended Resolution 13
- Bilateral Discussions of the Issue 14
- Questions remaining to be addressed 16

Generation Participation Model (FCRPS) / Resource Aggregation 18

- Parties' Understanding of the Issue and Intended Resolution 18
- Bilateral Discussions of the Issue 21
- Questions remaining to be addressed 22

Late Breaking Constraints 24

- Parties' Understanding of the Issue and Intended Resolution 24
- Bilateral Discussions of the Issue 24
- Questions remaining to be addressed 25

Treatment of Transmission 26

Parties' Understanding of the Issue and Intended Resolution 26
Bilateral Discussions of the Issue 26
Questions remaining to be addressed 26
Market Power 28
Parties' Understanding of the Issue and Intended Resolution 28
Bilateral Discussions of the Issue 28
Questions remaining to be addressed 28
BA Resource Sufficiency 30
Parties' Understanding of the Issue and Intended Resolution 30
Bilateral Discussions of the Issue 30
Questions remaining to be addressed 32
Metering 33
Parties' Understanding of the Issue and Intended Resolution 33
Bilateral Discussions of the Issue 33
Questions remaining to be addressed 34
Relationship of EIM to Other Emerging Markets / DAME & EDAM 35
Parties' Understanding of the Issue and Intended Resolution 35
Bilateral Discussions of the Issue 35
Questions remaining to be addressed 36
Carbon Obligation in EIM 37
Parties' Understanding of the Issue and Intended Resolution 37
Bilateral Discussions of the Issue 37
Questions remaining to be addressed 37
Subject Area Template [Do not Erase] 39
Parties' Understanding of the Issue and Intended Resolution 39
Bilateral Discussions of the Issue 39
Questions remaining to be addressed 39

Executive Summary: Proposal for EIM

To be populated later

Purpose of Documentation

Purpose

The Bonneville Power Administration (Bonneville) is considering whether to join the Western Energy Imbalance Market (EIM) operated by the California Independent System Operator(CAISO). Bonneville and the CAISO are engaged in ongoing bilaterial discussions regarding a myriad of issues regarding how Bonneville could potentially join as an EIM Entity as well as participate in the EIM with certain generation resources of the Federal Columbia River Power System (FCRPS).

This document memorializes the common understanding of Bonneville and the CAISO as they move through bilateral negotiation and towards potential execution of an Implmentation Agreement. An Implementation Agreement will include a scope of work and project/funding schedule to put Bonneville in a position to join the EIM as an EIM Entity and market participant. Following the Implementation Agreement negotiation phase, other tools will be used for follow-on documentation of issue identification and resolution. The template Implementation Agreement includes Exhibit A: Project Scope and Schedule. The first item on the schedule is a Detailed Project Management Plan for EIM Entity Implementation.[1]

While Bonneville is responsible for initially drafting this document, the CAISO is responsible for reviewing, commenting, and proposing edits to its contents. Bonneville will update this document after each discussion with the CAISO, and the CAISO will review, edit, and propose edits to each revised draft. Any areas where Bonneville and the CAISO fail to reach a consensus or common understanding, it will be memorialized in this document.

A new version of the document will be published following each of the bilateral discussion between Bonneville and the CAISO. Mark Symonds will be BPA's primary point of contact for this document.

Who will be the ISO's primary point of contact for the document?

Organization of the Document

This document is organized by issue and describes four items for each issue: 1) scope/description of the issue, including possible linkages to other issues; 2) Bonneville's and the CAISO's respective understandings of the issue ; 3) notes from bilateral discussions of the issue as they occur; and, 4) questions remaining to be addressed on the issue.

[2] Federal Resource Participation ADF v2, page 2-3.

EIM Process Mapping

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

EIM Implementation Tracks

Copy from BPA's stakeholder presentation

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshops. The following summarizes those discussions.

October 22

Janet Morris (ISO) reviewed the EIM tracks and project management approach. She proposed JoAnn Alai, who is currently working with BPA on RC implementation, as BPA's project manager for EIM. JoAnn is based in Portland, OR and has project managed EIM implementations for PacifiCorp and Portland General Electric.

The CAISO approach is to have Track 1 meetings first and concurrently start on Track 2 – Agreements. The goal of having Track 1 meetings first is to look for long poles and risks. Usually metering is one of the long poles.

Follow-up Items

These were the follow-up items to be provided based on our discussion:

Name	Item	Status
Janet and Khaled	Gap analysis on impact assessment	TBD
Janet	Two overview documents: a) On Agreements b) DMM one	Delivered to BPA, but not on Accellion

Janet and Jon	EIM Entity Agreements checklist	TBD
Janet	EIM Resource Data Template	TBD
Jon	Letter from one of Municipals on exemption to Market Based Rate Authority	TBD
Janet	Settlements Configuration Guides	TBD
Don	EIM Entity's EIM GB graphic that he presented in the meeting	TBD

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	Has BPA done an EIM gap assessment?	12/2018	

EIM Agreements

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

List of EIM Agreements

Copy from BPA stakeholder presentation

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

October 22

Jon Anders reviewed…

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Governance

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

EIM governance structure

Insert from Don's graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

October 22

Don Fuller reviewed…

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

EIM Settlements

The purpose of Bonneville engaging with the CAISO on EIM Settlements is to consider approaches to address and/or reduce complexity of EIM settlements, mitigate BPA's cost and credit exposure with the ISO, simplify BPA's customer experience with EIM-related charges, and increase transparency of CAISO data available to verify EIM settlements.

There are no show-stoppers related to signing the Implementation Agreement. Currently, we are not anticipating documenting anything regarding EIM settlements in our Implementation Agreement (subject to change). Nonetheless, this will be a complicated area of EIM implementation for BPA, in that EIM Settlements encompasses settlements between BPA's EIM Entity Scheduling Coordinator (EESC) and the CAISO, BPA's Participating Resource Scheduling Coordinator (PRSC) and the CAISO, and rate treatments for both of these settlements with BPA's Transmission and Power Customers.

Parties' Understanding of the Issue and Intended Resolution

BPA's EIM Settlements scoping team has evaluated areas of risk for the agency and we have communicated eight areas of concern with the CAISO (see ---). In summary, the eight areas are:

EIM Settlements for BPA can be segments into four functional categories. Then there are also additional global EIM settlement issues that cut across functional areas, such as transaparency and dispute resolution.

CAISO Settlement with the EIM Entity Scheduling Coordinator

This is expected to allocate BPA Power's credits and debits received from the CAISO as a Participating Resource Scheduling Coordinator.

Further description…

CAISO Settlement with the Participating Resource Scheduling Coordinator

This is expected to allocate BPA Power's credits and debits received from the CAISO as a Participating Resource Scheduling Coordinator.

Further description…

BPA's EIM Settlements with Transmission Customers

This is expected to allocate BPA Power's credits and debits received from the CAISO as a Participating Resource Scheduling Coordinator.

Further description…

BPA's EIM Settlements with Power Customers

This is expected to allocate BPA Power's credits and debits received from the CAISO as a Participating Resource Scheduling Coordinator.

Further description…

EIM Settlements Issues crosscutting functional areas

This could include dispute resolution and others.

Further description…

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

October 23

Laura and Bri reviewed…

December 3 and 4 Technical Workshop

See Agenda

We revisited our discussion…

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Settlements	BPA	Consider submitting a comment in DAME Phase 1 in order to retain option for manual dispatch of regulation and converting UIE to IIE like SMUD, rest of EIM is becoming optimal dispatch minus actual	TBD
Settlements	James	Will help with slide 57	12/18/18: Complete ISO reviewed the entire deck and BPA incorporated feedback
Settlements	Todd K	Provide presentation that we reviewed in last meeting	12/18/18: Complete BPA sent to George and Angela
Settlements	??	We need to submit our hourly load meter?	TBD
Settlements	James	Provide spreadsheet for the calculation of the RT offsets	TBD
Settlements	Bri	Provide ISO with list of questions that we went	12/18/18: in process We provided the list of

		through in last meeting	questions and BPA captured the answers we thought we heard
Settlements	BPA	Tell James exactly what we are looking for on our two objectives: (1) carrying cost; (2) distribution of charge codes	12/17/18: BPA provided and reviewed written explanation
Settlements	James	Verify 21 business days before they have to go to FERC?	TBD

January 8 and 9 Technical Workshop

See Agenda

BPA reiterated our need to review our earlier settlements follow-up items on (1) carrying cost; (2) distribution of charge codes. See written data request. CAISO indicated that they had completed a draft and was open to schedule a follow-up.

The group reviewed BPA's request for a trend over time for settlements dispute statistics. (see Kochheiser's 1/12/2019 e-mail). BPA will use this information to inform decisions about BPA's customer billing timeline and help set expectations with customers about extent and frequency of customer bill revisions.

Todd Kochheiser went through his presentation on Load Base Scheduling. BPA's intent is to help inform the level of risk the agency is exposed to given its relatively high level of wheel-through transactions and relatively variable actual real power losses on BPA's transmission system (as opposed to BPA's static 2-year rate provisions for losses). Other EIM Entities have relatively fewer wheel-through transactions, less variable real power losses and similarly static rate provisions for losses. As part of this discussion, CAISO agreed to provide a sample decomposition of the Real-time congestion offset. (see Kochheiser's 1/14/2019 e-mail)

Some take-aways:

- CAISO has two options:
  - Tariff losses (6 months or one year ago, most EIM Entities migrated to this option)
  - Losses look-up function (average losses from state estimator by hour of day – this is not differentiated between load and interties)
- EIM market software calculation uses actual losses
- UFE calculation can use either tariff loses or the look-up table
- CAISO determined load base schedule using our inputs (see slide 5 in Load Base Scheduling ppt)
- CAISO does not calculate load base actual
- Intertie SQMD can be either metered or ATF intertie schedules (but this does not include inadvertent); but this election must be consistent across the board, not point by point

- Watch out for pseudo ties – since it becomes part of the generation and not double count interchange (not meaningful for the psedo ties going out)
- Reg and ABC will be separated this year
- See slide 7: UIE = LBS – LM, where LM is load meter)
- Start-up energy is included as uplift
- Bid Cost recovery (BCR) and Real-time Congestion Offset (RTCO) are important parts of uplift
- TAC should not be an uplift

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Settlement	James	Reiterated Settlements deliverable	1/22/2019: ISO indicated their draft is complete and sub-team conference call should be scheduled; Mark followed up with Angela to schedule sub-team meeting 1/28/2019: call scheduled for Feb 5th from 3-5p
Settlement	James	Provide sample description of the Real-time congestion off-set	1/14/2019: Todd e-mailed specific request to ISO staff 1/23/2019: Symonds followed up
Settlement	Petar	Wants to address the 5-10% of the Settlements that cannot be verified	1/23/2019: Mark e-mailed ISO with this request
Settlement	ISO	Provide BPA EIM Dispute Statistics	1/12/2019: Todd e-mailed specific request to ISO staff 1/23/2019: Symonds followed up

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Federal Generation Participation Model

A threshold issue for Bonneville and the CAISO to address is how Bonneville's merchant function (Power Services) will participate in the EIM with the Federal generation resources. Bonneville markets the power from 31 hydro resources owned by the U.S. Army Corps of Engineers and U.S. Bureau of Reclamation, as well as from one nuclear power plant. The location of these resources are dispersed throughout the Pacific Northwest region. Federal resource participation modeling touches nearly on all aspects of EIM activity from generation operations, transmission operations, and settlements.

While the operational attributes and capabilities of each of these Federal resources may vary, there are some general attributes and capabilities of these resources that allow for the consideration of resource aggregation in terms of EIM participation. Bonneville has identified three such resource aggregations based on transmission availability/congestion, 18hydrological characteristics based on location and flow (storage vs. run-of-river), and utilization of the resources for things such as service to preference customers or making secondary surplus sales. The three aggregations Bonneville staff identified were the lower Columbia River projects, the upper Columbia River projects, and the Snake River projects.

Bonneville considered other forms of participation such as modeling each of the "Big-10" Federal projects separately or as a single system resource. Ultimately, Bonneville determined that aggregating its potential participating resources into the three aggregations was superior to these other participation forms based on the attributes and capabilities described above.

While Bonneville may have made a decision regarding aggregating its resources for EIM participation, there remains an issue as to how Bonneville's aggregated participation will be achieved in the EIM. To that end, as described below, Bonneville and the CAISO have had several bilateral conversations on this topic. To be clear, the issue below does not pertain to how Bonneville will aggregate its resources for EIM participation, but rather how Bonneville will participate in the EIM given its decision to aggregate its resources.

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

Bonneville understands from the CAISO that there are multiple methods available for resources to participate in the EIM. These methods include individual (or resource-by-resource) participation, aggregated resource participation via the Overlapping Resource Aggregation (ORA) model, and a new, untested aggregation model proposed by CAISO staff intended to simplify the CAISO's computational and compliance requirements.

Bonneville understands that modelling the Federal resources individually would best optimize the transmissio n system and that this is the predominant form of resource participation in the EIM. However, Bonneville markets the markets the entire system as if coming from one resource (i.e., a system sale). However, for operational purposes, Bonneville's Hydro Duty Scheduling desk manages the

hydraulic nature of the Federal hydro system in three groups: Upper Columbia, Lower Snake and Lower Columbia. In doing so, the Hydro Duty Scheduling desk sets basepoints for each project individually and sets response factors for each of the projects on response individually in order to manage the electrical output of the resources.[2]

Bonneville understands that aggregated resources must be electrically similar in order for the EIM to preserve the alignment between the physics of the transmission system and the incentives paid to resources in the form of congestion rents intend to mitigate modelled constraints on the Transmission system.

Intended Resolution

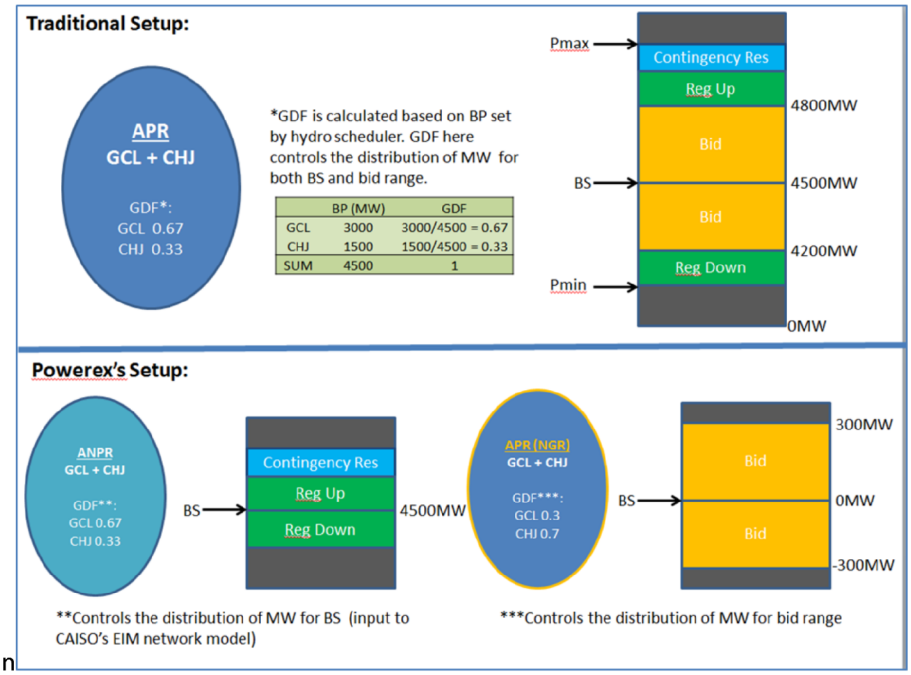
This section captures the parties understanding of how the issue will be dealt with up to and possibly including:

Is change needed to CAISO Tariff and/or CAISO Business Practice Manual?	No	Insert reference for ORA
Is language needed for the Implementation Agreement?	Yes	Draft language below
Is a Stakeholder Initiative required?	No	Not applicable

Bonneville and the CAISO agree that the intended resolution is to aggregate the participating Federal resources into three groups: Upper Columbia, Lower Snake and Lower Columbia. Each of these aggregated resources are electrically similar.

[2] Federal Resource Participation ADF v2, page 2-3.
Grid Modernization > Negotiation Strategy > Federal Resource Participation ADF

In



Bonneville will utilize CAISO's ORA model to implement these aggregations. This requires Bonneville to:

- Establish three Aggregate Participating Resources in the CAISO Master File: Upper Columbia, Lower Snake, and Lower Columbia
- Certify that the established APRs are electrically similar (Do we need to provide an example of the substance of this certification? See Federal Resource Participation ADF v2.
- Establish Aggregate Non-Participating Resources (ANPR) in the CAISO Master File that coincide with each established APR such that each FCRPS project participating in the Western EIM is partitioned into an APR component and a coinciding ANPR component
- Provide generation response factors hourly for each individual resource within the APR that are detailed for the following types of response:

	Base Schedule	Market Dispatch Up	Market Dispatch Down	Available Balancing Capacity	Available Balancing Capacity	Contingency Reserve (spin and non-spin)	3rd party Regulation sales (ie. BPAP to ISO
GDF Set # - ISO	1	2	2	2	2	3	a) not provided
GDF Set # - BPA	1	2	2b	3	3b	4	5
Notes:							
a) George indicated that we could add columns for other items that we thought were possible / useful. This is one such example as I understand that we have a distinct resource enabled for these sales to day.							
b) We are still trying to determine our use cases for separate up and down GDFs for EIM dispatches and ABC.							

- Establish participation model for Bonneville's other 21 resources that are non-participating resources
- [other]

This requires the CAISO to:

- Utilize and retain ORA for Bonneville's participating resources
- Deem the awarded energy as Instructed Imbalance Energy (IIE)
- [other]

The parties will incorporate the following language in the Implementation Agreement (this language needs to be reviewed and discussed at a future technical workshop between Bonneville and CAISO):

> *Bonneville has determined to participate in the EIM by aggregating certain Federal resources that are electrically similar in nature. The Parties agree that Bonneville may utilize the Overlapping Resource Aggregation (ORA) method for the participation of these aggregated resources. The CAISO will deem the awarded energy as Instructed Imbalance Energy. Bonneville will establish Aggregated Participating Resources, Aggregated Non-Participating Resources, and any other resources in the CAISO's Master File. Bonneville will certify that its Aggregated Participating Resources are electrically similar. Bonneville will design its system for EIM implementation to provide generation response factors hourly for each individual resource. Absent an order from the Federal Energy Regulatory Commission, the CAISO will not make (nor propose to make) any material changes to the ORA approach that impacts Bonneville's ability to participate with its aggregated resources.*

No tariff changes are required to support this implementation and no CAISO policy initiative process is required to implement this resolution.

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

September

We reviewed…

October 22

George revisited our prior discussion. We reviewed…

December 3 and 4 technical workshop

See Agenda

We revisited our discussion…

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Aggregation	Todd K	Write a best practices document for Intertie Base Schedule	12/18/18: in process Todd and George are corresponding

Aggregation	George	Provide the document with all of the graphs about Intertie Base Scheduling	12/18/18: in process Todd and George are corresponding
Aggregation	George	Provide e-mail used for aggregation discussion	12/3/18: Complete Mark has e-mail from George 12/3/2018 at 11:28am
Aggregation	Petar	Wants to talk about Ramp Protection	12/18/18: Potential Jan 8/9 agenda item if there is a write-up to talk from

January 8 and 9 Technical Workshop

See Agenda

We discussed:

- Ramp protection. See Shared Ramping Presentation. BPA will need to determine ramp to allocate between APR and ANPR.

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Aggregation	BPA	Spell out ORA in our Implementation Agreement	TBD
Aggregation	Russ	Write up plan for so-called "Automated Manual Dispatch" for next meeting	TBD
Aggregation	Mark	Send Jon Anders the Federal Participation slide deck	TBD

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Late Breaking Constraints

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Description…

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

October 22

We reviewed…

December 3 and 4 Technical Workshop

See Agenda

We revisited our discussion…

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Auto-matching	Petar / George	Write-up the t-30 rolling window	TBD
Auto-matching	Russ	Develop use cases	TBD
Auto-matching	Mark R / Petar	Is 15-minute bidding slated to come in 2020?	TBD

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Treatment of Transmission

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Provide description from BPA stakeholder presentation

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions.

September

We reviewed…

October 22

Don Fuller reviewed…

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Market Power

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Document understandings…

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discussions appearing at the end (you can use the section navigation to jump to or between sub-sections).

October 22

We reviewed…

December 3 and 4 Technical Workshop

See Agenda

We revisited our discussion…

These are the sub-set of follow-items pertaining to this topic:

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

BA Resource Sufficiency

For the EIM, the ISO established resource sufficiency to guard against commercial leaning between EIM Entity Balancing Authority Areas (BAA). Resource sufficiency is not intended to be a reliability product or requirement as the reliability function remains with the BAA in the EIM.

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

BPA is trying to calculate the distribution of potential ISO resource sufficiency requirements needed to inform the necessary bid range BPA's EiM Entity is required to bid-in in order to participate in the EIM.

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discusssions appearing at the end (you can use the section navigation to jump to or between sub-sections).

October 29 conference call

We reviewed…

Team, please fill in. Thank you.

December 3 and 4 Technical Workshop

See Agenda

We revisited our discussion…

Exports should not impact the uncertainty.

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Resource Sufficiency	George	RS software guidelines (this includes their methodology for cleaning data)	12/18/18: in process Mark and Mariano corresponding with George
Resource Sufficiency	George	Is there a minimum number of weekdays and/or weekend days in the 40-day histogram?	TBD
Resource Sufficiency	Mark R	Perform calculation – BPA needs to provide VER and load, ISO can calculate raw RS req'mt which includes the FRU and FRD req'mt as well as the uncertainty values for all intervals in each hourly test	12/18/18: In process BPA and ISO aligning on data elements needed (call 12/19/18)
Resource Sufficiency	George	Determine if the OASIS information is the "original" or the "adjusted"? (ie. do OASIS postings include or not include the diversity benefit?)	12/18/18: in process Mark and Mariano corresponding with George
Resource Sufficiency	George	Which is accurate – the formula in the BPM or the one presented on the slide (ie. there was a question about the sign convention)?	12/18/18: in process Mark and Mariano corresponding with George
Resource Sufficiency	George	One of the plots shows the FRD and the downward credit – it shows that as the Flex down credit becomes more positive, the flex ramp down becomes more negative. Is this the right relationship? Is it graphed incorrectly or is there another explanation?	12/18/18: in process Mark and Mariano corresponding with George
Resource Sufficiency	BPA	Provide e-mail with plots that we reviewed in the meeting	12/18/18: Complete BPA sent to George and Angela

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Metering

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Documentation of the issue

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discusssions appearing at the end (you can use the section navigation to jump to or between sub-sections).

December 3 and 4 technical workshop

See Agenda

We revisited our discussion…

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Metering	Priyanka	Review and provide feedback on BPA's SQMD templates	TBD
Metering	Priyanka	ISO EMS staff will tell us how they manage interchange meter corrections/estimates	TBD
Metering	CAISO Legal – John Anders	Is this statement sufficient to identify the existing	TBD

		business process of grandfathered for metering. Meter guide (STD-DC-5): This guide applies to both new and revised metering installations.	

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Relationship of EIM to Other Emerging Markets / DAME & EDAM

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Documentation of the issue

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discusssions appearing at the end (you can use the section navigation to jump to or between sub-sections).

October 22 technical workshop

We reviewed...

December 3 and 4 technical workshop

See Agenda

We revisited our discussion...

These are the sub-set of follow-items pertaining to this topic:

Section	Name	Item	Status
Principles of EDAM	Petar	Is there anything more than the 2019 stakeholder plan, slide 6?	Provided

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Carbon Obligation in EIM

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Documentation of the issue

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discusssions appearing at the end (you can use the section navigation to jump to or between sub-sections).

To be determined

We reviewed...

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Subject Area Template [Do not Erase]

Provide brief introduction for this issue

Parties' Understanding of the Issue and Intended Resolution

Description of the Issue

This subsection is intended to describe the issue and the problem we are trying to solve.

Documentation of the issue

Insert graphic

Intended Resolution

This section will include a subsection "Resolution" section (or named something else) that captures each parties understanding of how the issue will be dealt with up to and possibly including:

- CAISO Tariff and/or CAISO Business Practice Manual references
- Language intended for the Implementation Agreement as needed
- Stakeholder initiative proposals

Bilateral Discussions of the Issue

This issue has been discussed during multiple bilateral technical workshop. The following summarizes those discussions chronologically with the most recent discusssions appearing at the end (you can use the section navigation to jump to or between sub-sections).

October 22

We reviewed…

Questions remaining to be addressed

BPA

The following matrix captures BPA's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

CAISO

The following matrix captures the CAISO's running question list for this subject area:

#	List questions	Schedule For Discussion	Addressed?
1	TBD		

Non-Federal Resource Participation in the Western EIM

Bonneville is currently considering how it would participate in the Western EIM as an EIM Entity. Bonneville has made a decision that with respect to participation of Federal resources in the EIM, it would, as a starting point, propose to the CAISO that the Federal hydro power system be comprised of three aggregated generation zones—lower Columbia, upper Columbia, and Snake River.

As an EIM Entity, Bonneville must also consider how non-Federal resources may participate in the EIM. This paper memorializes staff's *initial* leanings on how non-Federal resources would participate. As with the Federal Resource ADF, the discussion below should be considered Bonneville's "starting point" for discussions with the CAISO. Based on further discussions and negotiations with the CAISO as well as discussions with interested stakeholders, Bonneville's policy and position may change.

With respect to the aggregations of non-Federal resources, Bonneville will apply the same principle it applied to the aggregation of Federal hydro resources; that is, *only resources that affect a flowgate similarly are considered electrically similar enough to be considered for aggregation.* Electrically similar is determined by resources' Generation Shift Factors (GSFs) on impacted flowgates. Resources that have GSFs of less than 10% are considered electrically similar enough to aggregate. Other decision criteria that were used to determine how Federal resources would be aggregated, such as maximizing participating resource flexibility, implementation simplicity, and etc., will also be considered.

Another aspect of resource participation is whether to treat an aggregated resource as a split aggregated participating resource (APR) and an aggregated non-participating resource (ANPR). The generator owner has the ultimate responsibility for determining how participating resources will be dispatched from the EIM. One choice would be to use Generation Distribution Factors (GDFs), but Bonneville believes that this approach limits the flexibility of Federal APRs. The APR/ANPR approach allows generator operators more control in how their aggregated resources are bid into the EIM and is initially the preferred method for aggregated Federal resources bidding into the EIM. Unless there are issues discovered that prevent using the APR/ANPR approach, non-Federal resources should have the same opportunity to use this method.

Issue

Energy imbalance market entities must identify which resources will be bid into the EIM. BPA is proposing to only bid energy from its big-10 hydropower projects. However, BPA will also have to decide how it plans to bid in these resources – by individual project or added together as aggregated participating resources. While a higher number of projects to bid into the market can be beneficial by providing more locational marginal prices and congestion relief revenue but it could also restrict the operation of the Federal Columbia River Power System.

Perspectives

BPA could determine to aggregate all resources participating to one level, into several smaller zones or model at individual projects. BPA will also need to determine how much of each project is included as an APR and how much will be allocated to be aggregated non-participating resources. One option would be to create one aggregated zone which would be the closest to how the FCRPS is optimized today and the least cost to implement. However, it would be the least efficient option for congestion relief and could limit revenue by only using one LMP to bid into the EIM.

On the other end of the spectrum, BPA could model each individual project which would maximize congestion relief and congestion revenue benefits. But this level of detail adds complexity and could impact FCRPS operations making them less efficient than they are today.

An alternative option would be to aggregate the system into several zones. This would provide some additional congestion benefits without introducing complexity that could harm the overall operation of the federal hydro system. BPA also could change its zones over time to better align to the needs it sees for congestion relief or to ensure safe and reliable system operations.

Customers will likely agree to the multiple zone approach as it provides some benefits without sacrificing system flexibility. They will also likely want the option to re-evaluate the effectiveness of the zones and see if there are better aggregates BPA should consider in the future.

Proposal in letter to the region

BPA is proposing to create three participating resource zones using the big-10 federal hydropower projects. This option provides a balance for increasing congestion revenue benefits with minimal complexity to implementation and risk to harming FCRPS operations.

Eugene Water & Electric Board
Comments to BPA in Response to BPA's October 11, EIM Stakeholder Meeting
October 23, 2018

EWEB is a BPA Slice/Block power customer and an NT/PTP transmission customer. We are Oregon's largest publically-owned electric utility. We serve about 95,000 customers and our load is about 280aMW. We own or purchase a little over 80 aMW of non-federal generation from wind, thermal, and hydro resources.

We provide the following comments as a part of BPA's EIM Stakeholder process.

We support BPA's effort to modernize its systems and processes. We understand BPA's interest to analyze the option to join the Energy Imbalance Market (EIM) as they look for cost efficiencies and revenue opportunities.

EWEB is supportive of the changes BPA is making to modernize assets and system operations. We agree that the Grid Modernization effort should be an organizational priority moving forward. Such modernization is critical for BPA and its customers to keep pace in a rapidly changing environment, and should provide operational benefits whether or not BPA chooses to join the EIM.

We also appreciate BPA's willingness to look at different organized market and product options in an effort to gain efficiencies and improve its financial outlook. EIM participation is expanding, and we believe it is in BPA and its customers' best interest to evaluate the opportunity.

We urge BPA to evaluate and consider its long-term interests in its evaluation of the EIM and only join the EIM if these interests will be met.

While we are supportive of BPA looking at the value proposition of the EIM, we also believe that fundamental market design and philosophy is important to consider before committing to join. In particular, consideration should be given to what the market may evolve to, as we have witnessed in other markets that energy imbalance markets are transitional, and tend to evolve into day-ahead markets, before finally transitioning into full Regional Transmission Organizations (RTOs). Further, we believe that there be many higher value market opportunities available to BPA. While these opportunities may not be mutually exclusive to participation in the EIM, we do not want the focus of BPA's internal resources limited and encourage the evaluation of other market opportunities.

For these reasons, we encourage BPA to evaluate the EIM relative to other opportunities, and to consider the potential evolution of the market relative to the interests outlined in the "NW Public Power Interests for Markets" (see below), prior to signing an Implementation

Agreement. We understand the EIM represents a small portion of the market trades at this point. However, we believe this market will evolve, and that Bonneville is in the best position to influence market evolution prior to the signing of an EIM Implementation Agreement.

NW Public Power Interests for Markets of September 3, 2018
• Independent, Representative Governance • Resource Adequacy and Resource Sufficiency Requirements Provide for Reliability and Equity • Transmission Owners Can Meet Existing and Future Load Service Obligations at Reasonable Cost • Market Power Mitigation recognizes the unique situation of hydropower • Fair Compensation for Services and Transparent Price Formation • Respects Existing Laws, Statutory Obligations, Regulations, and Local Regulatory Authorities

We encourage BPA to provide customers with a comprehensive view of the operational and economic impacts of joining the EIM.

There are business impacts to customers based on BPA's decisions. As BPA considers the EIM, we encourage staff to work with customers to understand the following:

- What forum decisions will be made in; e.g., BPA's transmission tariff, Rate Case proceedings, or business practices?
- How are BPA's existing power and transmission products and services impacted under EIM?
- What are the daily operational processes and economic impacts to EWEB, and what preparation is needed by EWEB prior to BPA entering the EIM?

We support BPA's transmission recommendation to use donated transmission in the EIM.

In the October 11th meeting BPA discussed its recommendation for the use of donated transmission when bidding into the EIM. We see the potential for a 0 priority NX transmission product to negatively impact EWEB's existing transmission rights, and we appreciate the work that went into this decision.

We support BPA's recommendation to participate under three aggregation points

At the same October 11th meeting, BPA outlined its generation participation options and recommended that Power Services would bid into the EIM at three distinct aggregation points. We support this recommendation and suggest, if BPA joins the EIM, they continue to monitor the performance of the three aggregation points to determine if changes need to be made.



EIM Stakeholder Meeting

May 15, 2019
9am – Noon
Rates Hearing Room

V1.2.2

For our WebEx and phone participants:

- We have muted all calls on entry, if you have a question, you will need to unmute by using *6. Then please identify yourself by name and let us know who you represent.
- Please do not put this call on hold OR take other calls while you are dialed into this one.
- If we identify a noisy line, you may be disconnected from the meeting.

Agenda

9:00-9:05	• Welcome, Safety Moment, Introductions
9:05 – 9:20	• Review of BPAs EIM Principles, EIM Process, Timeline
9:20- 11:45	• Cost Benefit Analysis
11:45 – Noon	• Next Steps, Q&A

Statement of BPA's Principles:

1. Participation is consistent with statutory, regulatory, and contractual obligations.

2. Maintain reliable delivery of power and transmission to our customers.

3. Resource participation in the EIM is and always will be voluntary.

4. BPA's decision to participate in the EIM will be based on a sound business rationale.

If BPA signs the EIM Implementation Agreement it would obligate BPA to begin spending on EIM implementation projects with the CAISO and signals BPA's intent to join the EIM as long as BPA's EIM principles continue to be met. However, it does not bind BPA to join the EIM.

Market Context

- A well designed electricity market is built on a foundation of resource adequacy and has features that:
  - Provide for intra-hour energy balancing
  - Compensate explicitly for capacity resources that provide system reliability and flexibility

- BPA views the EIM as *one piece* of a well-designed market
  - Additional market functions are required to fully compensate BPA for the capacity value of the flexible and carbon-free federal power system

- BPA will continue to work with CAISO and stakeholders to enhance regional resource adequacy by ensuring that flexible resources are appropriately compensated for the services that they provide

Timeline Leading up to the ROD

Agendas for previous and future monthly EIM Stakeholder meetings:

July 24	•Grid Modernization Overview, Strategic Plan Connection, Intro to 8 Issues BPA is Reviewing, Initial Cost Benefit Analysis
September 13	•EIM 101
October 11	•Process Plan, Transmission, Generation, Governance
November 14	•Process Plan, Market Power
December 18	•Settlements, Non-Federal Generation Participation
January 16	•Resource Sufficiency, Emerging Markets
February 20	•Base Case Structured Scenario, Market Mitigation
March 13	•EIM Issues and Venues, Oversupply Management Protocol, Settlements, Structured Scenario
April 10	•Carbon in the EIM, Cost Benefit Analysis Status Update, Structured Scenario
May 15	• Cost Benefit Analysis
June 12	• Cost Benefit Analysis Update, EIM Issues Summary Review
Late June / Early July	•Letter to the Region with a 30 day public comment
August	•BPA drafts Record of Decision (ROD)
September	•Final ROD for signing the EIM Implementation Agreement

Previous EIM Stakeholder Meeting Materials are available here: www.bpa.gov/goto/EIM

EIM Decision Process

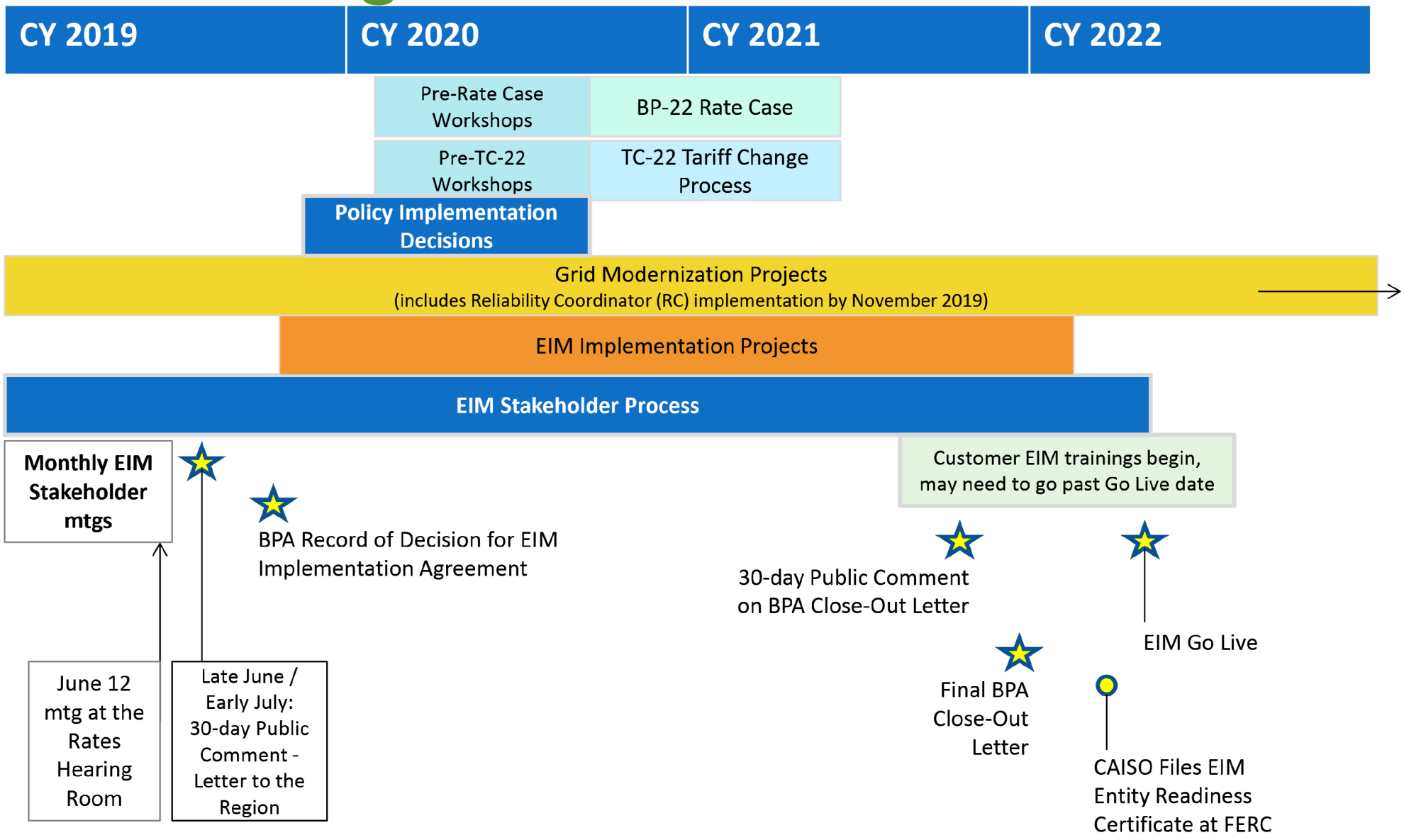
1. Letter to Region and Record of Decision — June 2019 – September 2019
   - Solicit stakeholder feedback on: Draft Implementation Agreement, Cost Benefit Analysis, Legal considerations, Roadmap of process/issues, Proposed Decisions on Certain Policy Issues, Principles for Joining
   - 30-day comment period
   - Final decision to sign Implementation Agreement, and on other items covered in Letter to Region

2. Policy Implementation Decisions — October 2019 – August 2020
   - Discuss all remaining policy issues with stakeholders.
   - Provide written proposal, solicit written stakeholder comment, and make final written decision(s) on policy issues
   - Final decisions on these policy issues

3. BP-22 and TC-22 Cases — October 2020 – July 2021
   - Settlement discussions August – October 2020
   - Follow 7(i) process and conclude with ROD / final decision

4. Draft and Final Close-Out Letters — October 2021 – December 2021
   - Draft Close-Out Letter addressing: principles for joining the EIM, any additional policy issues that have arisen, propose final decision whether to join the EIM, and incorporate final decisions made in steps 1 and 2 above.
   - 30-day comment period
   - Final Close-Out Letter: Address comments raised, Final Decision whether to join EIM, if decision is to join - move forward to sign relevant EIM Agreements

BPA's High Level EIM Timeline



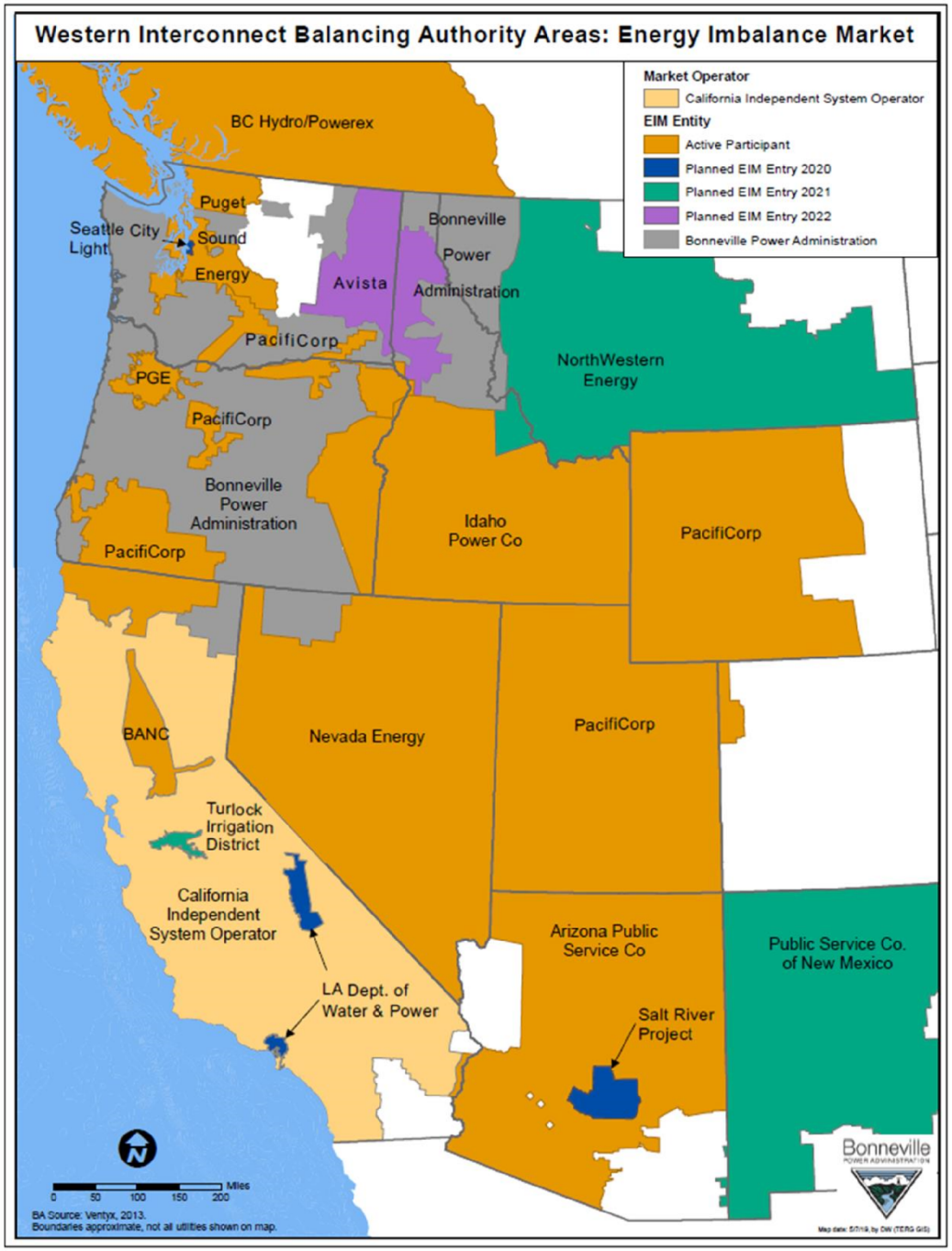
Previous EIM Stakeholder Meeting Materials are available here: www.bpa.gov/goto/EIM

EIM Issues and Venues

This shows BPA's current thinking but the matrix will evolve over time

Legend:
F = Final Decision
I = Implementation

Issue	Letter to Region / ROD (July 2019 – September 2019)	Policy Implementation Decisions (October 2019 – August 2020)	TC-22 Tariff Terms & Conditions Case (October 2020 – July 2021)	BP-22 Rate Case (October 2020 – July 2021)	Close-Out Letter (October 2021 – December 2021)
BPA's EIM Principles Development / Evaluation	F – Development	I	I	I	F – Evaluation of the issues against the principles
Statutory Authority for Joining the EIM	F				Confirm consistency with the principles.
EIM Impacts on BPA Contractual Commitments	F				
NEPA and Environmental Obligations	F				
EIM Governance	F				
Cost Benefit Analysis	F				
Carbon Obligations	F				
Market Power (LMPM, DEB)	F				
Oversupply Management Protocol	F				
OCBR and other Reliability Tools	F				
Federal Generation Participation Plan	F				
Load Zone (LAP)	F		I	I	Final action regarding decision to join.
Resource Sufficiency — BAA Level	F				
Transmission — Interchange	F		I	I	
Transmission — Network		F	I	I	
Allocation of EIM Charge Codes		F		I	
Resource Sufficiency — Sub-BAA Level		F	I	I	
Transmission Losses		F	I	I	
Nonfederal Resource Participation Requirements		F	I	I	
Settlements/Billing (Mechanics)		F	I		
Data Submission Requirements		F	I		
Metering Requirements		F	I		



EIM Entity Map

- Active and planned EIM participants
- BPA shown in grey



EIM
Cost Benefit Analysis

5/15/2019

Rates Hearing Room

BPA-2020-00700-F0055

Purpose

- We're updating the business case to achieve multiple objectives
  - Utilize an approach consistent with almost all potential and current EIM participants
  - Evaluate benefits in multiple scenarios
  - Refresh market assumptions and cost estimates
  - Flesh out Transmission benefits, potentially quantifying some of them
  - Provide more comprehensive support for an EIM-related ROD

- Steps taken to date
  - Contracted with E3 to perform an "industry standard" Benefits Analysis
  - Reviewed and updated cost estimates initially provided by Utilicast in 2017

- Expected timeline at upcoming EIM stakeholder meetings:
  - May 2019 (today): Share draft results and request feedback
  - June 2019: Discuss stakeholder comments
  - July 2019: Reflect results in Letter to the Region

Annual Net Benefits

- Modeled net dispatch benefits indicate significant financial benefits to BPA participation in the Western EIM

Net EIM Benefits ($M)

	Base Case
Gross Dispatch Benefits	48.9
Annual Ongoing Costs	6.2
Net Annual Dispatch Benefit	**42.7**

- Base Case results would quickly recover expected startup costs

- In addition to net dispatch benefits, EIM participation also brings considerable qualitative and illustrative Transmission benefits

Startup Cost Update

- BPA reviewed (and updated) Utilicast startup cost estimates to incorporate increased EIM-related knowledge within BPA
  - "One BPA" approach taken
    - Costs not allocated by business line
    - Focus on financial viability for BPA as a whole
  - Verify that costs are truly EIM Incremental
    - Spending that BPA would only undertake if we join the EIM
  - BPA's startup costs are higher than many other entities' but commensurate with BPA's relative size, complexity, and existing infrastructure

EIM Category	Cost* ($M)	CFTE	BFTE
Infrastructure	13.3	5.0	3.1
Operation	17.2	4.2	5.6
After-the-Fact	4.6	1.9	1.7
Total	**35.1**	**11.0**	**10.4**

*Startup costs include roughly $10M in existing BFTE costs that will be offset by cost reductions elsewhere in BPA due to temporary reallocation of resources.

Ongoing Cost Update

- BPA leveraged previous estimates of ongoing costs with an evolving understanding of EIM participation to estimate annual costs

EIM Category	Cost* ($M)
Infrastructure	N/A
Operation	5.0
After-the-Fact	1.2
Total	**6.2**

- Major cost drivers include:
  - Resource plan creation/submission
  - O&M Costs for IT systems
  - EIM Desk
  - Settlements
  - CAISO fees

*New staffing costs ($4.4M of the total) will be offset by cost reductions elsewhere in BPA due to reallocation of resources.

Net Benefits Sensitivities

- We tested the robustness of the benefits, by analyzing additional sensitivities; two have been completed and reflected below

Net EIM Benefits Sensitivities ($M)

	Base Case	Reduce Volatility by 50%	No Direct CA Deliveries
Gross Dispatch Benefits	48.9	44.6	44.5
Annual Ongoing Costs	6.2	6.2	6.2
Net Annual Dispatch Benefit	**42.7**	**38.4**	**38.3**

- Reduction in market volatility: Assumes intra-hour price volatility is reduced by 50%
- To reflect no direct CA deliveries, and avoid GHG compliance fee, we modeled that BPA receives lower LMP when selling during intervals where marginal GHG component is nonzero

BPA-Specific Modeling (CY16-18)

Constraints

- 24-hour energy neutrality is required (avoid river management issues)
- System feasible min/max limits (from the Slice Computer Application) are enforced
- Only residual INC/DEC spin capacity at Big 10 projects can be dispatched in EIM (eliminate simulated unit start/stops)
- All non-Big-10 generation in BPA's BAA is treated as non-dispatchable/fixed
- BPA-estimated operational spinning needs and Resource Sufficiency (RS) requirements resulted in RS failure ~15% of the time (no EIM benefits)

Feasibility Verification

- Verified model compliance with all constraints
- Verified simulated EIM net sales positions are within available transmission expectations
- Reviewed sensitivities and resulting effects
- Confirmed that historical spin capability was sufficient to pass EIM RS requirements the vast majority of the time
- 75% success rate applied to offset perfect foresight

Today's Agenda

- EIM Overview
- Production Cost Benefits Analysis
  - Methodology & Assumptions
  - Initial Scenario Results
- Stakeholder Sensitivities Discussion
- Transmission Benefits
- Summary and Next Steps

What Are EIM Benefits?

What EIM Is

- An **intra-hour real-time** energy market to serve load and imbalance across participating Balancing Authorities (EIM Entities) and the CAISO (a.k.a. the EIM Area)
- A tool for centralized 5-minute dispatch of resources that have been **voluntarily offered** to the market (at a price)
- **Economically dispatches** offered resources
- **Security-constrained**, meaning transmission and reliability constraints are not exceeded, improving grid reliability, reducing energy supply cost and enhancing integration of renewable resources

What EIM Is Not

- An RTO (with planning, day-ahead markets, BA consolidation)
- A centralized unit commitment tool
- A capacity market
- A replacement for the current contractual bilateral business structure

EIM Benefits to Date

- Currently, 10 BAAs participating in EIM
- By end of 2021, public power entities (BANC/SMUD, LADWP, SCL, TID, and SRP) plan to be participating in the EIM

Western EIM Gross Benefits – Through 3/31/2019

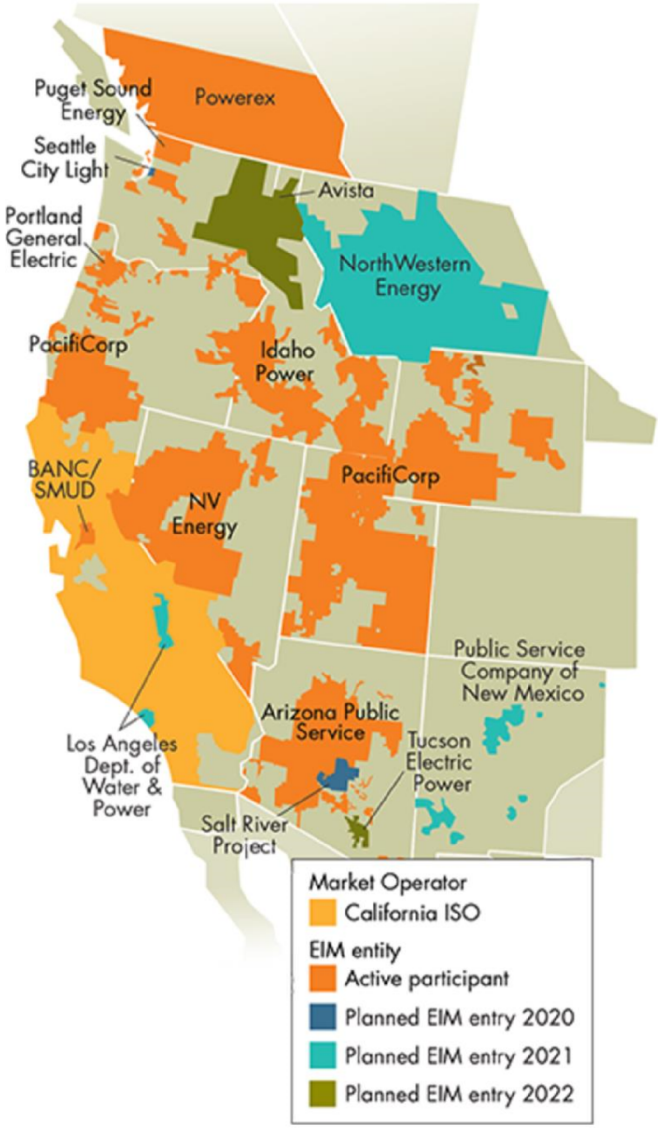
EIM PARTICIPANTS	2014	2015	2016	2017	2018	2019 Q1	TOTAL
Arizona Public Service Entered 10/2016			$5.98	$34.56	$45.30	$8.20	$94.04
California ISO Entered 11/2014	$1.24	$12.66	$28.34	$36.96	$67.94	$13.08	$160.22
Idaho Power Company Entered 04/2018					$26.88	$8.45	$35.33
NV Energy Entered 12/2015		$0.84	$15.57	$24.20	$25.55	$5.71	$71.87
PacifiCorp Entered 11/2014	$4.73	$26.23	$45.47	$37.41	$61.68	$23.76	$199.28
Portland General Electric Entered 10/2017				$2.83	$27.57	$11.74	$42.14
Powerex Entered 04/2018					$7.84	$7.23	$15.07
Puget Sound Energy Entered 10/2016			$1.56	$9.86	$13.68	$7.21	$32.31
TOTAL	$5.97	$39.73	$96.92	$145.82	$276.44	$85.38	**$650.26**

Source: Western EIM

E3 EIM Benefits Analyses

- EIM benefits analyses are intended as an **initial screen** for economic feasibility
  - Not a detailed analysis of all operating constraints and market interactions
- E3 has performed nearly all the EIM benefits studies to date
  - Market has matured and grown in size significantly since start
  - Migrated to **price-taker model**

GridView	WECC-Wide PLEXOS	Price-Taker Hydro	Price-Taker PLEXOS
• PacifiCorp (2013)	• PSE (2014)	• SCL (2016)	• BANC (2016)
• NVE (2014)	• APS (2015)	• Chelan (2016)	• PNM (2018)
	• IPC (2015)		• CENACE (2018)
	• PGE (2015)		• **BPA (2019)**
	• LADWP (2016)		
	• NWE (2017)		
	• SRP (2017)		



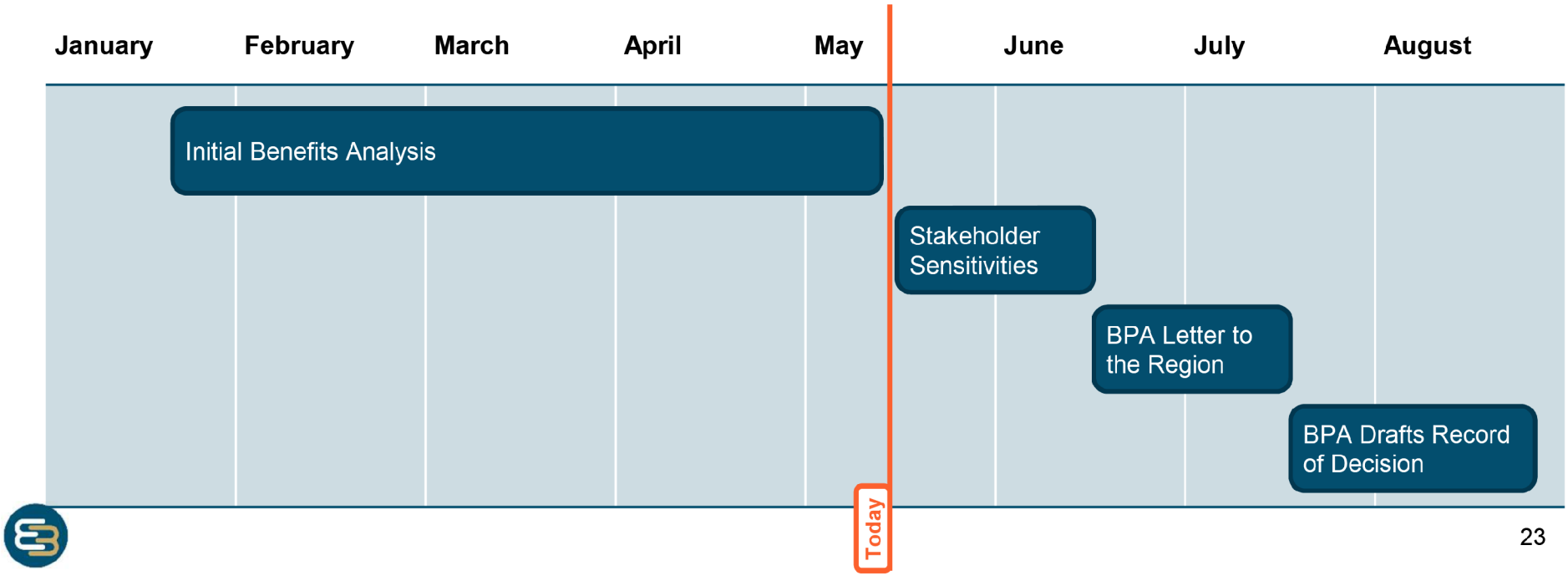
E3 "Pocket Guide" to Flexible Operations

	Solution	How it Helps Integrate Renewables
Net benefits even w/o renewables	**Regional coordination**	**More efficient dispatch and reduced curtailment**
Low-cost solutions with potentially large benefits	Time of use rates	Shifts energy consumption toward daylight hours
	Sub-hourly renewable dispatch	Allows system to operate with fewer thermal resources during overgeneration events
	Renewable portfolio diversity	Avoids curtailment by spreading renewable production over more hours of the year
Costs and benefits should be evaluated on project- or program- specific basis	Flexible loads/ Advanced DR	Shifts energy consumption toward hours with overgeneration, but cost and potential are unknown
	Additional storage	Reduces curtailment but requires significant investment
	Gas retrofits	Makes existing resources more flexible at a low cost
	New flexible gas resources	Provides limited dispatch flexibility at a high cost
Valuable, though not as much for integration	Energy efficiency	Provides significant cost and GHG savings but may not reduce curtailment
	Conventional demand response	Provides cost savings but does not significantly reduce curtailment

EIM

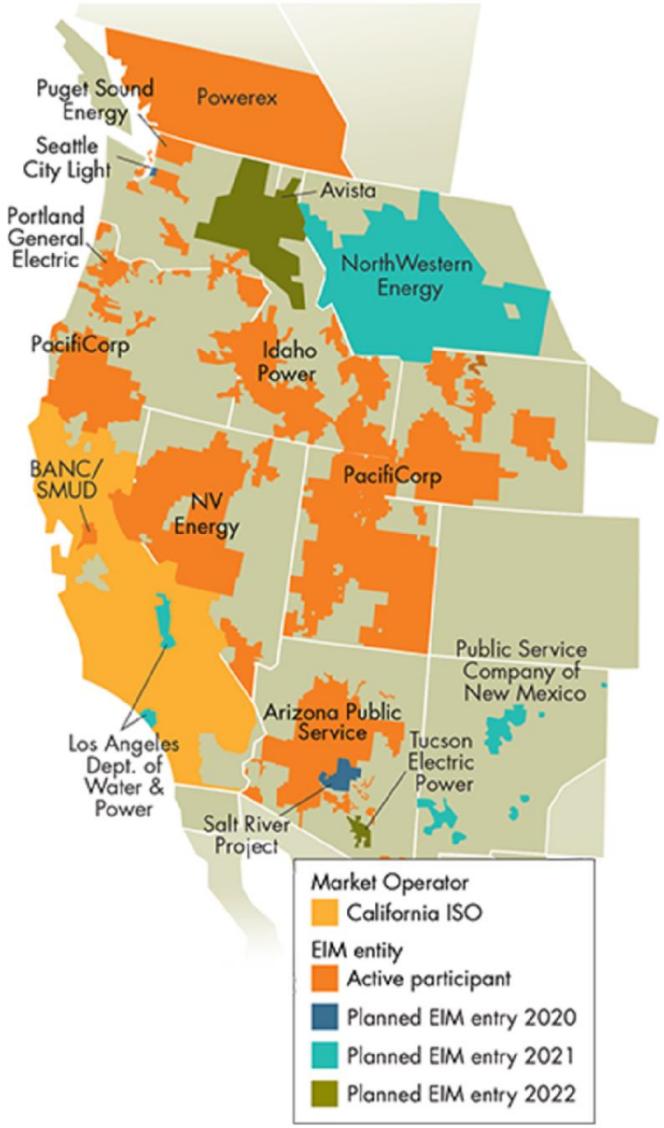
Where We Are in the Analysis Process

- BPA and E3 have been working on initial benefits analysis presented today
- Based on today's feedback, we will develop a suite of sensitivities and updates for June stakeholder meeting



BPA EIM Study Overview

- Following methodology from previous benefits studies with adjustments to reflect BPA's system
- Initial Base Scenario shows **$49 million/year** of incremental gross dispatch benefit due to EIM participation
  - 2 initial sensitivities modeled, volatility reduction & GHG compliance, both of which modestly reduced benefits
- EIM security-constrained economic dispatch provides congestion management and flow relief across entire BPA system
  - Alternative to existing solutions (e.g., transmission build or redispatch)



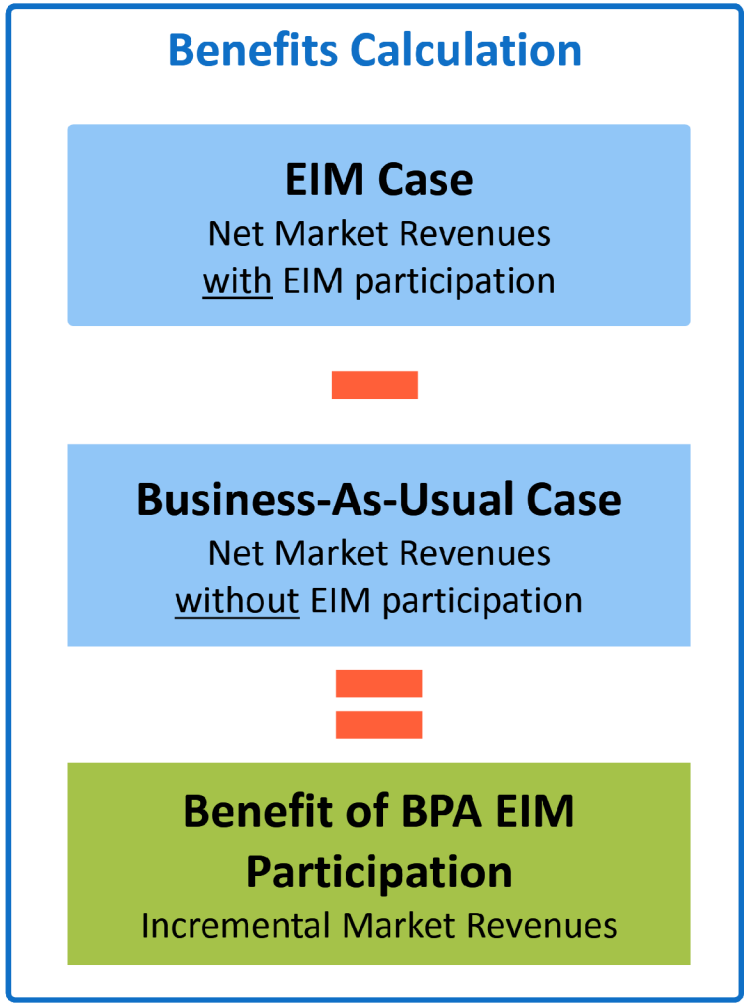
Dispatch Benefits Analysis

Initial Scenarios

Modeling Approach

Framework for Value Assessment

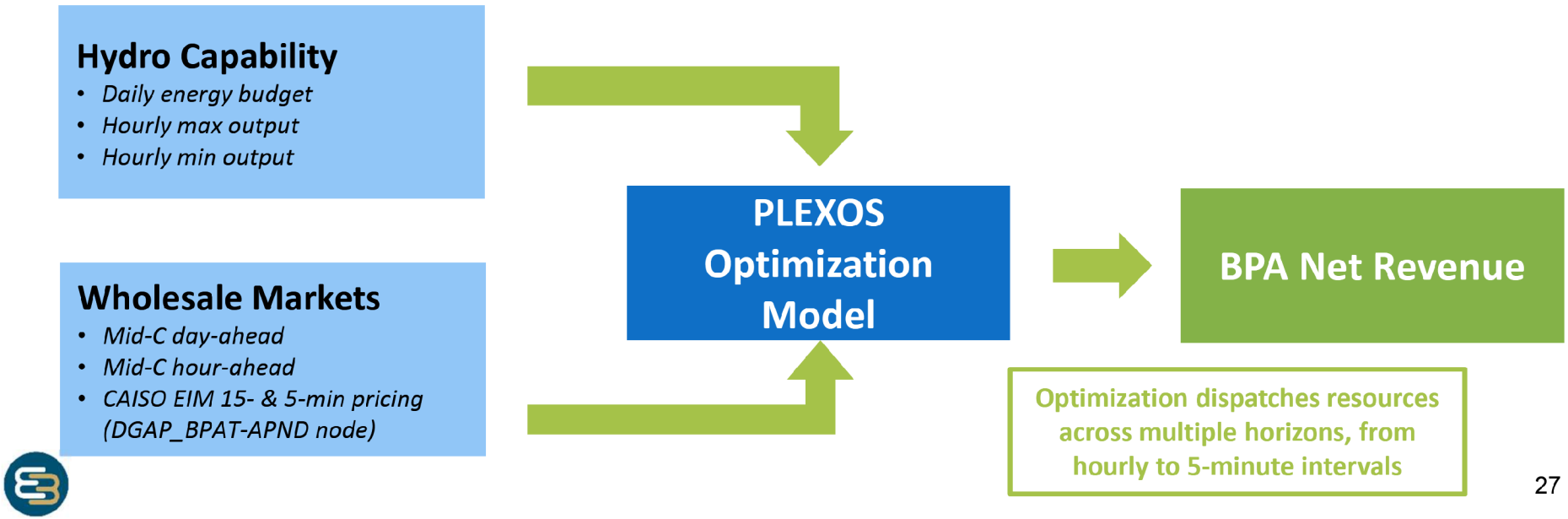
- E3's modeling will seek to estimate BPA's **net market revenues** with and without EIM participation
  - Will capture BPA's market behavior under different wholesale price streams
  - Model will assume BPA is a price-taker, but sensitivities can reflect potential price changes
- Flexible modeling approach allows streamlined development of new scenarios and sensitivity analysis



Modeling Approach

Dispatch Overview

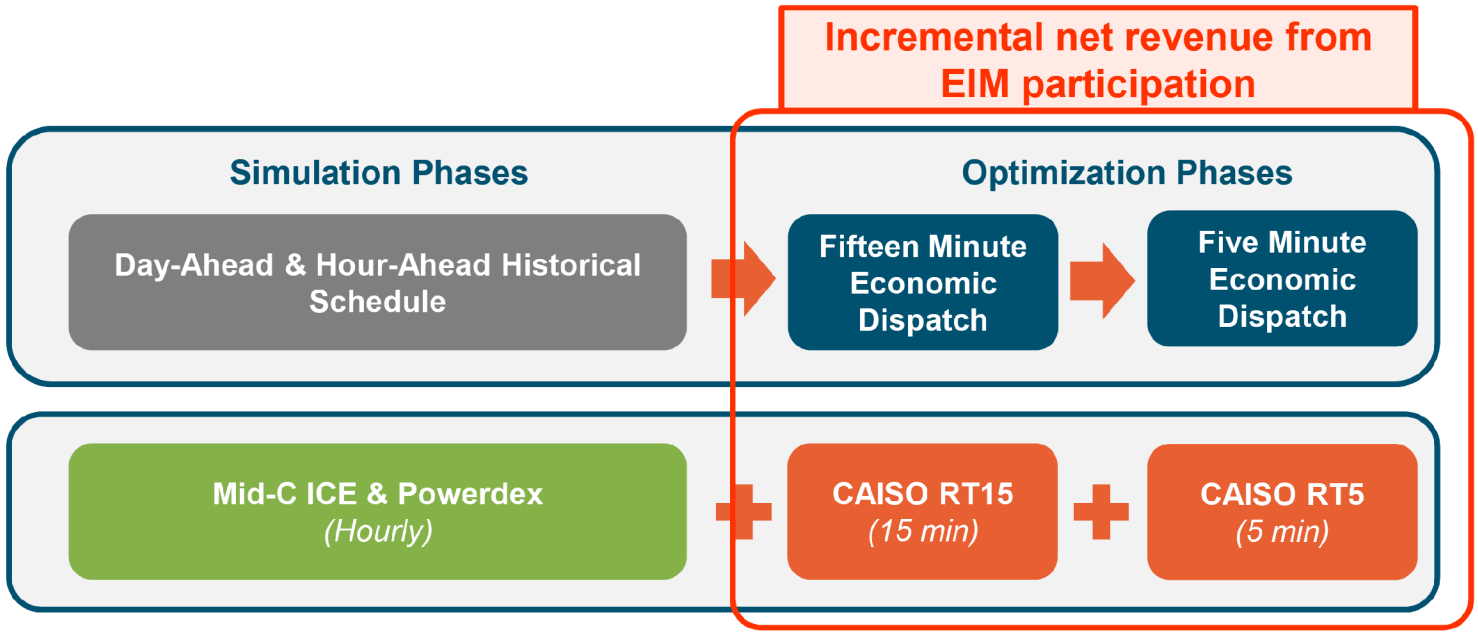
- E3 utilizes a PLEXOS model to **maximize BPA's net revenue** in wholesale markets subject to the constraints of hydroelectric dispatch
  - Utilizing 2016-2018 actual data for BPA BAA operations and wholesale market prices
- To account for model's perfect foresight, we discount reported benefits by 25%
  - Reflects assumption that BPA's imperfect knowledge of prices will result in only 75% success rate of its bids clearing the EIM



Modeling Approach

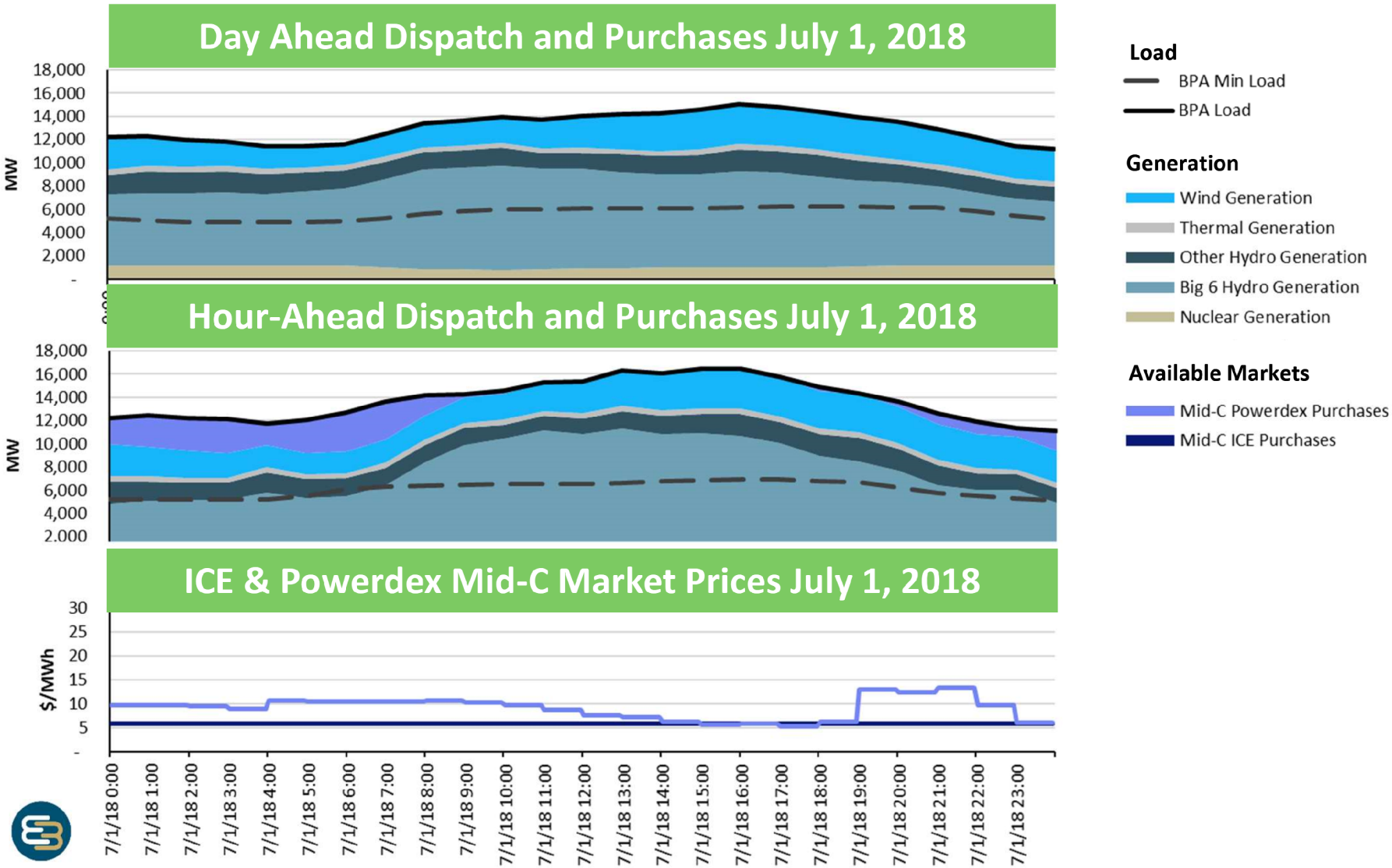
Four-Stage PLEXOS Production Cost Model

- Model quantifies the market value attributed to BPA's resources in four sequential stages:
  - Revenues captured in DA & HA dispatch reflect estimated market value of **all bilateral contracts and other out-of-market transactions**
  - Incremental revenues captured in 15- and 5-minute dispatch reflect **additional value of EIM participation** using BPA's selected hydro resources



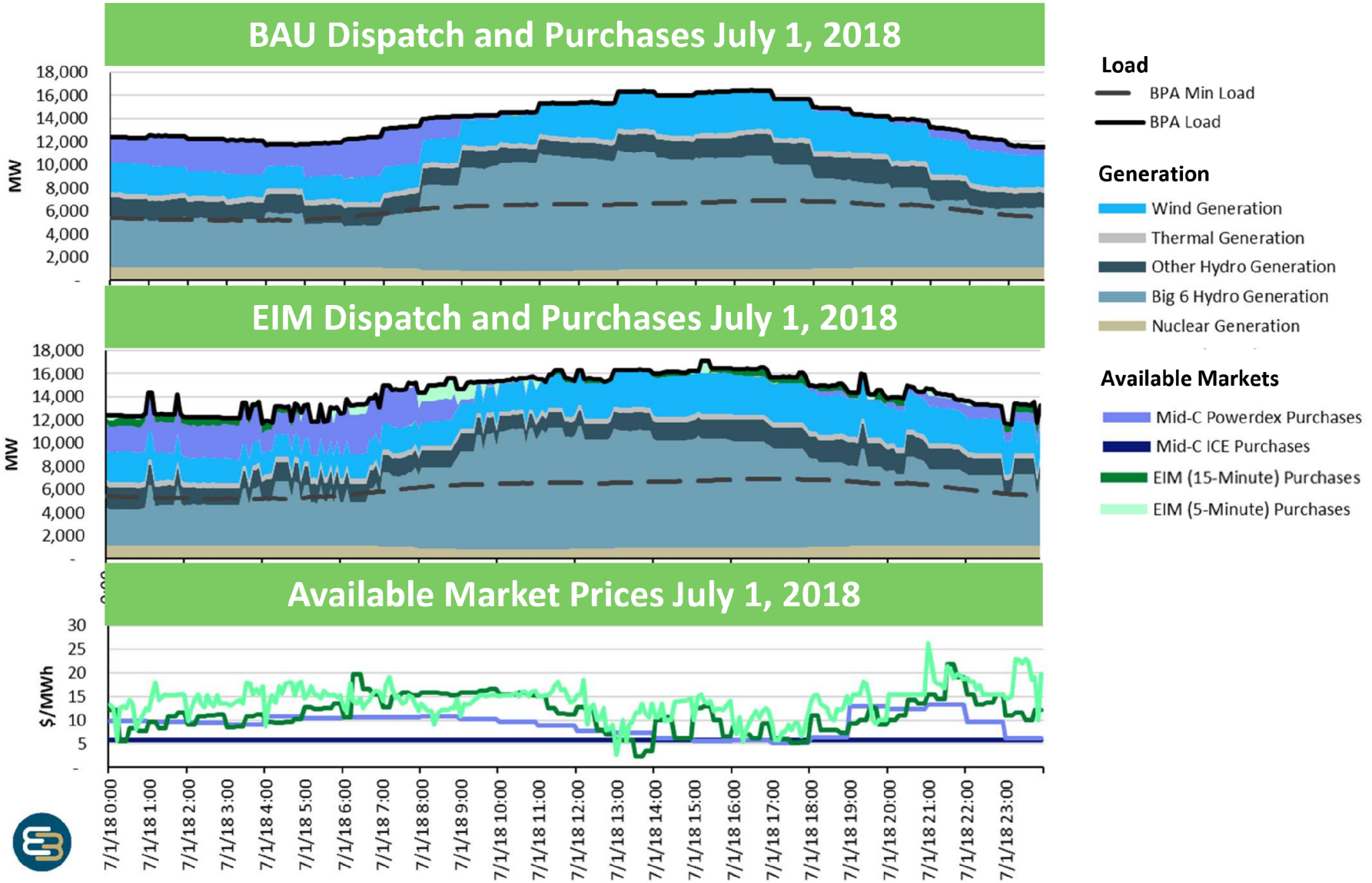
Base Scenario Results

Historical Hourly Schedules and Prices



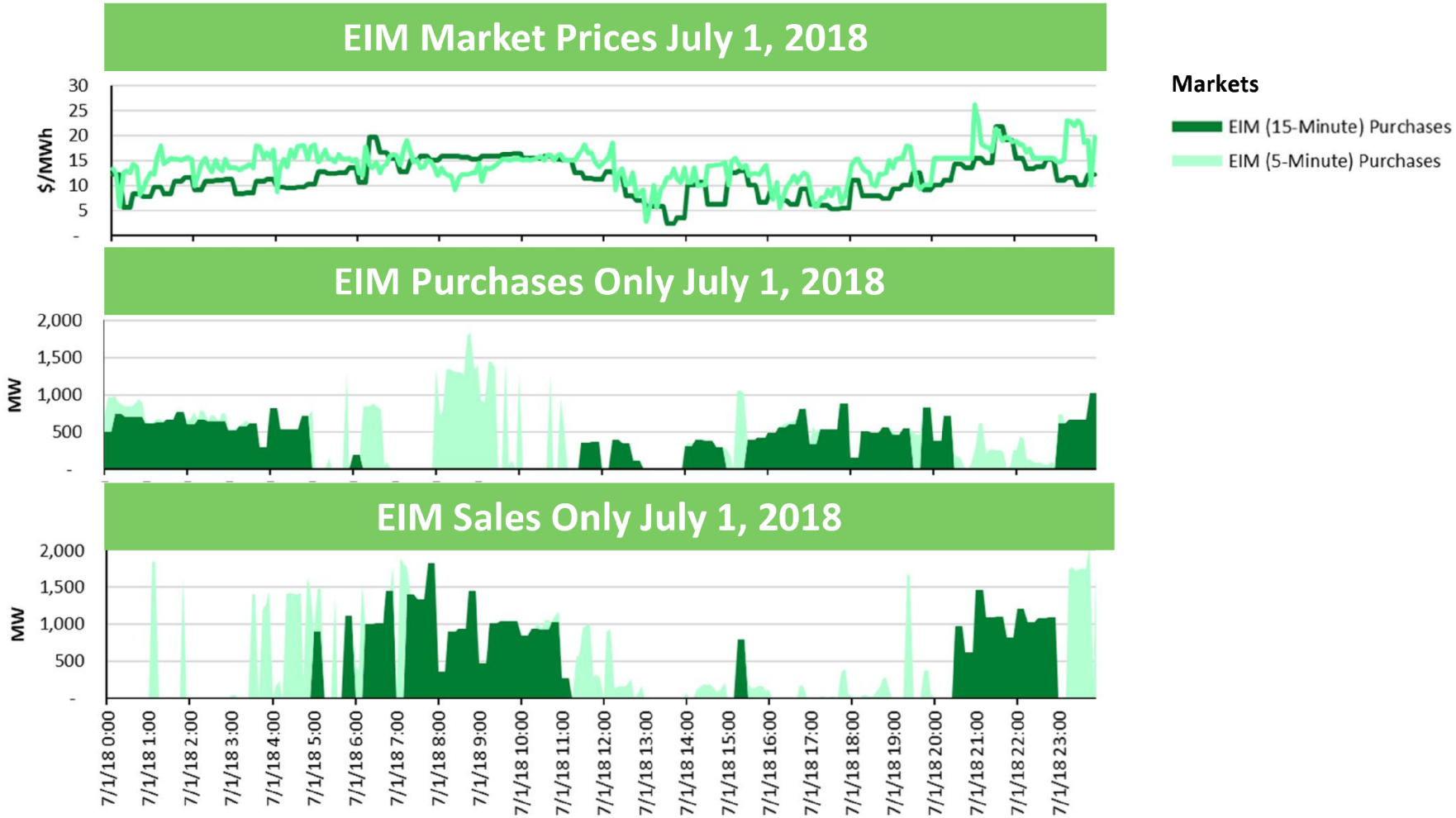
Base Scenario Results

5-Minute Real Time Dispatch and Prices



Base Scenario Results

EIM Market Prices, Purchases and Sales



Input Assumptions

Participating Resources



- **"Big 10 Hydro"** generators are the only participating resources
- Big 10 Hydro is fixed to BPA simulated schedule in DA and HA
- In RT stages, Big 10 constrained by:
  - Maximum feasible min/max output from Big 6 Hydro
  - INC and DEC flexibility relative to simulated HA setpoint
  - Daily energy balance from HA schedule
  - Operational spinning needs
- All other resources are non-participating and fixed to **historical output**

Input Assumptions

Flexible Ramping Sufficiency Test

- To be eligible to trade in the EIM, BPA must be able to meet CAISO flexible ramping sufficiency test (FRST)
  - With diversity benefits applied in its participating resources INC and DEC flexibility
- The Base Scenario showed that that BPA can meet the FRST and is eligible to trade in the majority of hours
  - In approximately 15% of the intervals, BPA did not meet the FRST in the upward or downward direction. To be conservative, the analysis did not assign BPA EIM trading benefits in those periods



Input Assumptions

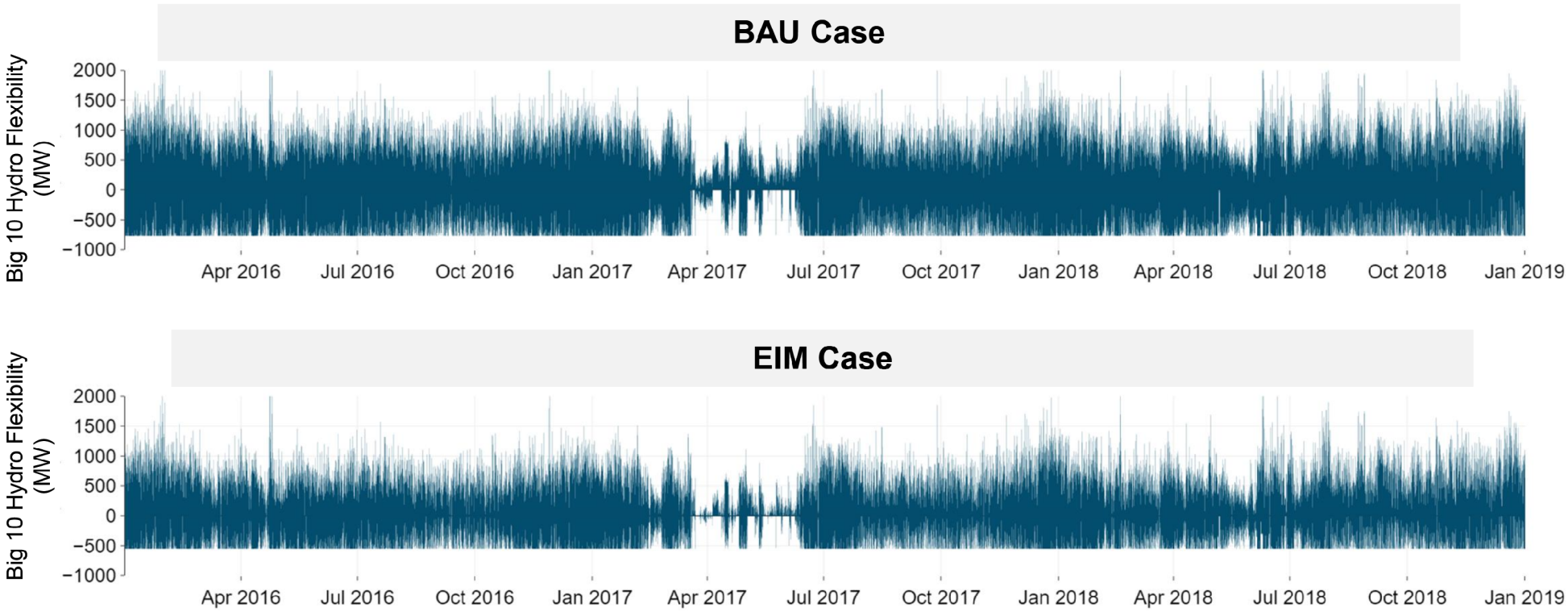
Available Spinning Capability

- We model the Big 10 Hydro spinning capability to meet BA operational needs in all hours
- Headroom and footroom held for BA operational needs cannot be used for EIM transactions
- EIM case deducts a more conservative amount for BA operational needs than BAU case
  - In effect, this deduction results in a decreased opportunity to monetize capacity in order to account for potential differences in operational assumptions between BAU and EIM cases

Input Assumptions

Big 10 Hydro Spinning Capability

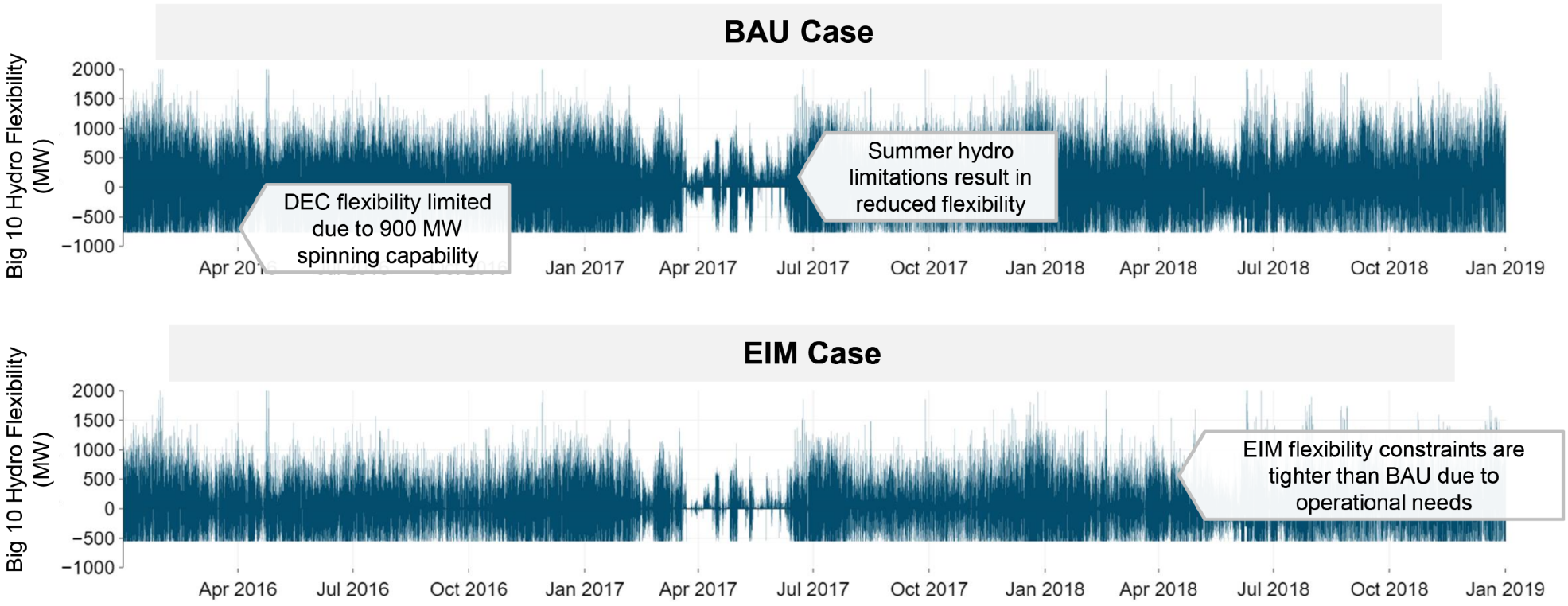
- After operational needs and flexibility constraints taken into account, we give Big 10 Hydro INC/DEC flexibility bounds



Input Assumptions

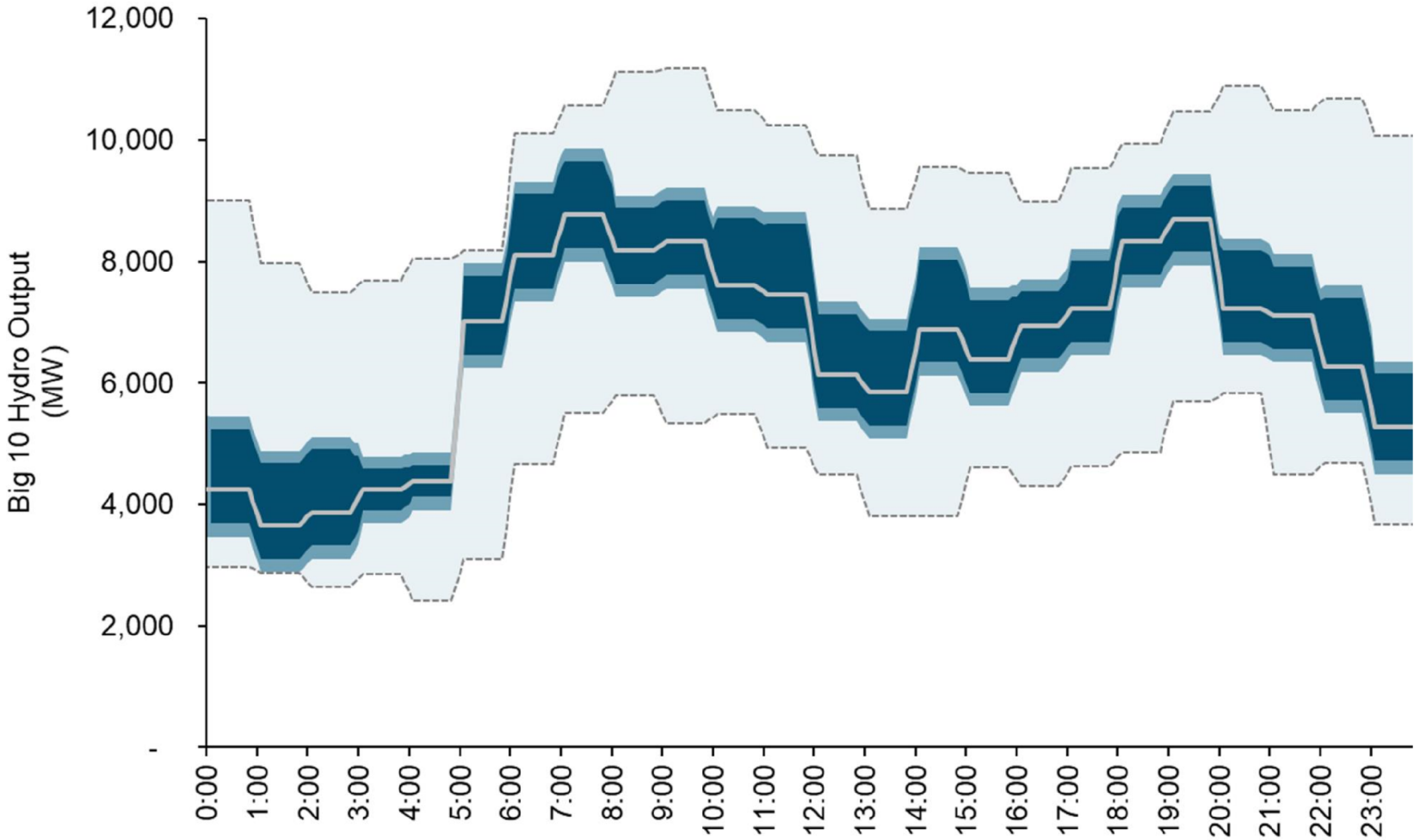
Big 10 Hydro Spinning Capability

- After operational needs and flexibility constraints taken into account, we give Big 10 Hydro INC/DEC flexibility bounds



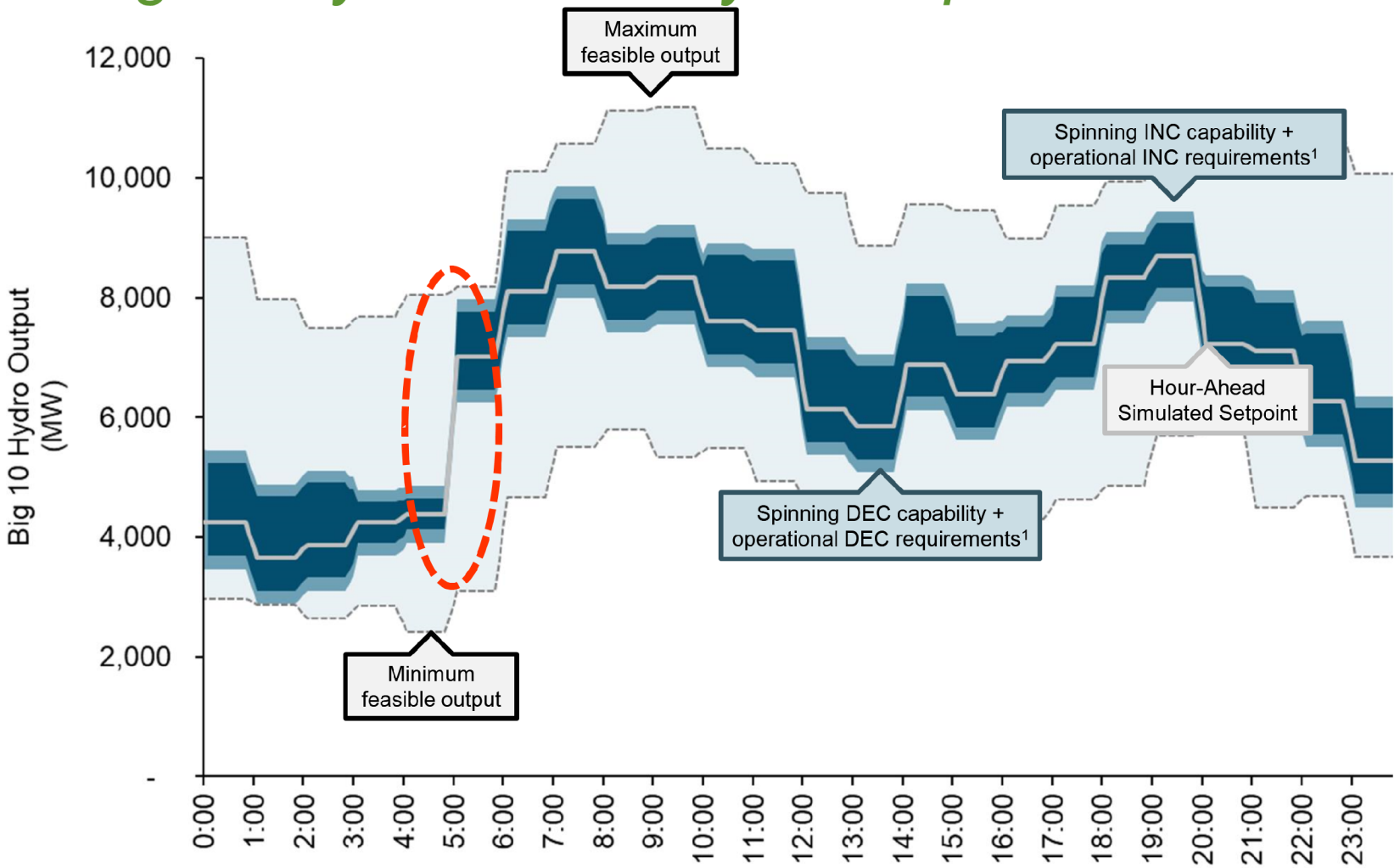
Input Assumptions

Big 10 Hydro Flexibility Example



Input Assumptions

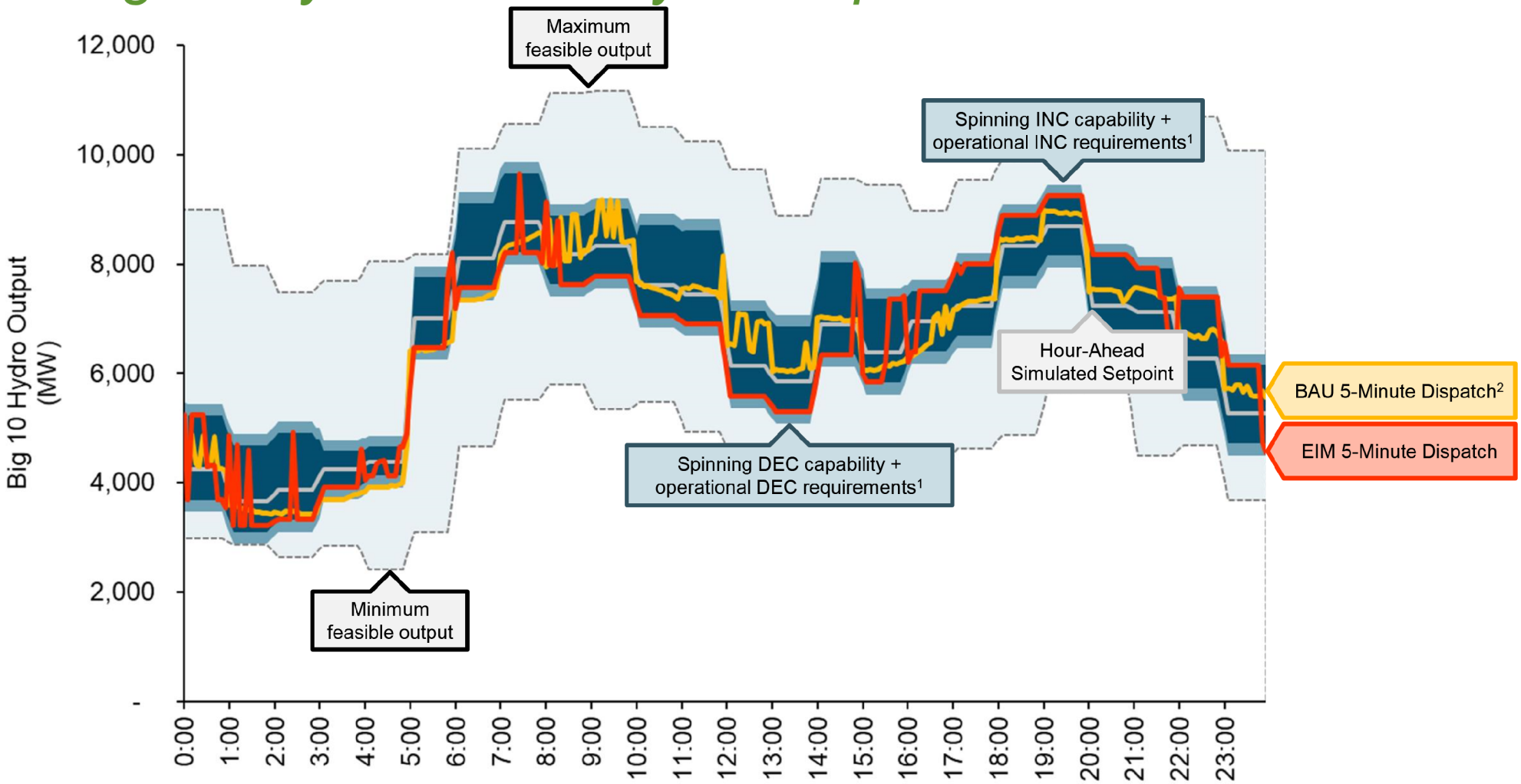
Big 10 Hydro Flexibility Example



[1] Operational requirements assumptions are more conservative in EIM case than BAU case, resulting in tighter flexibility bounds

Input Assumptions

Big 10 Hydro Flexibility Example



[1] Operational requirements assumptions are more conservative in EIM case than BAU case, resulting in tighter flexibility bounds
[2] BAU dispatch shows subhourly spikes due to balancing net load (load – wind) variability

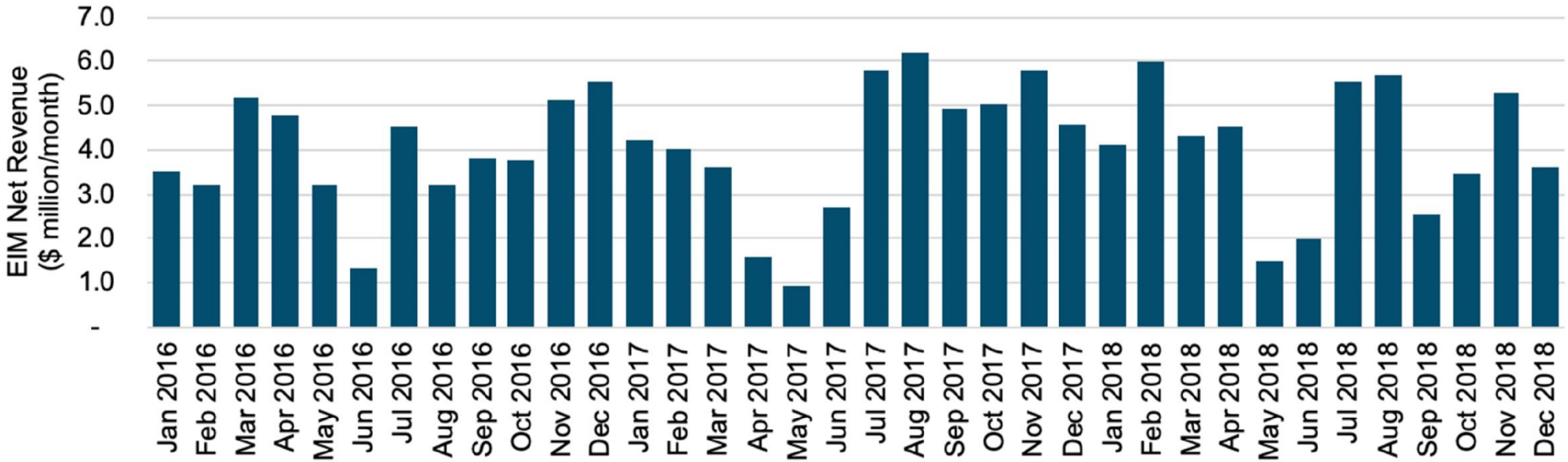
Benefits Analysis

Initial Scenario Results

Base Scenario Results

Net EIM Revenues

- Gross dispatch benefits of **$49* million/year**
  - Wide EIM spreads ($20-25/MWh) in most months
  - Net EIM revenues vary from $0.9-6.2* million/month
    - Driven by available hydro spinning capability in each month

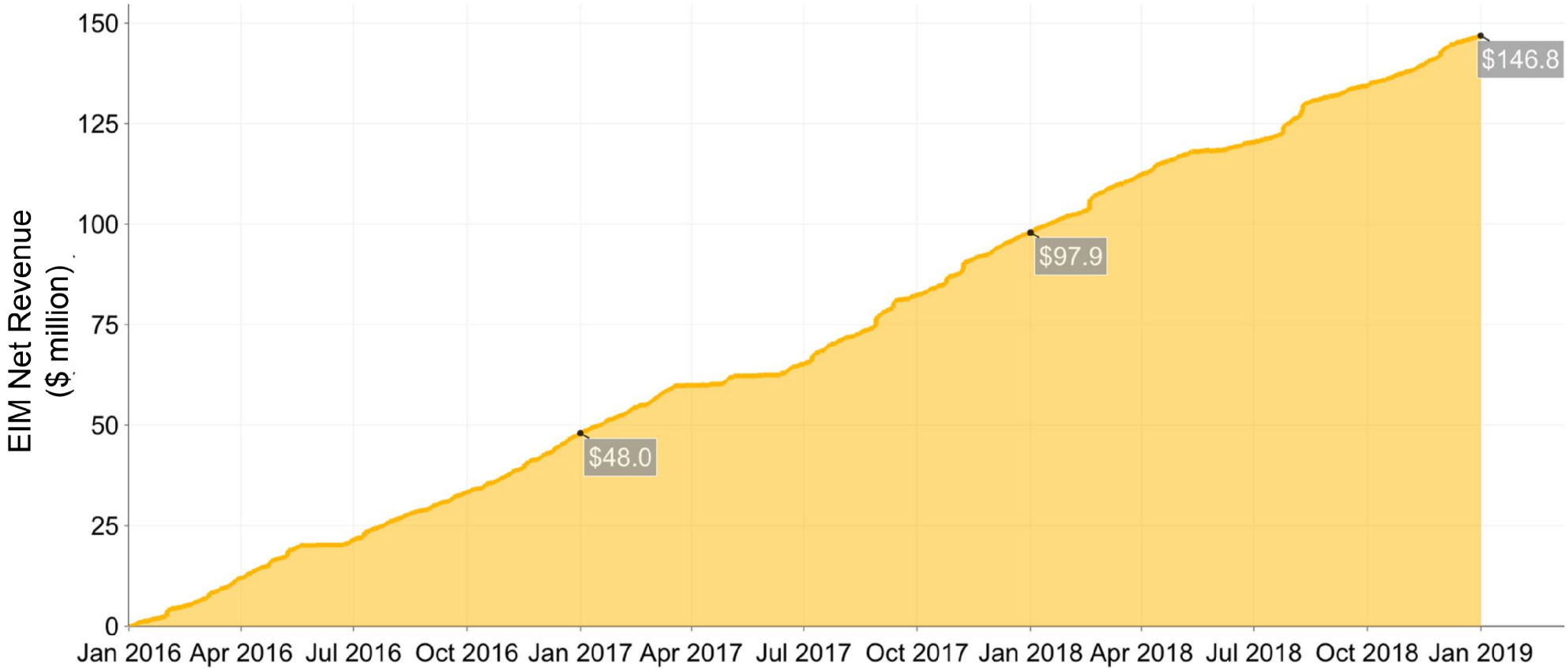


* Reported EIM benefit value includes a 75% "success rate" of BPA bids into EIM

Base Scenario Results

Cumulative EIM Gross Dispatch Benefits

- From 2016-2018, net EIM revenues average **$49* million/year**

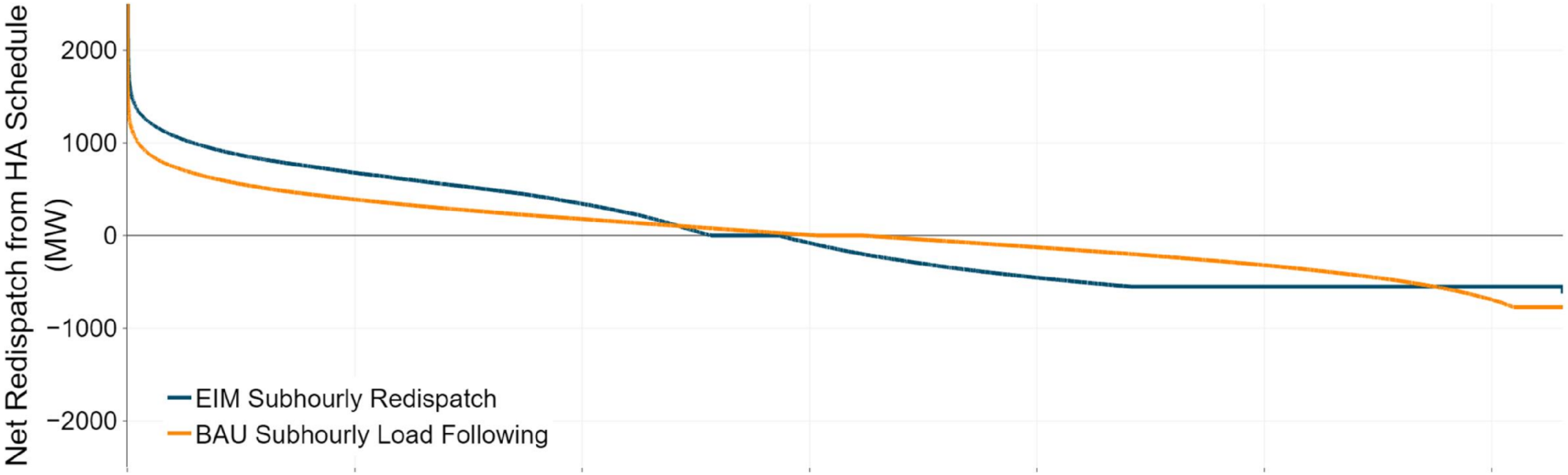


* Reported EIM benefit value includes a 75% "success rate" of BPA bids into EIM

Base Scenario Results

Big 10 Hydro Redispatch Duration Curve

- Under Business-As-Usual subhourly dispatch, BPA's hydro can only be used for **load-following within the BAA**
- EIM provides an **additional source/sink for hydro flexibility**, allowing Big 10 Hydro to dispatch to greater magnitude than in BAU
  - Increases monetized value of BPA's hydro flexibility



* EIM subhourly redispatch duration curve does not differ significantly with lower price volatility

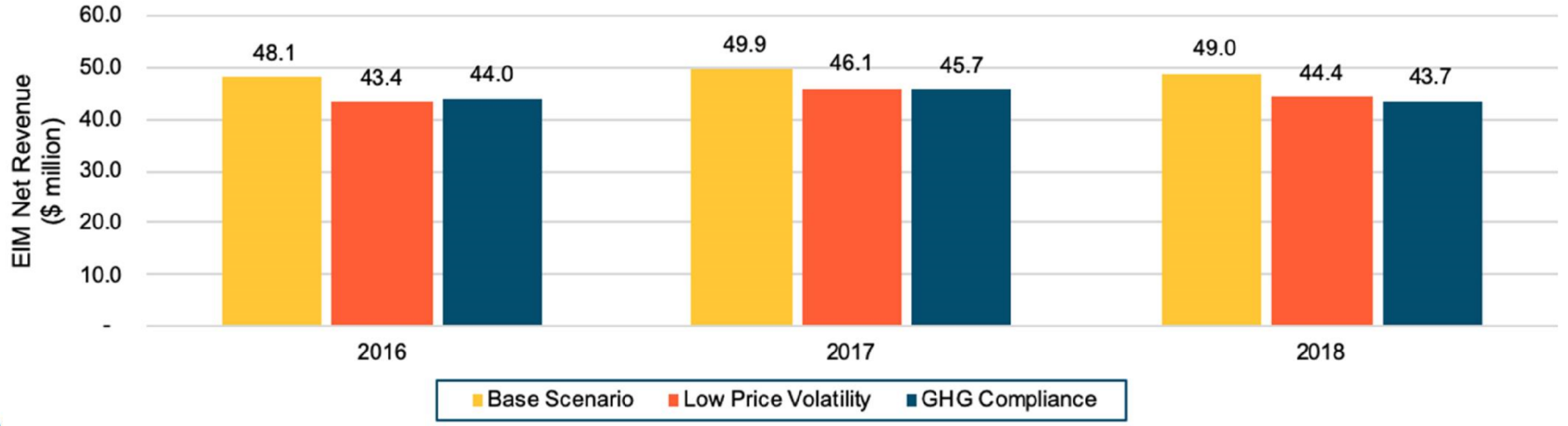
Benefits Analysis

Sensitivities Discussion

Initial Base Scenario Sensitivities

- Initial sensitivities tested:
  1. 50% lower intra-hour price volatility
  2. California GHG fee compliance
- Each sensitivity results in approximately $5 million/year less dispatch benefit than Base Scenario

Net EIM Revenues by Year* ($ million)



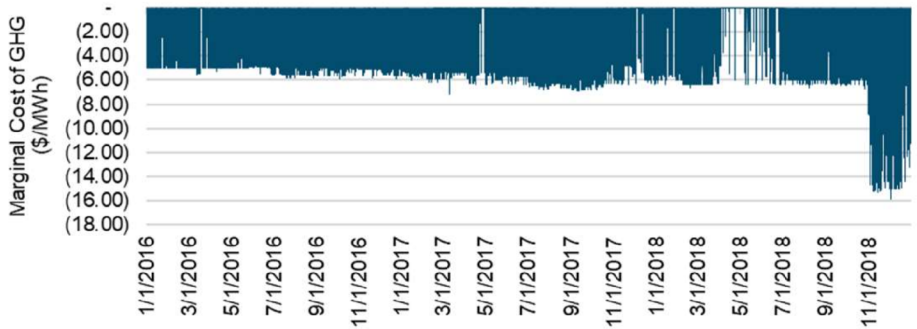
* Reported EIM benefit value includes a 75% "success rate" of BPA bids into EIM

Initial Base Scenario Sensitivities

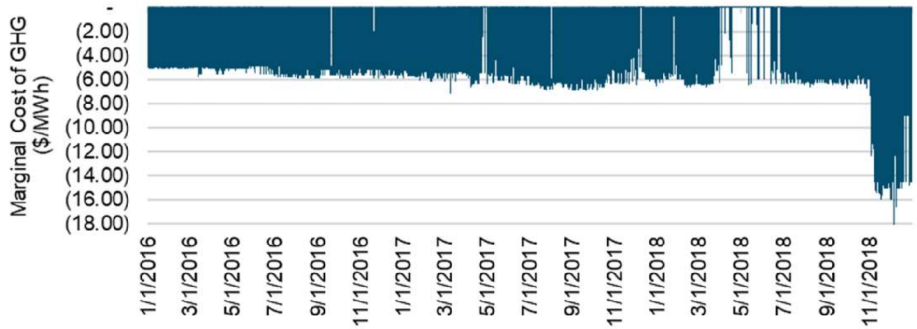
California GHG Compliance

- CAISO updated marginal GHG methodology for EIM in November 2018
- In LMPs, marginal GHG cost is nonzero only when all non-California entities as a group are exporting to California
  - CAISO collects GHG revenues for imbalance energy settlements and redistributes based on optimal export allocation

RT15 LMPs (from DGAP_PACW-APND)



RT5 LMPs (DGAP_PACW-APND)



Initial Base Scenario Sensitivities

California GHG Compliance

- To account for GHG compliance fee (which BPA cannot currently pay), we run a sensitivity where BPA receives lower LMP when selling during intervals where marginal GHG component is nonzero
- Accounting for historical marginal cost of GHG, incremental revenue from EIM participation is **$44.5 million/year**
  - BPA's GHG compliance needs further investigation, as CAISO's GHG methodology for EIM transfers changed in November 2018
  - Increased incidence of nonzero marginal GHG component after November 2018 results in greater impact to calculated EIM benefit

Transmission Benefits Discussion

Transmission Qualitative Benefits

- **Benefits accessible through EIM participation**:
  - Congestion management functions that are more economically efficient than present curtailment and bilateral redispatch capabilities
  - Optimized day to day operation of the power system

Improved Controls	Improved State Awareness	Improved Modeling & Coordination
• Proactive congestion management • Reactive congestion management • Proactive voltage control • Higher transmission utilization	• Increased accuracy and frequency of operational information • New visual displays of (near) real-time data, allowing operators to better predict operational issues • Access CAISO EIM dispatchers tools	• Improved network modeling • Improved outage modeling & coordination • Improved Power & Transmission coordination

1. Transmission Curtailment

Schedule Curtailments

- BPA curtails schedules pro-rata according to NERC Curtailment priority
- Curtailments are non-optimal as more schedules need to be curtailed to attain desired flow reductions
- Curtailments are limited to schedules where BPA is the TSP or TOP
- Curtailments result in imbalances that need to be resolved separately by each impacted BAA further reducing the effectiveness of curtailments

Energy Imbalance Market

- The EIM's Security-constrained economic dispatch (SCED) finds optimal solution to minimize cost given transmission constraints
  - Price signals incentivize resources closest to constraints to dispatch with higher $/MWh congestion value
  - Redispatch requests can be fulfilled by any EIM participant, potentially reducing burden on Transmission customers and reducing the likelihood of curtailments or scheduling restrictions
  - Existing scheduling practices/rights are unchanged by EIM
- Market model provides advisory dispatches ahead of real-time

- BPA tested EIM Area Total Flow (ETF) constraint compared to South-of-Allston curtailments to achieve flow relief
  - ETF constraint was able to provide in one 5-minute market run an amount of flow relief that would have required over 1200 MW of schedule curtailments

2. EIM as a Non-Wires Solution

- EIM is a **wide-area solution** that manages flows near real-time across the entire system based on **operating limits** and **system congestion**
  - EIM provides benefits across the entire footprint, whereas other options for relieving transmission flows are targeted local options
  - EIM dispatch is a precise method of achieving flow relief needed
- EIM can provide a **complementary tool** for BPA to use for grid management
  - EIM does not completely replace the need for transmission builds
  - Potentially defers the cost of building transmission or implementing other non-wires solutions
- In many situations, **BPA will still need to build transmission** (e.g., long-term load growth or replacing aging transmission assets)
  - Transmission may be a less applicable option to address short-term, moderate needs

2. EIM as a Non-Wires Solution

– A tool used to delay or avoid transmission expansion investment decisions to address congestion issues.

Categories of capital projects that the EIM could help defer or avoid:

- As a system-wide non-wires solution, network congestion driven projects could be remediated with security constrained economic dispatch, *for example*:
  - I-5 Corridor Reinforcement

Categories of capital projects that are driven by other needs that the EIM would *NOT* be expected to displace:

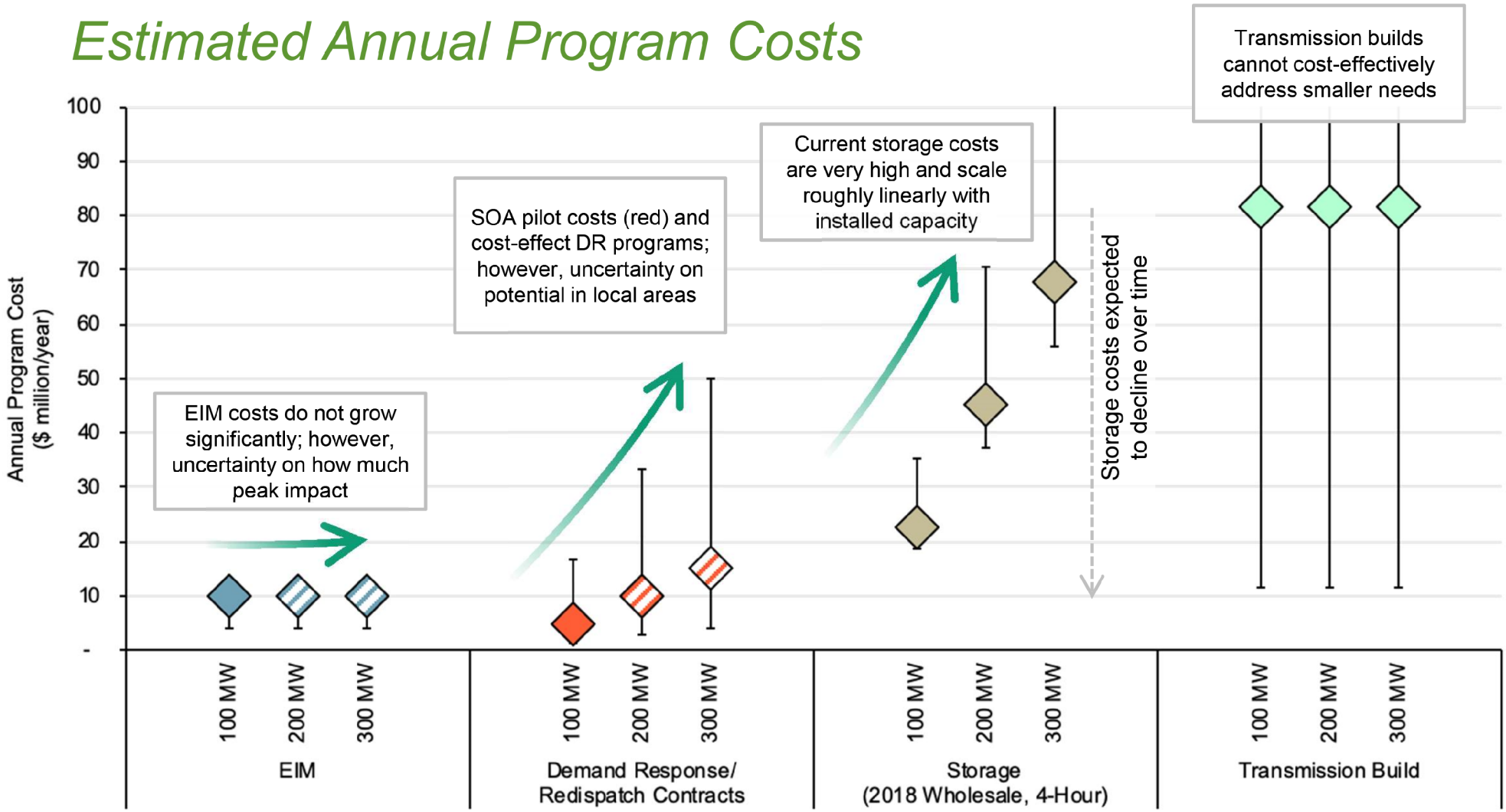
- Sustain Program projects for safe and reliable operation of existing facilities, *for example:*
  - wood pole replacement or transformers that have reached end of life
- Generation Interconnection, Line & Load Interconnection projects that are driven by requests from customers, *for example*:
  - data center loads
- Load Service Area Reinforcement projects required to mitigate reliability criteria violations, *for example*:
  - Hooper Springs project in SE Idaho

2. EIM as a Non-Wires Solution

	EIM	DR	Storage	Transmission Build
Generation Capacity Value	No	Yes	Yes	No
Energy Value	Yes	Yes	Yes	No
Transmission Capacity Value	Low	Low	Low	High
Congestion Area	Wide	Local	Local	Local
Congestion Value	High	Medium	Medium	High
Effort to Provision	Low	Medium	Medium	High
Levelized Costs	$	$$$	$$$$	$$
Call Option Timing	N/A	0-2 Days	0-2 days	N/A
Response Time	8-12 Minutes	0-4 hours	0-4 hours	N/A
Duration	5-240 Minutes	1-4 hours	1-4 hours	30-50 Years
Uses	Load Service Imbalance Energy Economic Dispatch Congestion Management Renewable Integration Energy Arbitrage	Load Service Peak Shaving	Load Service Renewable Integration Energy Arbitrage Operating Reserves	Load Service Renewable Integration

2. EIM as a Non-Wires Solution

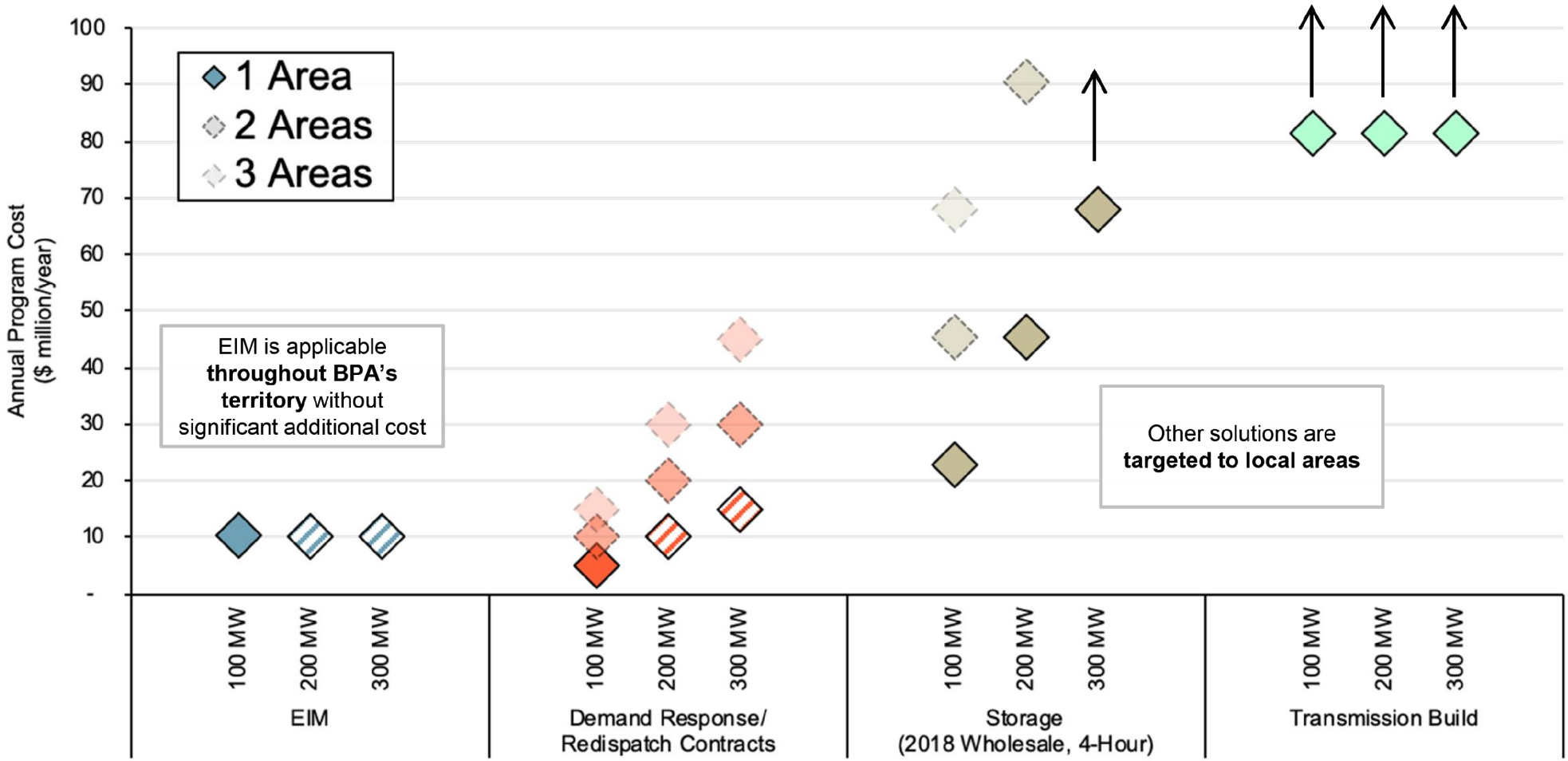
Estimated Annual Program Costs



Colored and striped diamonds represent sample middle costs from publicly available data

2. EIM as a Non-Wires Solution

Scaling Costs Over Multiple Project Areas



Colored and striped diamonds represent sample middle costs from publicly available data

2. EIM as a Non-Wires Solution

Illustrative Quantitative Example with Current Costs

- 2 flowgates, each needing 100 MW of intra-hour flow relief
  - Business-As-Usual Case: Assume that relief comes from 50/50 mix of battery storage and Redispatch contracts or DR
  - Assumed Redispatch/DR cost based on South of Allston Redispatch Pilot
  - EIM case: based on total estimated levelized EIM program cost

Business-As-Usual Case		EIM Case	
100 MW battery @ $226/kW-year	$22.6 million/year	$10 million/year (levelized startup and ongoing costs)	$10 million/year
100 MW Redispatch Contract / DR @ $50/kW-year	+ $5.0 million/year		
Annual Cost	**= $27.6 million/year**		**= $10 million/year**

Transmission Benefits Summary

- EIM provides many **qualitative benefits**
- EIM dispatch is an **additional tool** for BPA to use for grid management that produces **optimal economic dispatch** subject to transmission constraints
  - EIM may provide **more precision and higher effectiveness** compared to BPA's current practice of transmission schedule curtailments (non-optimized) to address events where intra-hour flow relief is needed
- EIM is a **complementary, low cost non-wires option** (among other non-wires options as well as new transmission build) for transmission congestion relief needs
  - EIM provides locational flexibility for addressing modest transmission relief needs that arise **across** the BPA system
  - EIM does not replace the need for all new transmission builds



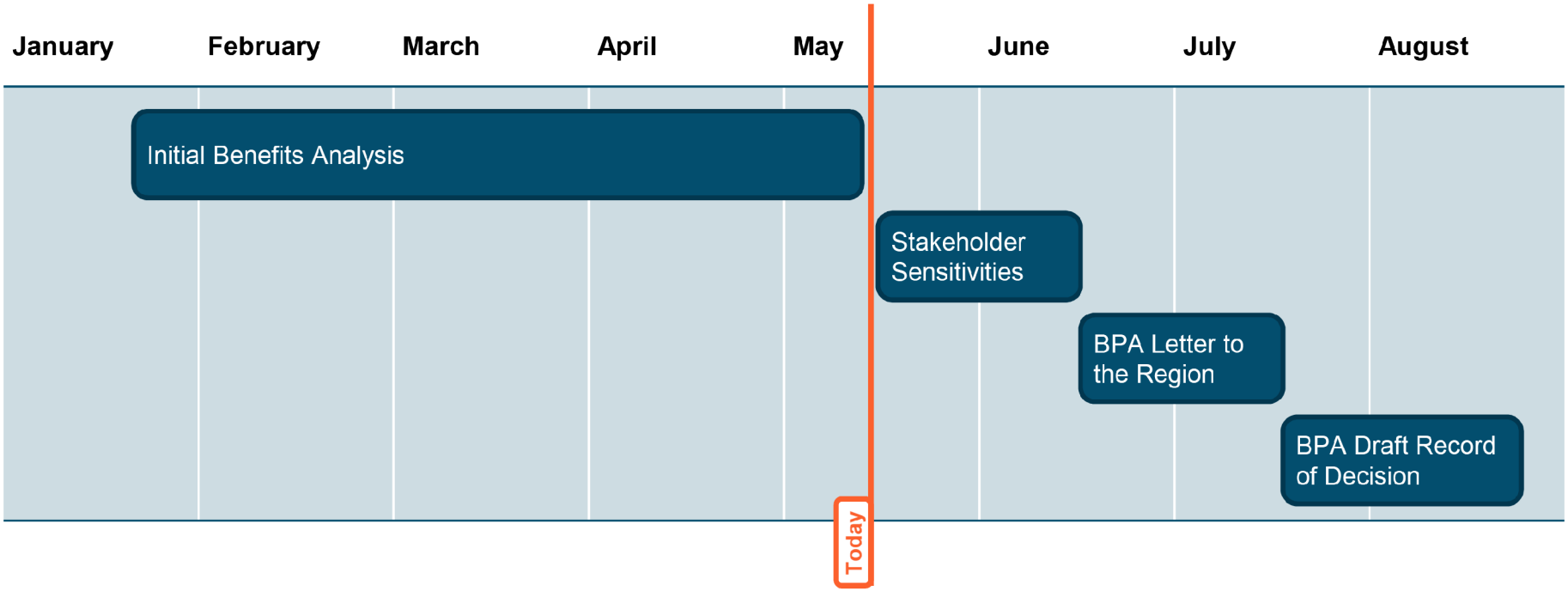
Summary & Next Steps

Wrap-Up

- E3 modeling suggests that dispatch benefits from EIM participation will quickly pay for itself and result in significant ongoing benefits:
  - Two sensitivities that were evaluated did not fundamentally change this conclusion
- E3 modeling suggests that EIM participation is a cost-effective non-wires solution and an effective intra-hour congestion management tool
- EIM participation will also:
  - Result in an efficient dispatch of generation to meet load across the entire EIM footprint
  - Provide increased visibility and discipline in the dispatch and marketing of FCRPS
  - Create additional visibility of conditions across the grid which will enhance reliability
  - Allow BPA to effectively participate in the development of future markets to enhance regional resource adequacy by ensuring that flexible resources are appropriately compensated for the services that they provide

Next Steps

- Based on today's feedback, we will develop a suite of sensitivities and updates for June stakeholder meeting



Next Steps

Next Steps

- Next meeting scheduled for **Wednesday June 12th** at the Rates Hearing Room.
  - WebEx and Phone participation will be available
  - Agenda and materials will be distributed in advance via Tech Forum

- We welcome feedback on this meeting. Your comments will help shape future EIM Stakeholder Meetings, please email us at techforum@bpa.gov and reference "EIM Stakeholder Meeting" in the subject. Comments are due by May 29th Wednesday.

- For more information on BPA's EIM Stakeholder process and meetings please visit:
  https://www.bpa.gov/Projects/Initiatives/EIM/Pages/Energy-Imbalance-Market.aspx

- For more information on BPA's Grid Modernization Initiative please visit:
  https://www.bpa.gov/goto/GridModernization

Question and Answer Session

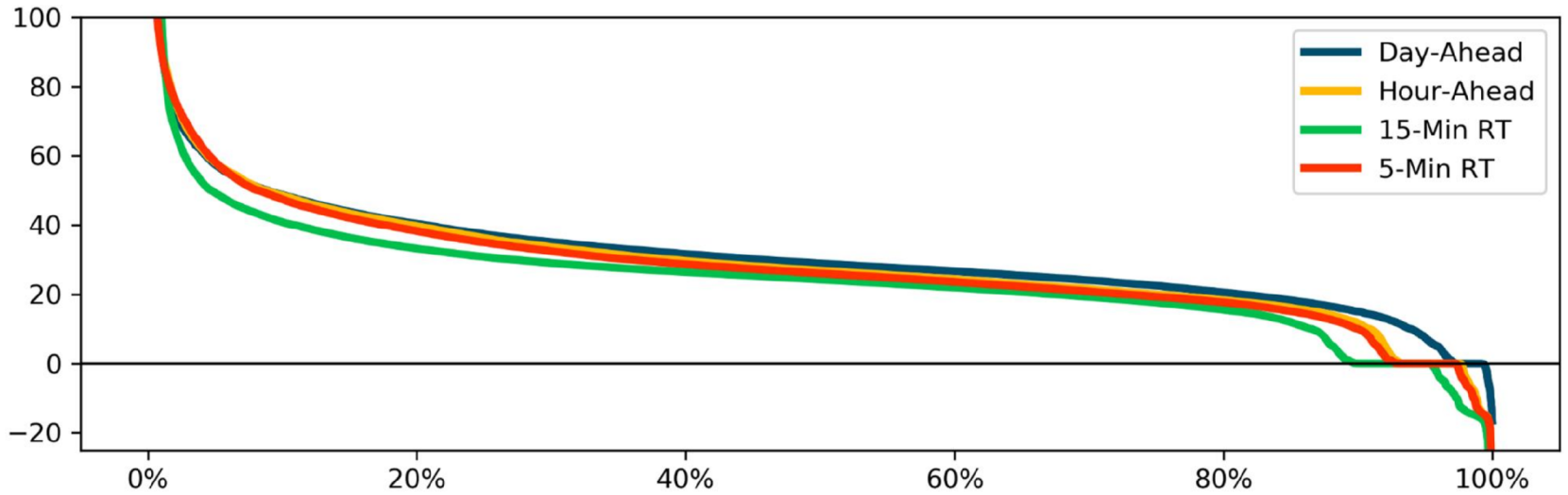
Appendix A. Benefits Analysis

Additional Material

Input Assumptions

Market Prices

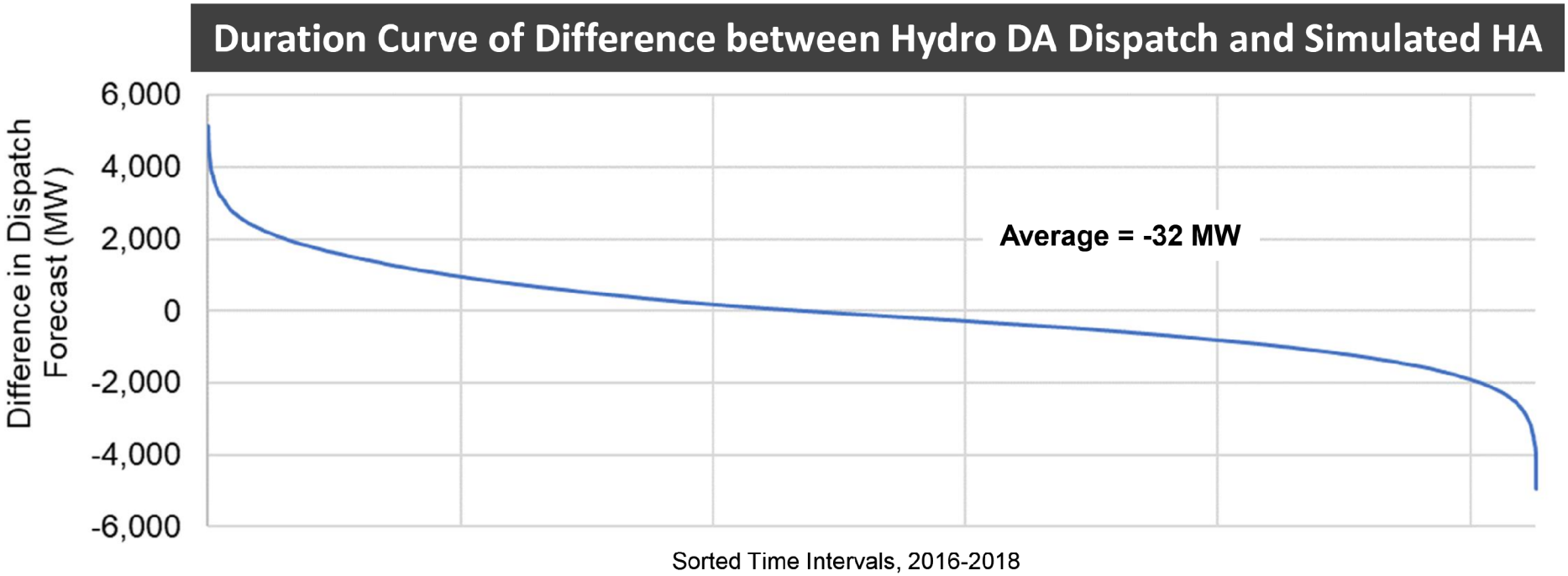
- Mid-C and EIM prices are based on historical for 2016-2018:
  - **Day-Ahead:** ICE Mid-C
  - **Hour Ahead:** Powerdex Mid-C
  - **EIM:** DGAP_BPAT-APND RTPD and RTM



Input Assumptions

Day-Ahead vs. Hour-Ahead Big 10 Hydro Setpoint

- Between 2016-2018, 45% of hours of day-ahead hydro tags are greater than the hour-ahead simulated hydro dispatch



Input Assumptions

Non-hydro BAA Generators

- All generators are given fixed loads in DA and HA
- By 2018 non-hydro BPA generators with fixed loads in real time include:

Generator Type	Max Output (MW)
Gas	2,949
Wind	2,760
Nuclear	1,191
Biomass	284
Coal	61
Geothermal	16
Solar	15

Input Assumptions

Hydro BAA Generators

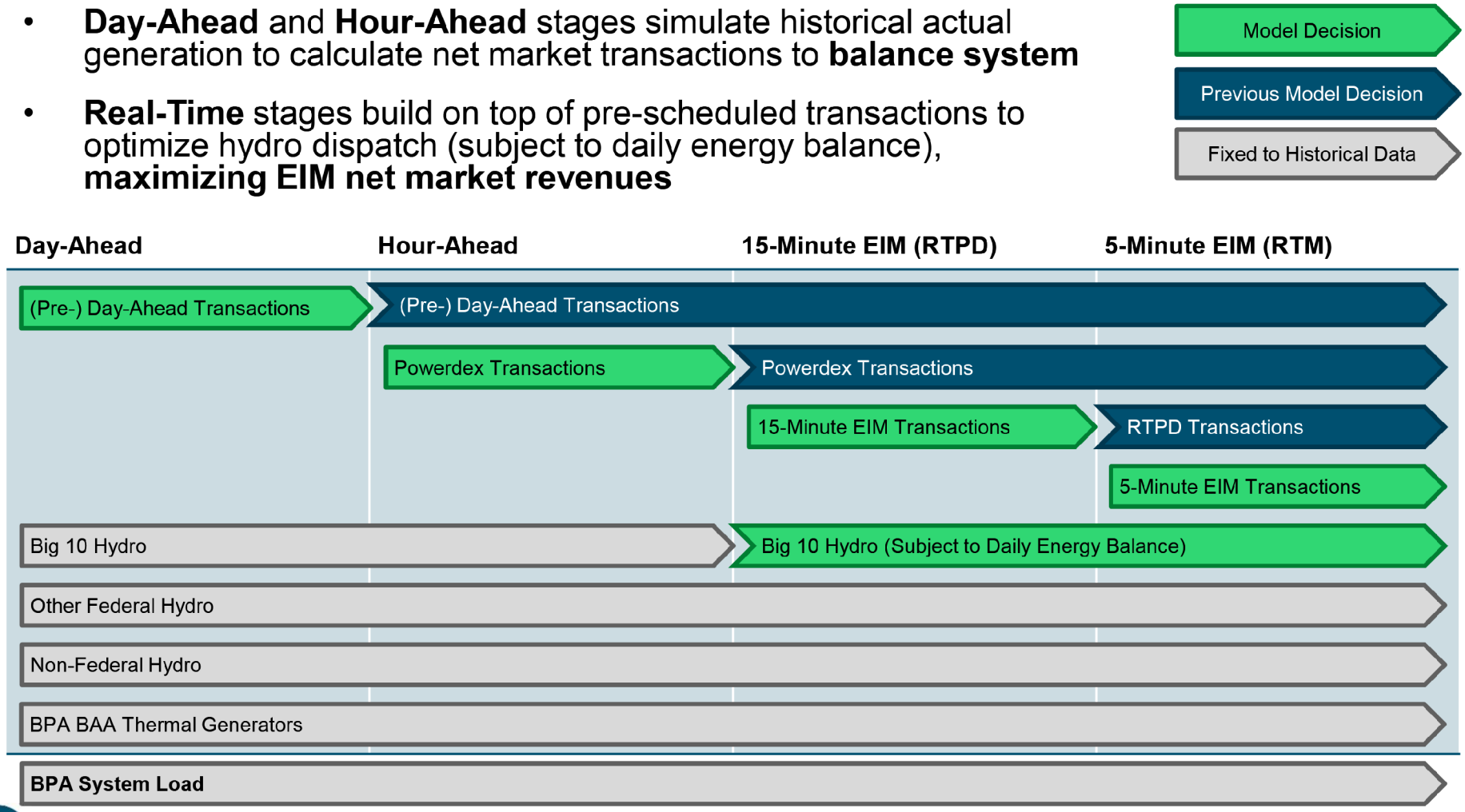
- **Hydro generation in BPA's BAA is categorized as Federal and Non-Federal:**
  - **Federal:**
    - **Big 6:** Bonneville, Grand Coulee, The Dalles, John Day, Chief Joseph, McNary
    - **4 of 10 largest federal hydro:** Lower Monumental, Lower Granite, Little Goose, Ice Harbor
    - **Other federal hydro:** Includes Libby, Hungry Horse, Dworshak
  - **Non-Federal:**
    - Dispatchable
    - Non-dispatchable (run of river)
- **All are given fixed load except for "Big 10" hydro**

Hydro Category	Max Capacity (MW)
Big 6	16,190
4 of 10	3,483
Other Federal	2,152
Non-Federal Dispatchable	43
Non-Federal Non-Dispatchable	306

Modeling Approach

Model Decisions

- **Day-Ahead** and **Hour-Ahead** stages simulate historical actual generation to calculate net market transactions to **balance system**
- **Real-Time** stages build on top of pre-scheduled transactions to optimize hydro dispatch (subject to daily energy balance), **maximizing EIM net market revenues**



Base Scenario Results

Annual Energy by Resource Category

- Half of energy generated in BPA BAA is traded/exported at Mid-C
- 5-7% of annual load is served by purchases in the EIM from 2016 to 2018

		Annual Energy Balance by Resource Category (GWh)					
		2016		2017		2018	
Category	Resource	EIM	Non-EIM	EIM	Non-EIM	EIM	Non-EIM
Generation	Thermal	9,443	9,443	9,141	9,141	8,837	8,837
	Nuclear	9,624	9,624	8,161	8,161	9,728	9,728
	Other Hydro	15,486	15,486	18,480	18,480	16,332	16,332
	Big 10 Hydro	59,303	59,303	63,199	63,199	62,163	62,163
	Wind & Solar	11,139	11,208	9,542	9,516	8,564	8,450
Purchases	Mid-C ICE	-	-	-	-	-	-
	Mid-C Powerdex	4,278	4,278	4,280	4,280	4,913	4,913
	EIM (15-Minute)	2,147	-	1,795	-	2,205	-
	EIM (5-Minute)	1,647	-	1,288	-	1,533	-
Sales	Mid-C ICE	(50,517)	(50,517)	(52,243)	(52,243)	(50,472)	(50,472)
	Mid-C Powerdex	(4,947)	(4,947)	(4,464)	(4,464)	(4,689)	(4,689)
	EIM (15-Minute)	(2,128)	-	(1,780)	-	(2,199)	-
	EIM (5-Minute)	(1,528)	-	(1,266)	-	(1,537)	-
Native Load		53,970	53,970	56,426	56,426	55,447	55,447

Base Scenario Results

Annual Energy Cost by Resource Category

- Average prices at Mid-C and EIM increase significantly from 2016 to 2018
- ~8% of sales revenue in every year is attributed to sales in the EIM

		Annual Energy Cost by Resource Category ($M)					
		2016		2017		2018	
Category	Resource	EIM	Non-EIM	EIM	Non-EIM	EIM	Non-EIM
Generation	Thermal	188	188	201.3	201.3	206.1	206.1
	Nuclear	7.8	7.8	6.6	6.6	7.9	7.9
	Other Hydro	-	-	-	-	-	-
	Big 10 Hydro	-	-	-	-	-	-
	Wind & Solar	-	-	-	-	-	-
Purchase Cost	Mid-C ICE	-	-	-	-	-	-
	Mid-C Powerdex	74.2	74.2	81.3	81.3	120.4	120.4
	EIM (15-Minute)*	28.1	-	28.7	-	40.4	-
	EIM (5-Minute)*	19.8	-	21.5	-	32.9	-
Sales Revenue	Mid-C ICE	934.4	934.4	958.4	958.4	1,242	1,242
	Mid-C Powerdex	97.9	97.9	109.2	109.2	151.5	151.5
	EIM (15-Minute)*	56.6	-	65.0	-	77.6	-
	EIM (5-Minute)*	39.4	-	35.1	-	44.6	-
Net Revenue of 15-minute		28.5		36.3		37.3	
Net Revenue of 5-minute		19.6		13.6		11.7	

* Reported EIM benefit value includes a 75% "success rate" of BPA bids into EIM

Base Scenario Results

EIM Transaction Volume Comparison

- For 2016-2018 period, average simulated BPA EIM transactions (MW) are on the high end of other BAAs' **historical EIM transfers**
  - PLEXOS model's perfect foresight and optimal dispatch allows larger volumes of redispatch (subject to hydro feasibility constraints)

BAA	15-Minute Sales (Average MW)	15-Minute Purchases (Average MW)	5-Minute Sales (Average MW)	5-Minute Purchases (Average MW)
AZPS	244	250	234	249
BCHA	77	121	89	151
CISO	631	487	715	471
IPCO	320	63	310	67
NEVP	128	299	142	305
PACE	389	718	376	749
PACW	501	133	493	147
PGE	116	138	117	146
PSEI	97	96	109	105
BPA	**647**	**533**	**397**	**416**

Source: CAISO OASIS EIM Transfer

Appendix B. Transmission Benefits

Assumptions and Examples

1. Transmission Curtailment

South-of-Allston Curtailment vs. ETF Constraint

- Performed three simulated curtailments with different flow relief requirements: **100 MW**, **300 MW**, and **500 MW** on South-of-Allston
  - **Curtailment:** Need to curtail **455 MW**, **1085 MW**, and **1711 MW** of schedules would be curtailed, respectively
  - **ETF Constraint:** EIM Area relief obligation would be **70.7 MW**, **208.0 MW**, and **344.9 MW** respectively
- Curtailments do not resupply energy to balance BAAs or control for the dispatch of resources that could reload the path/flowgate

Relief Required	Schedules to Curtail (Total)	Schedules to Curtail (EIM)	EIM Area Allocation
100	455	289	70.7
300	1085	780	208
500	1711	1270	344.9

1. Transmission Curtailment

South-of-Allston Curtailment vs. ETF Constraint

- The ETF constraint was able to provide up to **~335 MW** of flow reductions without relaxation in one 5-minute RTD run
- Shadow prices were **$14** and **$25** for the first two simulations (70.7MW and 208MW reductions)
- Compared to curtailments, fewer MW of resources were redispatched using ETF while simultaneously maintaining power balance.

2. EIM as a Non-Wires Solution

Example Transmission Build Costs

- **McNary—John Day 500 kV** (completed)
  - ~$192 million ≈ $19 million/year*
- **Central Ferry-Lower Monumental** (completed)
  - ~$112M ≈ $11 million/year*
- **Big Eddy – Knight** (completed)
  - ~$202M ≈ $20 million/year*
- **I-5 Reinforcement** (canceled)
  - ~$800 million ≈ $80 million/year*
- **Boardman to Hemingway** (planning)
  - ~$1,200 million ≈ $120 million/year*

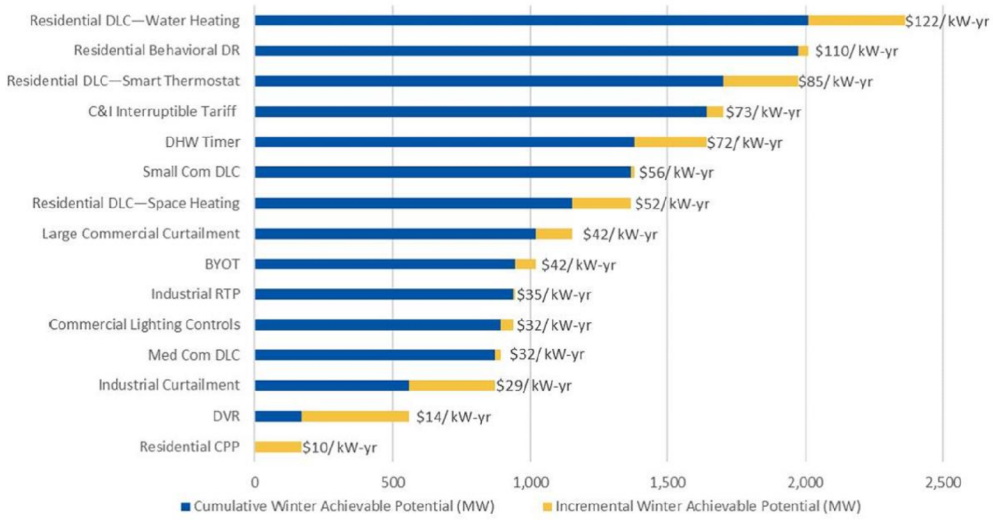
* Estimated levelized cost represents costs discounted over 40 years

2. EIM as a Non-Wires Solution

BPA Demand Response Potential & Costs

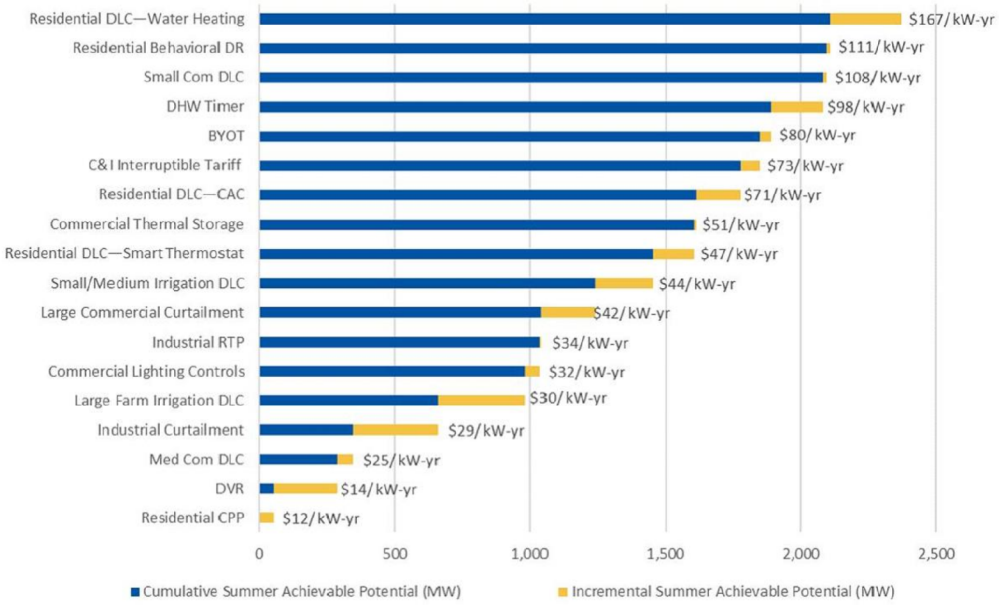
Winter Peak

Figure 4. 20-Year Supply Curve for Combined DR Products, Winter, with Levelized Costs



Summer Peak

Figure 3. 20-Year Supply Curve for Combined DR Products, Summer, with Levelized Costs



- BPA's DR costs are in line with neighboring BAAs (PacifiCorp and PSE)
  - Direct load control options in the range of **$29-$167/kW-year**
  - Pricing mechanisms in the **$10-$35/kW-year** range
- Over 2,000 MW of peak contribution across various measures

2. EIM as a Non-Wires Solution

South-of-Allston Redispatch Pilot

- Total cost for 2 years: $8.8 million
  - Does not include implementation cost for internal bid evaluation tool
- Pilot required BPA staff to notify participants day-ahead of redispatch and manually coordinate redispatch among participants

	SOA Non-Wires Pilot	FY17	FY18
A	SOA Pilot Budget	$ 5,000,000	$ 5,000,000
B	Capacity Costs	$ 3,393,053	$ 3,608,050
C	Energy + Other Costs	$ 180,370	$ 194,940
D	PTP TX Costs	$ 769,575	$ 690,525
E	**Total Budget - Total Cost**	**$ 657,002**	**$ 506,485**

2. EIM as a Non-Wires Solution

Battery Energy Storage Costs

- E3 uses Lazard's latest Levelized Cost of Storage 4.0 analysis as basis of a in-house financial pro forma to calculate cost of new storage build
- We estimate cost of storage in 2018 to be $226/kW-year for a 4-hour lithium-ion battery
  - Lazard's estimated CAGR for cost declines is 8%

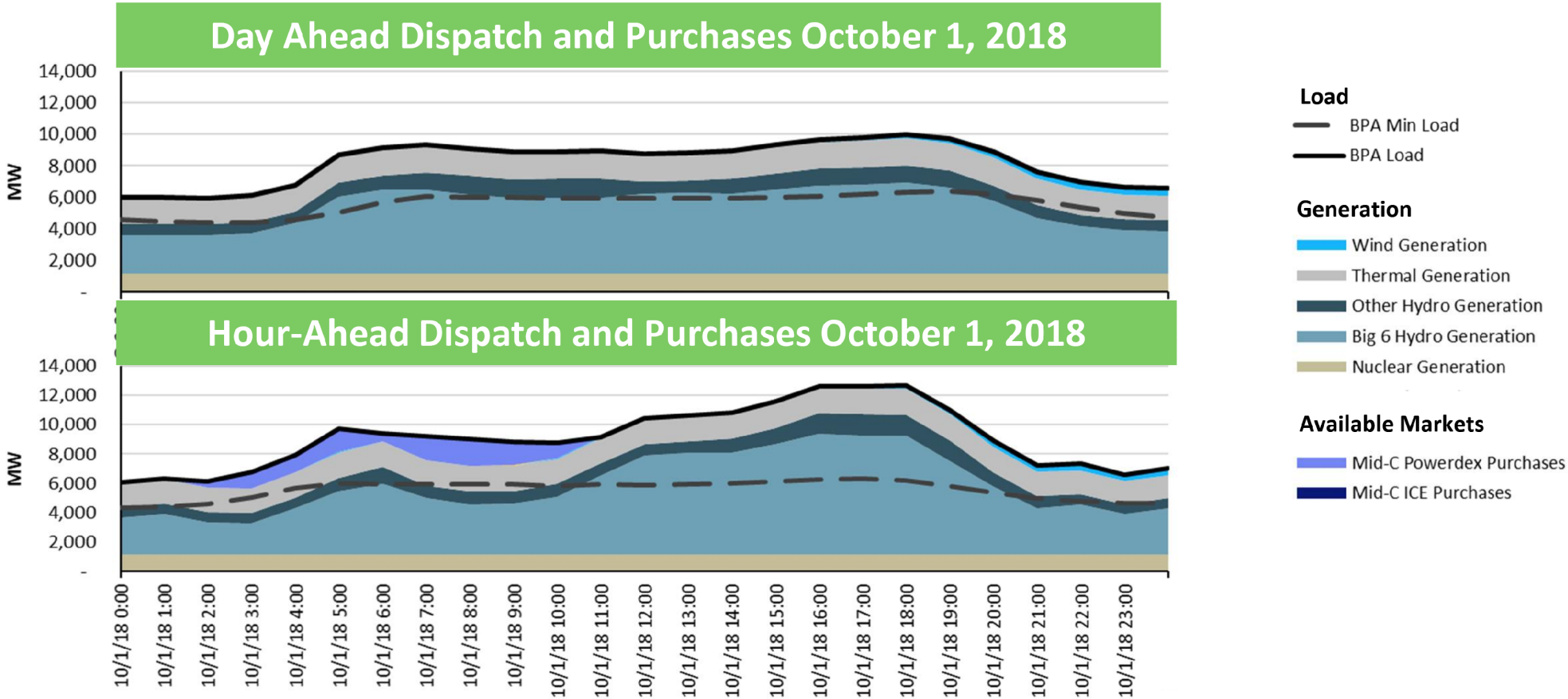


Source: Lazard's Levelized Cost of Storage Analysis – Version 4.0

Appendix C.
Example Dispatch Days

Base Scenario Results

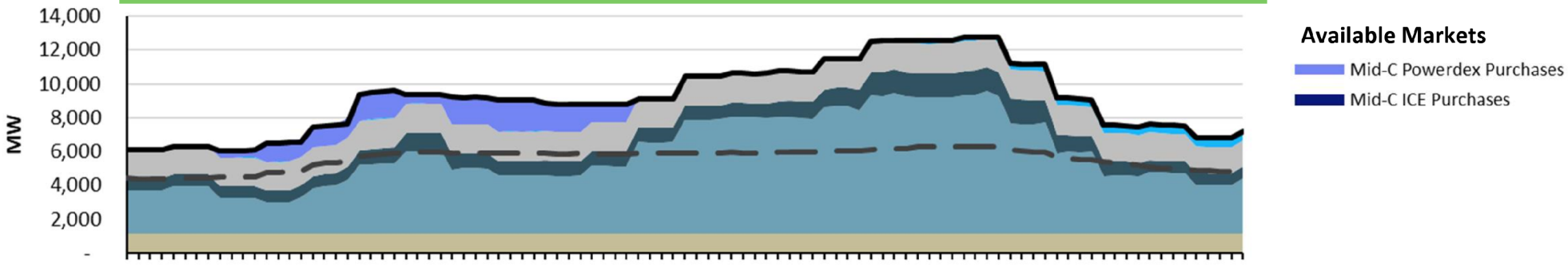
Four-Stage Dispatch: Pre-Real-Time (DA and HA)



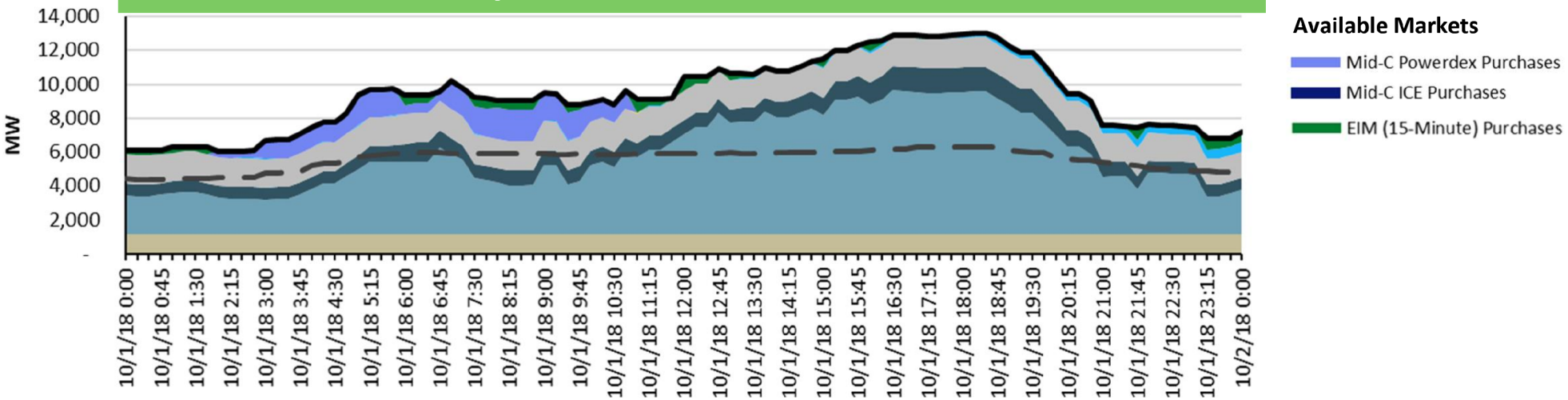
Base Scenario Results

Four-Stage Dispatch: RT15 BAU & EIM

BAU RT15 Dispatch and Purchases October 1, 2018

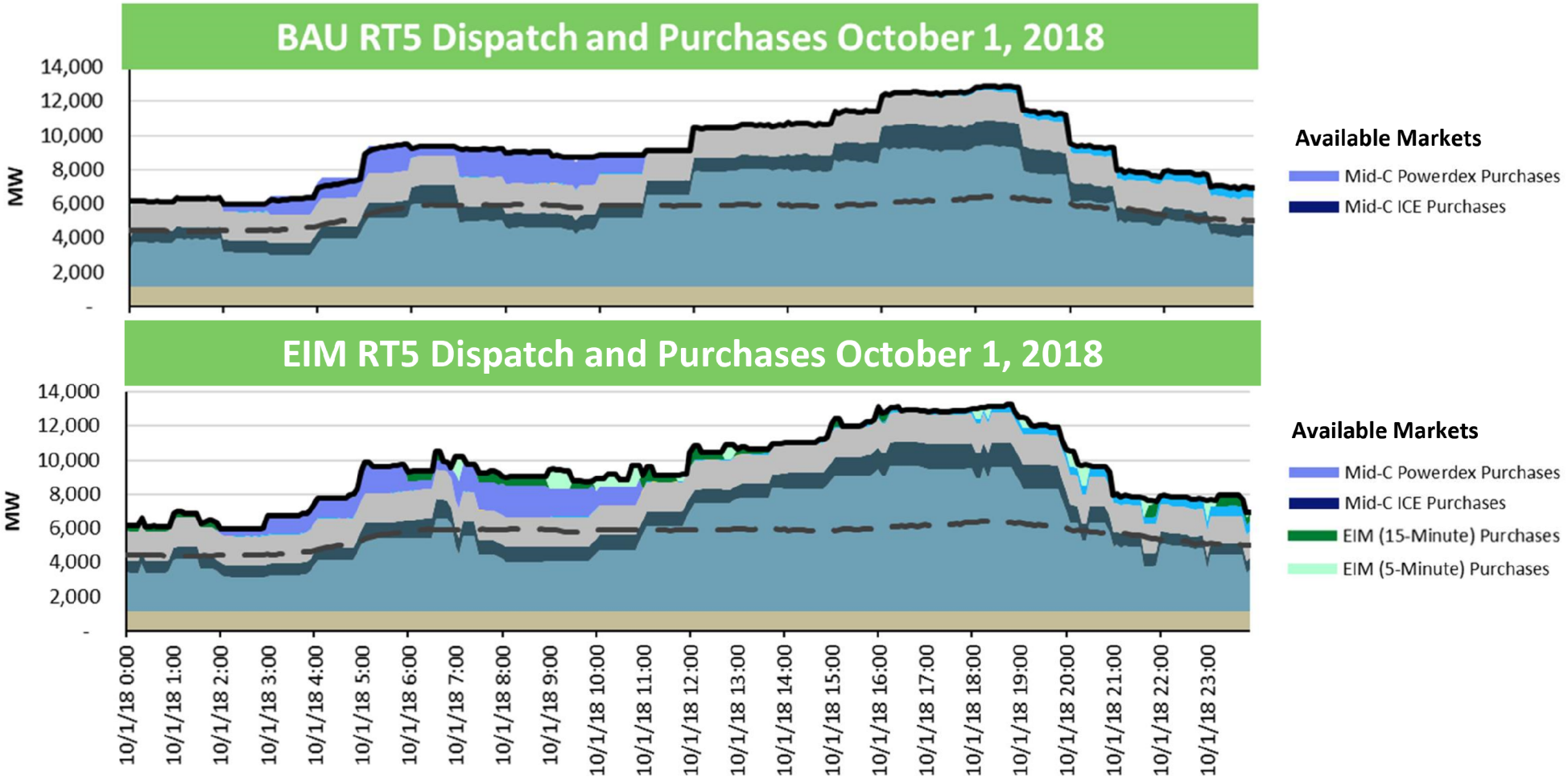


EIM RT15 Dispatch and Purchases October 1, 2018



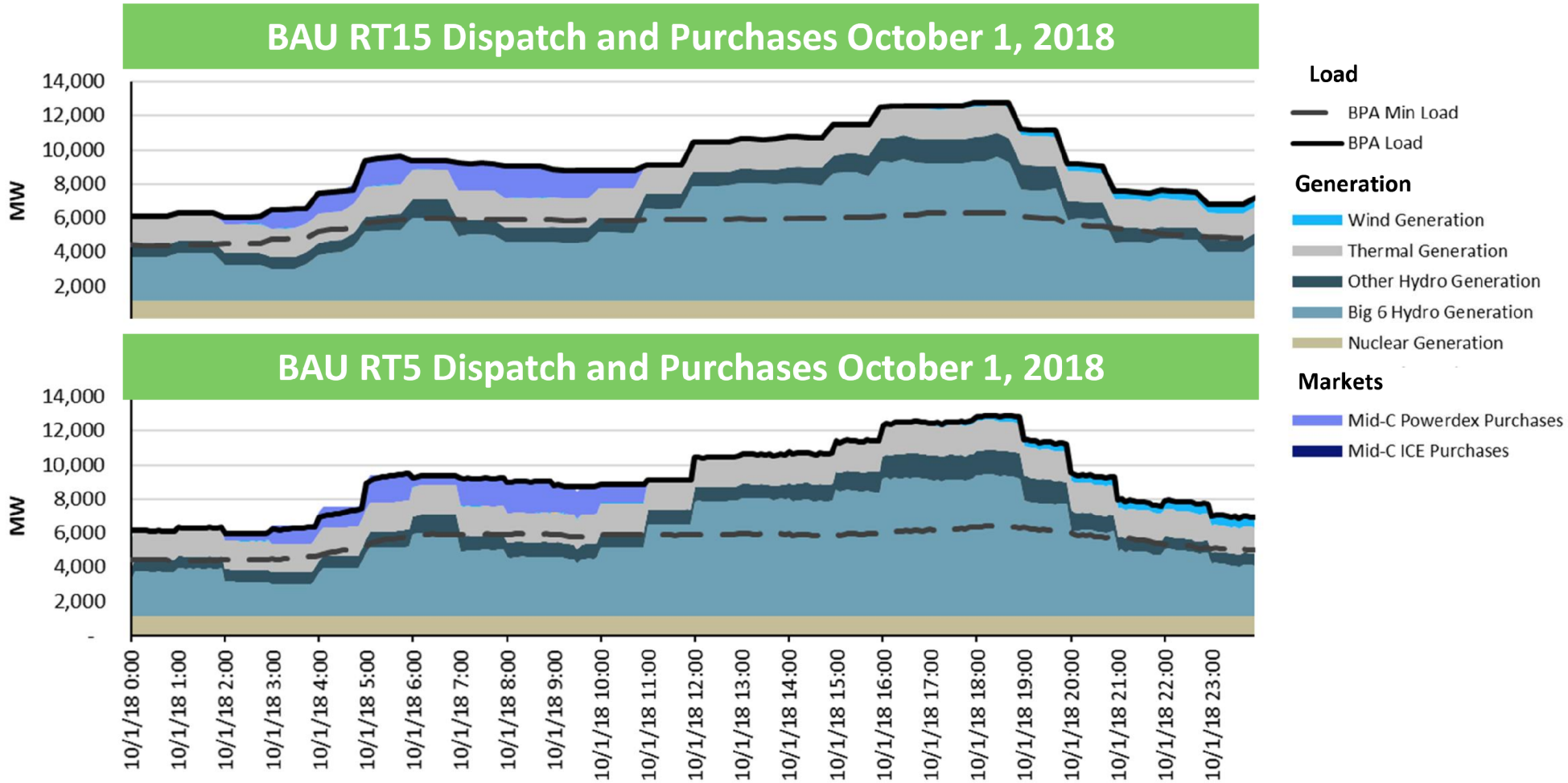
Base Scenario Results

Four-Stage Dispatch: RT5 BAU & EIM



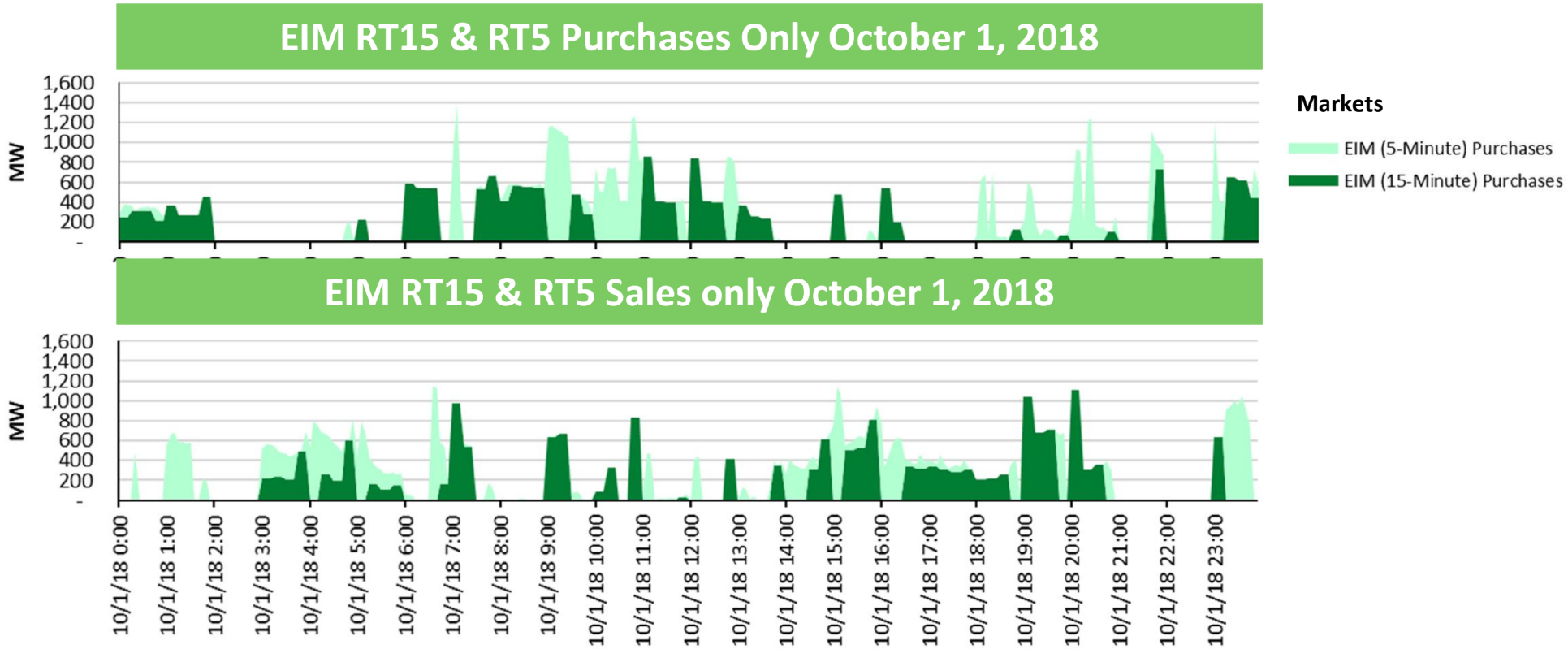
Base Scenario Results

Four-Stage Dispatch: RT15 & RT5 Non-EIM



Base Scenario Results

Dispatch, EIM Net Sales and Market Prices



BPA EIM Stakeholder Meeting

Public Generating Pool Comments
October 25, 2018

The Public Generating Pool (PGP) appreciates the opportunity to comment on BPA's Energy Imbalance Market (EIM) Stakeholder meeting held on October 11, 2018. PGP represents ten consumer-owned utilities in Oregon and Washington that own almost 6,000 MW of generation, 4,500 MW of which is hydro. Three of the PGP members operate their own Balancing Authority Area (BAA), while the remaining members have service territories within BPA's BAA. Nine PGP members purchase 37 percent of the requirements power sold by BPA.

A decision by BPA to join the EIM would significantly impact PGP members. Among other things, PGP members have a strong interest in BPA's decisions on issues such as treatment of transmission, allocation of costs and benefits, changes to products and services, resource sufficiency, billing, disputes, and settlements. If BPA decides to join the EIM, PGP members will need to make investments into their own systems and processes to conform to various EIM requirements. As BPA moves forward in evaluating its future participation as an EIM Entity, we request BPA engage with customers on their decisions and the associated system and process impacts with their power and transmission customers.

PGP appreciates the initial discussion of key issues BPA is considering as part of their participation in the EIM and looks forward to continued dialogue on these issues. PGP remains concerned over final resolution of market power mitigation for hydro resources in the EIM, particularly given the value and flexibility the Federal Columbia River Power System stands to offer the EIM, and look forward to a discussion on the issue in a future meeting.

PGP's comments are limited to the issues discussed at the October 11 meeting, namely BPA's process and timeline, treatment of transmission, generation participation, and EIM governance.

I. BPA EIM PROCESS AND TIMELINE

PGP thanks BPA for providing a high-level EIM process map and timeline along with the list of issues that will be discussed in the monthly stakeholder meetings before summer 2019. PGP looks forward to engaging with BPA on the eight issues identified at the July 24th meeting in these stakeholder meetings. There are also other areas of interest PGP would like to have more discussion on, and it is unclear where and when some of these other topics will be discussed.

For example, BPA has indicated that important issues such as the allocation of costs and benefits and impacts to current BPA products and services will be discussed in the rate case and tariff processes, but those processes are scheduled to take place after BPA issues a Record of

Comments submitted by:
Laura Trolese, ltrolese@publicgeneratingpool.com, (360) 513-6465
Therese Hampton, thampton@publicgeneratingpool.com, (360) 852-7366

Decision and signs the EIM Implementation Agreement. PGP requests BPA provide an outline of what issues will be discussed in what forum.

PGP also requests that BPA provide a draft schedule of what issues will be addressed during each of the public meetings between now and BPA's letter to the region, scheduled for July 2019. We recognize that changes may need to be made to the schedule, but an initial draft of the schedule will provide a good reference point for customers. Further, it provides an opportunity to identify issues that customers feel are key to their response to BPA's Record of Decision that may not currently be on the list of identified issues.

II. TREATMENT OF TRANSMISSION

PGP strongly supports BPA's initial determination to make transmission available for EIM transfers via customer donation of firm PTP transmission only. PGP agrees that BPA will be a "net wheeler" in the EIM and that providing 0-NX transmission to the EIM at no charge would result in cost shifts and free-ridership.

With regard to the use of transmission internal to BPA's network, PGP believes beginning discussions in the BP-22 pre-rate case workshops and TC-22 forums - after the record of decision is issued and implementation agreement is signed - is too late. PGP has concerns about potential cost shifts and free-ridership on BPA's internal network and requests that BPA move the discussion of the use of its internal transmission network ahead of the record of decision issuance.

III. GENERATION PARITICIPATION MODEL

PGP supports BPA's initial determination to use three aggregates (i.e., Upper Columbia, Lower Columbia, and Lower Snake) for participation in the EIM. PGP found BPA's analysis of the three options very helpful and agrees with BPA's conclusion. If BPA decides to join the EIM, PGP expects BPA will monitor the performance of its participation using three aggregates and modify as needed to improve BPA's participation benefits in the future.

IV. GOVERNANCE

PGP appreciates the presentation and discussion of BPA's perspectives on EIM Governance. Governance is a critical issue for PGP. The governance structure of a centralized market determines the market rules and how those rules are implemented determine how value is distributed in the market.

PGP understands that BPA has determined that there are no legal barriers to BPA joining the EIM given the current EIM Governance Structure. PGP believes there are enhancements

BPA-2020-00700-F0131

needed to the current EIM Governance structure to ensure that current governance represents all affected parties, provides the EIM Governing Body with appropriate input to the ISO Board of Governors' decision-making authority, and establishes a strong governance foundation for any future market expansion. PGP understands the venue for addressing these governance issues will be in the EIM Governance Review, scheduled to begin in 2019 and looks forward to working with BPA to advance these enhancements.

Below are some key areas from BPA's October 11 presentation material that PGP believes needs clarification:

- Slide 38: The initial EIM Governing Body members were recommended by a Nominating Committee and approved by the ISO Board of Governors. However, all subsequent EIM Governing Body members are also recommended by a Nominating Committee but approved by the EIM Governing Body.

- Slide 38: The Regional Issues Forum is an "information only" body.

  Section 6.1.1 Charter for the Energy Imbalance Market: "*Generally speaking, the Regional Issues Forum would not consider individual policy issues that are currently part of an ongoing stakeholder process, but rather address broader issues of EIM operations. The Regional Issus Form may, on occasion, discuss items that may already be in an ongoing ISO stakeholder process. In such instances, the function of the Forum will be to facilitate discussion or to provide educational or information content and not to serve as a means for duplicating or circumventing the formal ISO stakeholder process. Such discussion should not be considered to be part of any such formal stakeholder process and should not result in an opinion of the Forum on such issues.*"

- Slide 38: The Body of State Regulators advisory role is limited to "upon request" from the EIM Governing Body.

  Section 5.1.2.3 Charter for the Energy Imbalance Market: "*The Body of Regulators should provide advice to the EIM Governing Body upon request, and otherwise provide input to the EIM Governing Body.*"

- Slide 39: This slide seems to suggest that the EIM Governing Body has independent decision-making authority on issues that are considered "primary." However, it is important to note that the EIM Governing Body does not have any tariff filing authority and that all EIM Governing Body decisions are subject to review and approval by the CAISO Board of Governors.

BPA-2020-00700-F0132

PGP supports the recommended improvements to the EIM Governing Body identified by BPA on slide 40. In addition, PGP recommends consideration of transitioning the Regional Issues Forum and the Body of State Regulators into Advisory Bodies consistent with other ISO/RTOs in the country. This would require a change to the existing charters and could include changes to provide for more direct public power representation. Given that the EIM is fully based on the ISO real-time market, another area of consideration is expanding the primary authority of the EIM Governing Body to include market design rules of the real-time market. As mentioned above, PGP understands the best opportunity and venue to address the EIM Governance Structure will be during the EIM Governance Review in 2019.

V. CONCLUSION

PGP appreciates the thoughtfulness with which BPA has approached the last two public meetings on this topic. We look forward to future discussions and meetings.

BPA-2020-00700-F0133

Background:

Participation of FCRPS hydro projects in an EIM will require a decision on how these resources will be bid and how dispatch instructions from the market operator will be implemented. The intent of this paper is to discuss options on how FCRPS resources can participate in an EIM as well as pros/cons with each approach.

For discussion purposes in this paper, the term *EIM resource* will be used to reference the type of resource that the market operator sees and are limited to the dispatchable "Big10" FCRPS hydro projects. The assumption about the other non-dispatchable FCRPS projects is that they will be self-scheduled (as is the current practice) and not considered by the market operator for EIM dispatches. Data that is required to be submitted to the market operator for the *EIM resources* include base generation, minimum generation, maximum generation, and a bid curve for the upcoming hour, as well as an indication of the regulation, load following and contingency reserve requirements. The market operator will perform a calculation every five minutes and send a dispatch instruction to each *EIM resource* depending upon their submitted flexibility and the cleared price.

The fundamental question is how granular should FCRPS "Big10" resources be bid into the EIM, and there appear to be four options:

1. **BIG10 Level:** all "Big10" projects' data will be aggregated into one *EIM resource*.
2. **Zonal Level: "**Big10" projects' data will be aggregated into zones each corresponding to an *EIM resource* (Coulee/Chief, Lower Snake, and Lower Columbia, for example)
3. **Project Level:** all "Big10" projects' data will be submitted as individual *EIM resources*.
4. **Hybrid:** Big10 will be broken up into self-scheduled resources and individual *EIM resources*. (Coulee/John Day as individual *EIM resources*, the rest of the "Big10" self-scheduled, for example)

As pros/cons of each of the alternatives are developed, there are a few things to keep in mind:

- For purposes of grid reliability and congestion management, there is a desire for as much granularity as possible for the *EIM resources*
- The current practice in BPA's BA of dispatching balancing reserves to manage load and generation imbalance is market price-insensitive and generally fairly random within an hour. However, EIM market dispatches are price-driven and tend to dispatch *EIM resources* in a similar manner throughout the hour except for the *EIM resource* that is setting the price on the 5-minute interval. The result is that FCRPS

EIM resources could be frequently dispatched at their minimum or maximum generation levels.

- Moving to a market dispatch that is more granular than the **Big10 Level** risks de-optimizing the FCRPS[1] unless we figure out a way to reflect the costs of de-optimizing the FCRPS in the development of the price curves, limit the FCRPS flexibility that is being submitted, or develop a hydro-optimization post-processor.
- Moving to a market dispatch
- EIM losses….

Alternatives:

1. **BIG10 Level:** all "Big10" projects' data will be aggregated into one *EIM resource*. From an implementation perspective, this is probably the easiest since the market operators dispatch instructions could be post-processed by using an improved version of response factors. However, there is very little, if any, benefits to grid reliability or congestion management from this approach

   Pros:

   - Hydro and price curve data submission is fairly straight-forward
   - Market operator dispatch instructions can be translated to project-level in a manner close to status quo
   - No increased risk of hydraulic de-optimization

   Cons:

   - Little, if any, benefit to grid reliability or congestion management
   - No financial benefit to Power Services beyond what is expected in the cost/benefit analysis
   - Outages would have to be aggregated to submit at the Big10 Level
   - May introduce most additional uncertainty via losses amounts included in the CAISO dispatch instructions (uncertainty for CAISO because they may be less sure where we are actually dispatching it and continued uncertainty for Power and Transmission)

[1] For purposes of this discussion, *de-optimization of the FCRPS* refers to EIM dispatches that result in an un-anticipated reduction in future flexibility. For example, with the same bid curve, Lower Columbia projects could be given dispatch instructions that draft some of the projects and fills the other projects. This could leave some projects too full (which risks spill) or too empty (which limits fuel).

2. **Zonal Level: "**Big10" projects' data will be aggregated into zones each corresponding to an *EIM resource.* At first blush, using three zones (GCL/CHJ, LSN, LCOL) would seem doable (but more challenging) from an implementation perspective and would allow for some benefits for grid reliability and congestion management. This approach could also potentially allow for some additional financial benefits for Power Services since the bid curves could be tuned to reflect more refined opportunity costs in each of the zones (for example, the opportunity costs of moving water around at Grand Coulee could be different than moving water around on the Lower Snakes). Another challenge would be developing a methodology to post-process market operator zonal dispatch instructions to project-level.

   Pros:

   - Some benefit to grid reliability or congestion management
   - Potential of some additional financial benefit to Power Services

   Cons:

   - Hydro and price curve data submission is fairly complex
   - Increased risk of hydraulic de-optimization
   - Outages would have to be aggregated to submit at the Zonal Level
   - Market operator dispatch instructions can be translated to project-level could be fairly complex
   - May introduce some additional uncertainty via losses amounts included in the CAISO dispatch instructions (uncertainty for CAISO because they may be less sure where we are actually dispatching it and continued uncertainty for Power and Transmission)

3. **Project Level:** all "Big10" projects' data will be submitted as individual *EIM resources*. From a hydro data submission perspective, this approach is not much different from the the **Big10 Level** alternative since the data exists. However, there is a wild card in how complex the development of the bid curve data will be. This approach would maximize the benefit for grid reliability and congestion management. This approach could also potentially allow for some additional financial benefits for Power Services since the bid curves could be tuned to reflect more refined opportunity costs in the same manner as the **Zonal Level** alternative. While there is no need to develop a methodology to post-process the market instructions since they are already at the project level, there is risk

of hydraulic de-optimization if we aren't careful in how the hydro and price data are constructed.

Pros:

- Hydro data submission is fairly straight-forward
- Maximum benefits to grid reliability or congestion management
- Potential of some additional financial benefit to Power Services
- Minimizes need to post process market operator dispatch instructions
- Creates same opportunity to reduce uncertainty of losses amounts as Hybrid since losses would be included in the CAISO dispatch instructions (uncertainty for CAISO because they may be less sure where we are actually dispatching it and continued uncertainty for Power and Transmission)

Cons:

- Price curve data submission could be very complex
- Increased risk of hydraulic de-optimization

4. **Hybrid:** Big10 will be broken up into self-scheduled resources and individual *EIM resources*. The idea here is find a way that preserves the potential benefits while minimizing the risk of hydraulic de-optimization. Suppose we picked just a couple projects from the "Big 10" (Grand Coulee and John Day being the most obvious, but McNary and Lower Granite could also be candidates at times) and only offered them as *EIM resources*, and the remaining projects would be self-scheduled. Using the most operationally flexible and isolated projects minimizes the risk of hydro de-optimization within the hour and maintaining the project granularity that maximizes the grid reliability and congestion management benefits. However, to do this, we would have to completely change how we allocate regulation, load following and contingency reserves[2] so that these *EIM resources* can have maximum flexibility offered to the market operator to preserve the financial benefits for Power Services. In addition, there is a risk of incurring imbalance at the remaining "Big 10" projects.

   Pros:

   - Hydro and price curve data submission is fairly straight-forward
   - Maximum benefits to grid reliability or congestion management
   - Potential of some additional financial benefit to Power Services
   - No increased risk of hydraulic de-optimization

[2] This is part of the Reserves Enhancement CommOps project.

- No need to post process market operator dispatch instructions
- Creates same opportunity to reduce uncertainty of losses amounts as Project-level since losses would be included in the CAISO dispatch instructions (uncertainty for CAISO because they may be less sure where we are actually dispatching it and continued uncertainty for Power and Transmission)

Cons:

- Risk of incurring imbalance from the self-scheduled "Big10" projects
- Additional work to change how reserves are carried[3]

[3] While there is additional work that is noted as a "con", there is value for both Transmission Services and Power Services in the Reserve Enhancements CommOps project whether or not we join an EIM.

Background:

Participation of FCRPS hydro projects in an EIM will require a decision on how these resources will be bid and how dispatch instructions from the market operator will be implemented. The intent of this paper is to discuss options on how FCRPS resources can participate in an EIM as well as pros/cons with each approach.

For discussion purposes in this paper, the term *EIM resource* will be used to reference the type of resource that the market operator sees and are limited to the dispatchable "Big10" FCRPS hydro projects. The assumption about the other non-dispatchable FCRPS projects is that they will be self-scheduled (as is the current practice) and not considered by the market operator for EIM dispatches. Data that is required to be submitted to the market operator for the *EIM resources* include base generation, minimum generation, maximum generation, and a price curve for the upcoming hour, as well as an indication of the regulation, load following and contingency reserve requirements. The market operator will perform a calculation every five minutes and send a dispatch instruction to each *EIM resource* depending upon their submitted flexibility and the cleared price.

The fundamental question is how granular should FCRPS "Big10" resources be bid into the EIM, and there appear to be four options:

1. **BIG10 Level:** all "Big10" projects' data will be aggregated into one *EIM resource*.
2. **Zonal Level: "**Big10" projects' data will be aggregated into zones each corresponding to an *EIM resource* (Coulee/Chief, Lower Snake, and Lower Columbia, for example)
3. **Project Level:** all "Big10" projects' data will be submitted as individual *EIM resources*.
4. **Hybrid:** Big10 will be broken up into self-scheduled resources and individual *EIM resources*. (Coulee/John Day as individual *EIM resources*, the rest of the "Big10" self-scheduled, for example)

As pros/cons of each of the alternatives are developed, there are a few things to keep in mind:

- For purposes of grid reliability and congestion management, there is a desire for as much granularity as possible for the *EIM resources*
- The current practice in BPA's BA of dispatching balancing reserves to manage load and generation imbalance is market price-insensitive and generally fairly random within an hour. However, EIM market dispatches are price-driven and tend to dispatch *EIM resources* in a similar manner throughout the hour except for the *EIM resource* that is setting the price on the 5-minute interval. The result is that we

should expect FCRPS *EIM resources* to be frequently dispatched at their minimum or maximum generation levels.

- Moving to a market dispatch that is more granular than the **Big10 Level** risks de-optimizing the FCRPS unless we figure out a way to reflect the costs of de-optimizing the FCRPS in the development of the price curves, limit the FCRPS flexibility that is being submitted, or develop a hydro-optimization post-processor.

Alternatives:

1. **BIG10 Level:** all "Big10" projects' data will be aggregated into one *EIM resource*. From an implementation perspective, this is probably the easiest since the market operators dispatch instructions could be post-processed by using an improved version of response factors. However, there is very little, if any, benefits to grid reliability or congestion management from this approach

   Pros:

   - Hydro and price curve data submission is fairly straight-forward
   - Market operator dispatch instructions can be translated to project-level in a manner close to status quo
   - No increased risk of hydraulic de-optimization

   Cons:

   - Little, if any, benefit to grid reliability or congestion management

2. **Zonal Level: "**Big10" projects' data will be aggregated into zones each corresponding to an *EIM resource*. At first blush, using three zones (GCL/CHJ, LSN, LCOL) would seem doable (but more challenging) from an implementation perspective and would allow for some benefits for grid reliability and congestion management. This approach could also potentially allow for some additional financial benefits for Power Services since the price curves could be tuned to reflect more refined opportunity costs in each of the zones (for example, the opportunity costs of moving water around at Grand Coulee could be different than moving water around on the Lower Snakes). Another challenge would be developing a methodology to post-process market operator zonal dispatch instructions to project-level.

   Pros:

- Some benefit to grid reliability or congestion management
- Potential of some additional financial benefit to Power Services

Cons:

- Hydro and price curve data submission is fairly complex
- Increased risk of hydraulic de-optimization
- Market operator dispatch instructions can be translated to project-level could be fairly complex

3. **Project Level:** all "Big10" projects' data will be submitted as individual *EIM resources*. From a hydro data submission perspective, this approach is not much different from the the **Big10 Level** alternative since the data exists. However, there is a wild card in how complex the development of the price curve data will be. This approach would maximize the benefit for grid reliability and congestion management. This approach could also potentially allow for some additional financial benefits for Power Services since the price curves could be tuned to reflect more refined opportunity costs in the same manner as the **Zonal Level** alternative. While there is no need to develop a methodology to post-process the market instructions since they are already at the project level, there is risk of hydraulic de-optimization is we aren't careful in how the hydro and price data are constructed.

   Pros:

   - Hydro data submission is fairly straight-forward
   - Maximum benefits to grid reliability or congestion management
   - Potential of some additional financial benefit to Power Services
   - No need to post process market operator dispatch instructions

   Cons:

   - Price curve data submission could be very complex
   - Increased risk of hydraulic de-optimization

4. **Hybrid:** Big10 will be broken up into self-scheduled resources and individual *EIM resources*. The idea here is find a way that preserves the potential benefits while minimizing the risk of hydraulic de-optimization. Suppose we picked just a couple projects from the "Big 10" (Grand Coulee and John Day being the most obvious, but McNary and Lower Granite could also be candidates at times) and only offered them as *EIM resources*, and the remaining projects would be self-scheduled. Using the most

operationally flexible and isolated projects minimizes the risk of hydro de-optimization within the hour and maintaining the project granularity maximizes the grid reliability and congestion management benefits. However, to do this, we would have to completely change how we allocate regulation, load following and contingency reserves[1] so that these *EIM resources* can have maximum flexibility offered to the market operator to preserve the financial benefits for Power Services. In addition, there is a risk of incurring imbalance at the remaining "Big 10" projects.

Pros:

- Hydro and price curve data submission is fairly straight-forward
- Maximum benefits to grid reliability or congestion management
- Potential of some additional financial benefit to Power Services
- No increased risk of hydraulic de-optimization
- No need to post process market operator dispatch instructions

Cons:

- Risk of incurring imbalance from the self-scheduled "Big10" projects
- Additional work to change how reserves are carried[2]

[1] This is part of the Reserves Enhancement CommOps project.
[2] While there is additional work that is noted as a "con", there is value for both Transmission Services and Power Services in the Reserve Enhancements CommOps project whether or not we join an EIM.

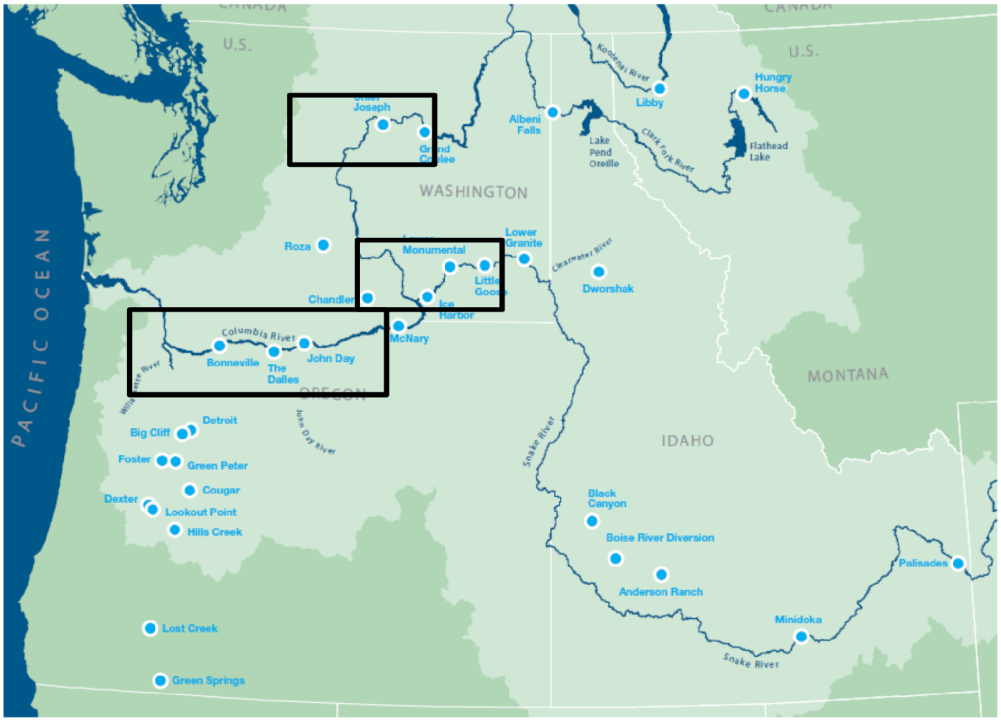
Objective & Approach:

In order to determine which of the big-10 FCRPS resources are electrically similar to one another relative to BPA's internal flowgates, a set of Generation Shift Factors (GSFs) were calculated from a 2019 all lines in service planning case. In the context of any specific flowgate, resources that have very similar GSFs are considered to be electrically similar for that flowgate - in this analysis, if the difference between any two GSFs were less than 10%, the resources were considered to be electrically similar. Three separate aggregations of resources were specifically considered: Upper Columbia (Chief and Coulee), Lower Columbia (Bonneville, The Dalles, John Day, McNary), and the Snake River projects (Ice Harbor, Low Mo, Little Goose, Lower Granite).

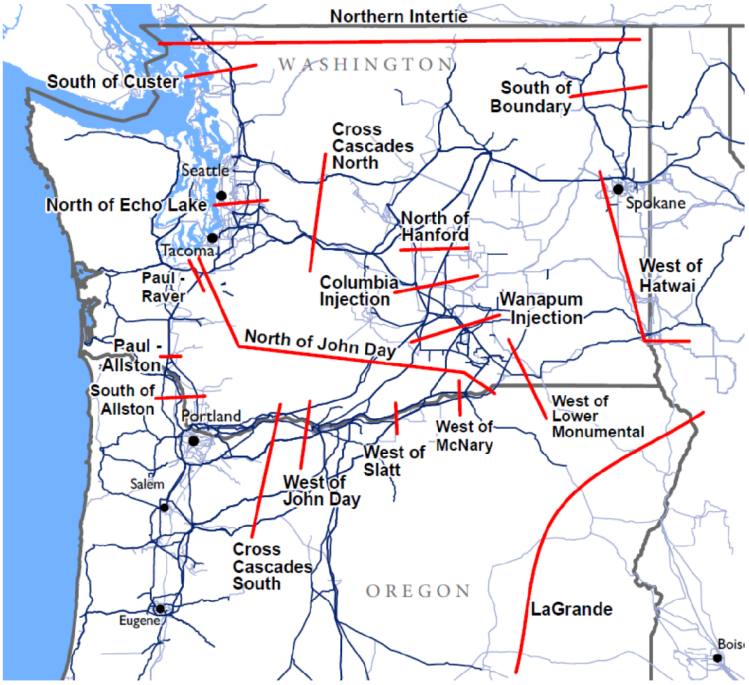
Methodology:

- Used 2019 planning case – all lines in service
- Used Generation Shift Factors (i.e., GSF/PTDFs) - analyzed impacts of each plant relative to one another
- Used 10% threshold
- Outages were not considered
- Not verified – draft results!

Definitions:

- UPPER = Upper Columbia (Chief and Coulee)
- LOWER = Lower Columbia (Bonneville, The Dalles, John Day, McNary)
- SNAKE = Snake River (Ice Harbor, Low Mo, Little Goose, Lower Granite)
- 

Flowgates:



Summary:

ELECTRICALLY SIMMILAR @ 10%				
FLOWGATE	**UPPER**	**LOWER**	**SNAKE**	**NOTES**
CCN	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
CCS	YES	NO	YES	Bonneville much higher than 10% in Lower
NOEL	YES	YES	YES	
NOH	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
NJD	YES	YES	NO	Ice Harbor much higher than 10%
PA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
RP	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOC	YES	YES	YES	
WOJD	YES	NO	YES	
WOLM	YES	YES	NO	Ice Harbor has a large impact (>80%)
WOM	YES	NO	MAYBE	Ice Harbor a little less than 20%
WOS	YES	MAYBE	YES	Impacts range from 5-32%

Based on the preliminary/draft results, Upper Columbia resources can be considered electrically similar. For the Lower Columbia resources, Bonneville and McNary would ideally not be included in an aggregation. However, WOJD is problematic for the Lower Columbia resources in total and doesn't lend itself to any Lower Columbia aggregation - additional analysis will be required to determine if an aggregation can be allowed. For the Snake resources, excluding Ice Harbor from the aggregation would probably be acceptable, pending further analysis.

Congestion/Curtailment Risk:

FLOWGATE:		CROSS CASCADES NORTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.7%	3.5%	14.8%	2.2%	4.6%	3.5%	3.2%	2.2%	4.6%	4.7%	4.7%	3.2%	15.6%	17.9%
LOW2	JDA	1.7%	0.0%	1.8%	13.1%	0.5%	6.3%	5.2%	4.9%	0.5%	6.3%	6.3%	6.4%	4.9%	17.3%	19.6%
LOW3	TDA	3.5%	1.8%	0.0%	11.3%	1.3%	8.1%	7.0%	6.7%	1.3%	8.1%	8.2%	8.2%	6.7%	19.1%	21.4%
LOW4	BON	14.8%	13.1%	11.3%	0.0%	12.8%	19.4%	18.3%	18.0%	12.8%	19.4%	19.4%	19.5%	18.0%	30.4%	32.7%
OTH	ALF	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
OTH	DWR	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.5%	11.0%	13.3%
OTH	HGH	3.5%	5.2%	7.0%	18.3%	5.7%	1.1%	0.0%	0.3%	5.7%	1.1%	1.1%	1.2%	0.3%	12.1%	14.4%
OTH	LIB	3.2%	4.9%	6.7%	18.0%	5.4%	1.4%	0.3%	0.0%	5.4%	1.4%	1.4%	1.5%	0.0%	12.4%	14.7%
OTH	BLK	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
SNK1	LWG	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.4%	11.0%	13.3%
SNK2	LGS	4.7%	6.3%	8.2%	19.4%	6.9%	0.0%	1.1%	1.4%	6.9%	0.0%	0.0%	0.0%	1.5%	11.0%	13.3%
SNK3	LMN	4.7%	6.4%	8.2%	19.5%	6.9%	0.1%	1.2%	1.5%	6.9%	0.1%	0.0%	0.0%	1.5%	10.9%	13.3%
SNK4	IHR	3.2%	4.9%	6.7%	18.0%	5.4%	1.5%	0.3%	0.0%	5.4%	1.4%	1.5%	1.5%	0.0%	12.4%	14.8%
UP1	GCL	15.6%	17.3%	19.1%	30.4%	17.8%	11.0%	12.1%	12.4%	17.8%	11.0%	11.0%	10.9%	12.4%	0.0%	2.3%
UP2	CHJ	17.9%	19.6%	21.4%	32.7%	20.1%	13.3%	14.4%	14.7%	20.1%	13.3%	13.3%	13.3%	14.8%	2.3%	0.0%

FLOWGATE:		CROSS CASCADES SOUTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.1%	2.4%	76.8%	12.8%	8.5%	11.1%	11.3%	12.8%	5.8%	5.1%	4.7%	3.3%	14.0%	15.2%
LOW2	JDA	0.1%	0.0%	2.2%	77.0%	12.9%	8.7%	11.2%	11.5%	12.9%	5.9%	5.2%	4.8%	3.4%	14.1%	15.3%
LOW3	TDA	2.4%	2.2%	0.0%	79.2%	15.1%	10.9%	13.5%	13.7%	15.1%	8.1%	7.4%	7.0%	5.7%	16.3%	17.5%
LOW4	BON	76.8%	77.0%	79.2%	0.0%	64.1%	68.3%	65.7%	65.5%	64.1%	71.1%	71.7%	72.2%	73.5%	62.9%	61.7%
OTH	ALF	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
OTH	DWR	8.5%	8.7%	10.9%	68.3%	4.2%	0.0%	2.6%	2.8%	4.2%	2.8%	3.5%	3.9%	5.2%	5.4%	6.6%
OTH	HGH	11.1%	11.2%	13.5%	65.7%	1.6%	2.6%	0.0%	0.2%	1.6%	5.3%	6.0%	6.4%	7.8%	2.9%	4.1%
OTH	LIB	11.3%	11.5%	13.7%	65.5%	1.4%	2.8%	0.2%	0.0%	1.4%	5.6%	6.2%	6.7%	8.0%	2.6%	3.8%
OTH	BLK	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
SNK1	LWG	5.8%	5.9%	8.1%	71.1%	7.0%	2.8%	5.3%	5.6%	7.0%	0.0%	0.7%	1.1%	2.5%	8.2%	9.4%
SNK2	LGS	5.1%	5.2%	7.4%	71.7%	7.7%	3.5%	6.0%	6.2%	7.7%	0.7%	0.0%	0.4%	1.8%	8.9%	10.1%
SNK3	LMN	4.7%	4.8%	7.0%	72.2%	8.1%	3.9%	6.4%	6.7%	8.1%	1.1%	0.4%	0.0%	1.4%	9.3%	10.5%
SNK4	IHR	3.3%	3.4%	5.7%	73.5%	9.5%	5.2%	7.8%	8.0%	9.5%	2.5%	1.8%	1.4%	0.0%	10.7%	11.9%
UP1	GCL	14.0%	14.1%	16.3%	62.9%	1.2%	5.4%	2.9%	2.6%	1.2%	8.2%	8.9%	9.3%	10.7%	0.0%	1.2%
UP2	CHJ	15.2%	15.3%	17.5%	61.7%	2.4%	6.6%	4.1%	3.8%	2.4%	9.4%	10.1%	10.5%	11.9%	1.2%	0.0%

FLOWGATE:	NORTH OF ECHO LAKE S>N															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.4%	0.4%	0.7%	10.7%	3.2%	5.9%	6.4%	10.7%	1.2%	0.6%	0.3%	0.3%	3.2%	10.3%
LOW2	JDA	0.4%	0.0%	0.0%	0.3%	11.1%	3.6%	6.3%	6.8%	11.1%	1.6%	1.0%	0.7%	0.7%	3.6%	10.7%
LOW3	TDA	0.4%	0.0%	0.0%	0.2%	11.2%	3.7%	6.3%	6.8%	11.2%	1.6%	1.1%	0.8%	0.8%	3.6%	10.7%
LOW4	BON	0.7%	0.3%	0.2%	0.0%	11.4%	3.9%	6.6%	7.1%	11.4%	1.8%	1.3%	1.0%	1.0%	3.9%	10.9%
OTH	ALF	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
OTH	DWR	3.2%	3.6%	3.7%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.1%	2.6%	2.9%	2.9%	0.0%	7.0%
OTH	HGH	5.9%	6.3%	6.3%	6.6%	4.9%	2.7%	0.0%	0.5%	4.9%	4.7%	5.2%	5.6%	5.6%	2.7%	4.4%
OTH	LIB	6.4%	6.8%	6.8%	7.1%	4.3%	3.2%	0.5%	0.0%	4.3%	5.2%	5.8%	6.1%	6.1%	3.2%	3.9%
OTH	BLK	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
SNK1	LWG	1.2%	1.6%	1.6%	1.8%	9.6%	2.1%	4.7%	5.2%	9.6%	0.0%	0.5%	0.8%	0.8%	2.0%	9.1%
SNK2	LGS	0.6%	1.0%	1.1%	1.3%	10.1%	2.6%	5.2%	5.8%	10.1%	0.5%	0.0%	0.3%	0.3%	2.6%	9.6%
SNK3	LMN	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
SNK4	IHR	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
UP1	GCL	3.2%	3.6%	3.6%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.0%	2.6%	2.9%	2.9%	0.0%	7.1%
UP2	CHJ	10.3%	10.7%	10.7%	10.9%	0.5%	7.0%	4.4%	3.9%	0.5%	9.1%	9.6%	9.9%	9.9%	7.1%	0.0%

FLOWGATE:	NORTH OF HANFORD N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.2%	0.1%	12.2%	38.1%	14.8%	29.0%	30.7%	38.1%	1.7%	5.9%	8.4%	1.5%	56.3%	55.6%
LOW2	JDA	4.2%	0.0%	4.1%	16.3%	42.3%	18.9%	33.1%	34.8%	42.3%	2.5%	1.7%	4.2%	5.6%	60.4%	59.7%
LOW3	TDA	0.1%	4.1%	0.0%	12.2%	38.2%	14.8%	29.1%	30.8%	38.2%	1.6%	5.8%	8.3%	1.6%	56.3%	55.6%
LOW4	BON	12.2%	16.3%	12.2%	0.0%	26.0%	2.6%	16.8%	18.5%	26.0%	13.9%	18.0%	20.5%	10.7%	44.1%	43.4%
OTH	ALF	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
OTH	DWR	14.8%	18.9%	14.8%	2.6%	23.4%	0.0%	14.2%	15.9%	23.4%	16.4%	20.6%	23.1%	13.3%	41.5%	40.8%
OTH	HGH	29.0%	33.1%	29.1%	16.8%	9.2%	14.2%	0.0%	1.7%	9.2%	30.7%	34.8%	37.4%	27.5%	27.3%	26.6%
OTH	LIB	30.7%	34.8%	30.8%	18.5%	7.5%	15.9%	1.7%	0.0%	7.5%	32.4%	36.5%	39.0%	29.2%	25.6%	24.9%
OTH	BLK	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
SNK1	LWG	1.7%	2.5%	1.6%	13.8%	39.8%	16.4%	30.7%	32.4%	39.8%	0.0%	4.2%	6.7%	3.2%	57.9%	57.2%
SNK2	LGS	5.9%	1.7%	5.8%	18.0%	44.0%	20.6%	34.8%	36.5%	44.0%	4.2%	0.0%	2.5%	7.3%	62.1%	61.4%
SNK3	LMN	8.4%	4.2%	8.3%	20.5%	46.5%	23.1%	37.4%	39.0%	46.5%	6.7%	2.5%	0.0%	9.8%	64.6%	63.9%
SNK4	IHR	1.5%	5.6%	1.6%	10.7%	36.7%	13.3%	27.5%	29.2%	36.7%	3.2%	7.3%	9.8%	0.0%	54.8%	54.1%
UP1	GCL	56.3%	60.4%	56.3%	44.1%	18.1%	41.5%	27.3%	25.6%	18.1%	57.9%	62.1%	64.6%	54.8%	0.0%	0.7%
UP2	CHJ	55.6%	59.7%	55.6%	43.4%	17.4%	40.8%	26.6%	24.9%	17.4%	57.2%	61.4%	63.9%	54.1%	0.7%	0.0%

FLOWGATE:	NORTH OF JOHN DAY N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.4%	1.2%	4.4%	71.3%	73.3%	69.3%	69.8%	71.3%	81.1%	83.7%	85.3%	0.5%	75.1%	74.5%
LOW2	JDA	4.4%	0.0%	3.2%	8.8%	75.7%	77.7%	73.7%	74.2%	75.7%	85.5%	88.1%	89.7%	4.9%	79.5%	78.9%
LOW3	TDA	1.2%	3.2%	0.0%	5.6%	72.5%	74.5%	70.5%	71.0%	72.5%	82.3%	84.9%	86.5%	1.7%	76.3%	75.7%
LOW4	BON	4.4%	8.8%	5.6%	0.0%	66.9%	68.9%	64.9%	65.4%	66.9%	76.7%	79.3%	80.9%	3.9%	70.7%	70.1%
OTH	ALF	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
OTH	DWR	73.3%	77.7%	74.5%	68.9%	2.0%	0.0%	4.0%	3.5%	2.0%	7.8%	10.4%	11.9%	72.8%	1.7%	1.1%
OTH	HGH	69.3%	73.7%	70.5%	64.9%	2.0%	4.0%	0.0%	0.5%	2.0%	11.8%	14.4%	15.9%	68.8%	5.7%	5.1%
OTH	LIB	69.8%	74.2%	71.0%	65.4%	1.5%	3.5%	0.5%	0.0%	1.5%	11.3%	13.9%	15.4%	69.3%	5.2%	4.6%
OTH	BLK	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
SNK1	LWG	81.1%	85.5%	82.3%	76.7%	9.8%	7.8%	11.8%	11.3%	9.8%	0.0%	2.6%	4.2%	80.6%	6.0%	6.6%
SNK2	LGS	83.7%	88.1%	84.9%	79.3%	12.4%	10.4%	14.4%	13.9%	12.4%	2.6%	0.0%	1.6%	83.2%	8.6%	9.2%
SNK3	LMN	85.3%	89.7%	86.5%	80.9%	13.9%	11.9%	15.9%	15.4%	13.9%	4.2%	1.6%	0.0%	84.7%	10.2%	10.8%
SNK4	IHR	0.5%	4.9%	1.7%	3.9%	70.8%	72.8%	68.8%	69.3%	70.8%	80.6%	83.2%	84.7%	0.0%	74.5%	73.9%
UP1	GCL	75.1%	79.5%	76.3%	70.7%	3.7%	1.7%	5.7%	5.2%	3.7%	6.0%	8.6%	10.2%	74.5%	0.0%	0.6%
UP2	CHJ	74.5%	78.9%	75.7%	70.1%	3.1%	1.1%	5.1%	4.6%	3.1%	6.6%	9.2%	10.8%	73.9%	0.6%	0.0%

FLOWGATE:	PAUL TO ALLSTON N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.8%	3.3%	12.4%	10.7%	6.7%	8.7%	9.0%	10.7%	4.9%	4.4%	4.2%	2.8%	12.5%	13.6%
LOW2	JDA	1.8%	0.0%	1.6%	10.7%	12.5%	8.5%	10.5%	10.8%	12.5%	6.6%	6.2%	6.0%	4.6%	14.3%	15.4%
LOW3	TDA	3.3%	1.6%	0.0%	9.1%	14.1%	10.1%	12.0%	12.4%	14.1%	8.2%	7.8%	7.5%	6.2%	15.9%	16.9%
LOW4	BON	12.4%	10.7%	9.1%	0.0%	23.1%	19.2%	21.1%	21.5%	23.1%	17.3%	16.9%	16.6%	15.2%	24.9%	26.0%
OTH	ALF	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
OTH	DWR	6.7%	8.5%	10.1%	19.2%	4.0%	0.0%	2.0%	2.3%	4.0%	1.9%	2.3%	2.6%	3.9%	5.8%	6.9%
OTH	HGH	8.7%	10.5%	12.0%	21.1%	2.0%	2.0%	0.0%	0.3%	2.0%	3.8%	4.3%	4.5%	5.9%	3.8%	4.9%
OTH	LIB	9.0%	10.8%	12.4%	21.5%	1.7%	2.3%	0.3%	0.0%	1.7%	4.2%	4.6%	4.9%	6.2%	3.5%	4.6%
OTH	BLK	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
SNK1	LWG	4.9%	6.6%	8.2%	17.3%	5.9%	1.9%	3.8%	4.2%	5.9%	0.0%	0.4%	0.7%	2.1%	7.7%	8.7%
SNK2	LGS	4.4%	6.2%	7.8%	16.9%	6.3%	2.3%	4.3%	4.6%	6.3%	0.4%	0.0%	0.3%	1.6%	8.1%	9.2%
SNK3	LMN	4.2%	6.0%	7.5%	16.6%	6.5%	2.6%	4.5%	4.9%	6.5%	0.7%	0.3%	0.0%	1.4%	8.3%	9.4%
SNK4	IHR	2.8%	4.6%	6.2%	15.2%	7.9%	3.9%	5.9%	6.2%	7.9%	2.1%	1.6%	1.4%	0.0%	9.7%	10.8%
UP1	GCL	12.5%	14.3%	15.9%	24.9%	1.8%	5.8%	3.8%	3.5%	1.8%	7.7%	8.1%	8.3%	9.7%	0.0%	1.1%
UP2	CHJ	13.6%	15.4%	16.9%	26.0%	2.9%	6.9%	4.9%	4.6%	2.9%	8.7%	9.2%	9.4%	10.8%	1.1%	0.0%

FLOWGATE:	RAVER TO PAUL N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.3%	2.6%	10.2%	8.2%	5.2%	6.7%	6.9%	8.2%	3.9%	3.6%	3.4%	2.2%	9.8%	10.6%
LOW2	JDA	1.3%	0.0%	1.3%	8.9%	9.5%	6.6%	8.0%	8.2%	9.5%	5.2%	4.9%	4.7%	3.6%	11.1%	12.0%
LOW3	TDA	2.6%	1.3%	0.0%	7.6%	10.8%	7.9%	9.3%	9.5%	10.8%	6.5%	6.2%	6.0%	4.9%	12.4%	13.3%
LOW4	BON	10.2%	8.9%	7.6%	0.0%	18.4%	15.5%	16.9%	17.1%	18.4%	14.1%	13.8%	13.6%	12.5%	20.0%	20.9%
OTH	ALF	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
OTH	DWR	5.2%	6.6%	7.9%	15.5%	2.9%	0.0%	1.4%	1.7%	2.9%	1.4%	1.7%	1.9%	3.0%	4.6%	5.4%
OTH	HGH	6.7%	8.0%	9.3%	16.9%	1.5%	1.4%	0.0%	0.2%	1.5%	2.8%	3.1%	3.3%	4.4%	3.1%	4.0%
OTH	LIB	6.9%	8.2%	9.5%	17.1%	1.3%	1.7%	0.2%	0.0%	1.3%	3.0%	3.3%	3.5%	4.7%	2.9%	3.7%
OTH	BLK	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
SNK1	LWG	3.9%	5.2%	6.5%	14.1%	4.3%	1.4%	2.8%	3.0%	4.3%	0.0%	0.3%	0.5%	1.6%	5.9%	6.8%
SNK2	LGS	3.6%	4.9%	6.2%	13.8%	4.6%	1.7%	3.1%	3.3%	4.6%	0.3%	0.0%	0.2%	1.3%	6.2%	7.1%
SNK3	LMN	3.4%	4.7%	6.0%	13.6%	4.8%	1.9%	3.3%	3.5%	4.8%	0.5%	0.2%	0.0%	1.1%	6.4%	7.3%
SNK4	IHR	2.2%	3.6%	4.9%	12.5%	5.9%	3.0%	4.4%	4.7%	5.9%	1.6%	1.3%	1.1%	0.0%	7.6%	8.4%
UP1	GCL	9.8%	11.1%	12.4%	20.0%	1.6%	4.6%	3.1%	2.9%	1.6%	5.9%	6.2%	6.4%	7.6%	0.0%	0.9%
UP2	CHJ	10.6%	12.0%	13.3%	20.9%	2.5%	5.4%	4.0%	3.7%	2.5%	6.8%	7.1%	7.3%	8.4%	0.9%	0.0%

FLOWGATE:	SOUTH OF ALLSTON N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	2.1%	4.0%	16.0%	13.2%	8.3%	10.7%	11.2%	13.2%	6.0%	5.5%	5.2%	3.5%	15.4%	16.8%
LOW2	JDA	2.1%	0.0%	2.0%	13.9%	15.3%	10.4%	12.8%	13.2%	15.3%	8.1%	7.6%	7.2%	5.6%	17.4%	18.8%
LOW3	TDA	4.0%	2.0%	0.0%	11.9%	17.3%	12.4%	14.8%	15.2%	17.3%	10.1%	9.5%	9.2%	7.5%	19.4%	20.8%
LOW4	BON	16.0%	13.9%	11.9%	0.0%	29.2%	24.3%	26.7%	27.1%	29.2%	22.0%	21.5%	21.2%	19.5%	31.4%	32.7%
OTH	ALF	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
OTH	DWR	8.3%	10.4%	12.4%	24.3%	4.9%	0.0%	2.4%	2.8%	4.9%	2.3%	2.8%	3.2%	4.8%	7.1%	8.4%
OTH	HGH	10.7%	12.8%	14.8%	26.7%	2.5%	2.4%	0.0%	0.4%	2.5%	4.7%	5.2%	5.6%	7.2%	4.7%	6.0%
OTH	LIB	11.2%	13.2%	15.2%	27.1%	2.1%	2.8%	0.4%	0.0%	2.1%	5.1%	5.7%	6.0%	7.7%	4.2%	5.6%
OTH	BLK	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
SNK1	LWG	6.0%	8.1%	10.1%	22.0%	7.2%	2.3%	4.7%	5.1%	7.2%	0.0%	0.5%	0.8%	2.5%	9.4%	10.7%
SNK2	LGS	5.5%	7.6%	9.5%	21.5%	7.7%	2.8%	5.2%	5.7%	7.7%	0.5%	0.0%	0.3%	2.0%	9.9%	11.3%
SNK3	LMN	5.2%	7.2%	9.2%	21.2%	8.1%	3.2%	5.6%	6.0%	8.1%	0.8%	0.3%	0.0%	1.7%	10.2%	11.6%
SNK4	IHR	3.5%	5.6%	7.5%	19.5%	9.7%	4.8%	7.2%	7.7%	9.7%	2.5%	2.0%	1.7%	0.0%	11.9%	13.3%
UP1	GCL	15.4%	17.4%	19.4%	31.4%	2.2%	7.1%	4.7%	4.2%	2.2%	9.4%	9.9%	10.2%	11.9%	0.0%	1.4%
UP2	CHJ	16.8%	18.8%	20.8%	32.7%	3.5%	8.4%	6.0%	5.6%	3.5%	10.7%	11.3%	11.6%	13.3%	1.4%	0.0%

FLOWGATE:		SOUTH OF CUSTER N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.3%	0.4%	0.8%	15.1%	3.6%	7.0%	7.7%	15.1%	1.3%	0.8%	0.5%	0.2%	0.3%	1.5%
LOW2	JDA	0.3%	0.0%	0.1%	0.5%	15.3%	3.8%	7.3%	8.0%	15.3%	1.6%	1.1%	0.7%	0.4%	0.1%	1.2%
LOW3	TDA	0.4%	0.1%	0.0%	0.4%	15.4%	3.9%	7.4%	8.1%	15.4%	1.7%	1.2%	0.8%	0.6%	0.0%	1.1%
LOW4	BON	0.8%	0.5%	0.4%	0.0%	15.9%	4.4%	7.8%	8.5%	15.9%	2.1%	1.6%	1.3%	1.0%	0.5%	0.7%
OTH	ALF	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
OTH	DWR	3.6%	3.8%	3.9%	4.4%	11.5%	0.0%	3.4%	4.1%	11.5%	2.2%	2.8%	3.1%	3.4%	3.9%	5.0%
OTH	HGH	7.0%	7.3%	7.4%	7.8%	8.1%	3.4%	0.0%	0.7%	8.1%	5.7%	6.2%	6.5%	6.8%	7.3%	8.5%
OTH	LIB	7.7%	8.0%	8.1%	8.5%	7.4%	4.1%	0.7%	0.0%	7.4%	6.4%	6.9%	7.2%	7.5%	8.0%	9.2%
OTH	BLK	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
SNK1	LWG	1.3%	1.6%	1.7%	2.1%	13.7%	2.2%	5.7%	6.4%	13.7%	0.0%	0.6%	0.9%	1.2%	1.7%	2.8%
SNK2	LGS	0.8%	1.1%	1.2%	1.6%	14.3%	2.8%	6.2%	6.9%	14.3%	0.6%	0.0%	0.3%	0.6%	1.1%	2.3%
SNK3	LMN	0.5%	0.7%	0.8%	1.3%	14.6%	3.1%	6.5%	7.2%	14.6%	0.9%	0.3%	0.0%	0.3%	0.8%	1.9%
SNK4	IHR	0.2%	0.4%	0.6%	1.0%	14.9%	3.4%	6.8%	7.5%	14.9%	1.2%	0.6%	0.3%	0.0%	0.5%	1.7%
UP1	GCL	0.3%	0.1%	0.0%	0.5%	15.4%	3.9%	7.3%	8.0%	15.4%	1.7%	1.1%	0.8%	0.5%	0.0%	1.1%
UP2	CHJ	1.5%	1.2%	1.1%	0.7%	16.5%	5.0%	8.5%	9.2%	16.5%	2.8%	2.3%	1.9%	1.7%	1.1%	0.0%

FLOWGATE:		WEST OF JOHN DAY E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	22.3%	56.4%	33.2%	10.4%	7.3%	8.7%	9.1%	10.4%	6.0%	5.7%	5.5%	3.1%	12.4%	12.9%
LOW2	JDA	22.3%	0.0%	78.6%	55.4%	32.7%	29.5%	31.0%	31.3%	32.7%	28.2%	27.9%	27.6%	25.3%	34.6%	35.2%
LOW3	TDA	56.4%	78.6%	0.0%	23.2%	46.0%	43.1%	47.6%	47.3%	46.0%	50.4%	50.7%	50.8%	53.3%	44.0%	43.4%
LOW4	BON	33.2%	55.4%	23.2%	0.0%	22.7%	25.9%	24.4%	24.1%	22.7%	27.2%	27.5%	27.6%	30.1%	20.8%	20.2%
OTH	ALF	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
OTH	DWR	7.3%	29.5%	43.1%	25.9%	3.1%	0.0%	1.4%	1.8%	3.1%	1.3%	1.6%	1.8%	4.2%	5.1%	5.6%
OTH	HGH	8.7%	31.0%	47.6%	24.4%	1.7%	1.4%	0.0%	0.3%	1.7%	2.8%	3.0%	3.2%	5.7%	3.6%	4.2%
OTH	LIB	9.1%	31.3%	47.3%	24.1%	1.4%	1.8%	0.3%	0.0%	1.4%	3.1%	3.4%	3.5%	6.0%	3.3%	3.9%
OTH	BLK	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
SNK1	LWG	6.0%	28.2%	50.4%	27.2%	4.4%	1.3%	2.8%	3.1%	4.4%	0.0%	0.3%	0.4%	2.9%	6.4%	7.0%
SNK2	LGS	5.7%	27.9%	50.7%	27.5%	4.7%	1.6%	3.0%	3.4%	4.7%	0.3%	0.0%	0.2%	2.6%	6.7%	7.2%
SNK3	LMN	5.5%	27.6%	50.8%	27.6%	4.9%	1.8%	3.2%	3.5%	4.9%	0.4%	0.2%	0.0%	2.5%	6.8%	7.4%
SNK4	IHR	3.1%	25.3%	53.3%	30.1%	7.3%	4.2%	5.7%	6.0%	7.3%	2.9%	2.6%	2.5%	0.0%	9.3%	9.9%
UP1	GCL	12.4%	34.6%	44.0%	20.8%	2.0%	5.1%	3.6%	3.3%	2.0%	6.4%	6.7%	6.8%	9.3%	0.0%	0.6%
UP2	CHJ	12.9%	35.2%	43.4%	20.2%	2.5%	5.6%	4.2%	3.9%	2.5%	7.0%	7.2%	7.4%	9.9%	0.6%	0.0%

FLOWGATE:		WEST OF LOWER MONUMENTAL E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.1%	1.5%	2.4%	25.0%	30.3%	33.7%	32.2%	25.0%	76.9%	86.0%	90.3%	3.2%	9.0%	8.2%
LOW2	JDA	1.1%	0.0%	0.4%	1.4%	23.9%	29.2%	32.6%	31.2%	23.9%	77.8%	84.9%	89.2%	4.3%	7.9%	7.2%
LOW3	TDA	1.5%	0.4%	0.0%	1.0%	23.5%	29.8%	32.2%	30.8%	23.5%	77.4%	84.5%	88.8%	4.7%	7.5%	6.8%
LOW4	BON	2.4%	1.4%	1.0%	0.0%	22.6%	30.9%	31.3%	29.8%	22.6%	76.4%	83.5%	87.8%	5.6%	6.6%	5.8%
OTH	ALF	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
OTH	DWR	30.3%	29.2%	29.8%	30.9%	28.3%	0.0%	19.6%	21.1%	28.3%	25.6%	32.7%	36.9%	56.5%	44.3%	45.1%
OTH	HGH	33.7%	32.6%	32.2%	31.3%	8.7%	19.6%	0.0%	1.5%	8.7%	45.2%	52.3%	56.6%	36.9%	24.7%	25.5%
OTH	LIB	32.2%	31.2%	30.8%	29.8%	7.2%	21.1%	1.5%	0.0%	7.2%	46.6%	53.7%	58.0%	35.4%	23.2%	24.0%
OTH	BLK	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
SNK1	LWG	76.9%	77.8%	77.4%	76.4%	53.9%	25.6%	45.2%	46.6%	53.9%	0.0%	7.1%	11.4%	82.1%	68.9%	70.6%
SNK2	LGS	86.0%	84.9%	84.5%	83.5%	61.0%	32.7%	52.3%	53.7%	61.0%	7.1%	0.0%	4.3%	89.2%	77.0%	77.7%
SNK3	LMN	90.3%	89.2%	88.8%	87.8%	65.3%	36.9%	56.6%	58.0%	65.3%	11.4%	4.3%	0.0%	93.4%	81.3%	82.0%
SNK4	IHR	3.2%	4.3%	4.7%	5.6%	28.2%	56.5%	36.9%	35.4%	28.2%	82.1%	89.2%	93.4%	0.0%	12.2%	11.4%
UP1	GCL	9.0%	7.9%	7.5%	6.6%	16.0%	44.3%	24.7%	23.2%	16.0%	68.9%	77.0%	81.3%	12.2%	0.0%	0.8%
UP2	CHJ	8.2%	7.2%	6.8%	5.8%	16.8%	45.1%	25.5%	24.0%	16.8%	70.6%	77.7%	82.0%	11.4%	0.8%	0.0%

FLOWGATE:		WEST OF MCNARY E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	72.5%	70.4%	67.4%	52.4%	47.1%	50.9%	51.1%	52.4%	43.6%	42.8%	42.3%	23.8%	55.5%	55.8%
LOW2	JDA	72.5%	0.0%	2.1%	5.1%	20.1%	25.4%	21.6%	21.4%	20.1%	28.9%	29.7%	30.2%	48.7%	17.0%	16.7%
LOW3	TDA	70.4%	2.1%	0.0%	3.0%	18.0%	23.3%	19.5%	19.3%	18.0%	26.8%	27.6%	28.1%	46.6%	14.9%	14.6%
LOW4	BON	67.4%	5.1%	3.0%	0.0%	14.9%	20.3%	16.5%	16.3%	14.9%	23.8%	24.6%	25.1%	43.6%	11.9%	11.6%
OTH	ALF	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
OTH	DWR	47.1%	25.4%	23.3%	20.3%	5.3%	0.0%	3.8%	3.9%	5.3%	3.6%	4.3%	4.8%	23.3%	8.4%	8.7%
OTH	HGH	50.9%	21.6%	19.5%	16.5%	1.5%	3.8%	0.0%	0.2%	1.5%	7.3%	8.1%	8.6%	27.1%	4.6%	4.9%
OTH	LIB	51.1%	21.4%	19.3%	16.3%	1.4%	3.9%	0.2%	0.0%	1.4%	7.5%	8.3%	8.7%	27.3%	4.4%	4.7%
OTH	BLK	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
SNK1	LWG	43.6%	28.9%	26.8%	23.8%	8.9%	3.6%	7.3%	7.5%	8.9%	0.0%	0.8%	1.3%	19.8%	11.9%	12.2%
SNK2	LGS	42.8%	29.7%	27.6%	24.6%	9.6%	4.3%	8.1%	8.3%	9.6%	0.8%	0.0%	0.5%	19.0%	12.7%	13.0%
SNK3	LMN	42.3%	30.2%	28.1%	25.1%	10.1%	4.8%	8.6%	8.7%	10.1%	1.3%	0.5%	0.0%	18.5%	13.2%	13.5%
SNK4	IHR	23.8%	48.7%	46.6%	43.6%	28.6%	23.3%	27.1%	27.3%	28.6%	19.8%	19.0%	18.5%	0.0%	31.7%	32.0%
UP1	GCL	55.5%	17.0%	14.9%	11.9%	3.0%	8.4%	4.6%	4.4%	3.0%	11.9%	12.7%	13.2%	31.7%	0.0%	0.3%
UP2	CHJ	55.8%	16.7%	14.6%	11.6%	3.3%	8.7%	4.9%	4.7%	3.3%	12.2%	13.0%	13.5%	32.0%	0.3%	0.0%

FLOWGATE:	WEST OF SLATT E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	32.4%	27.7%	22.3%	10.7%	8.0%	10.4%	10.4%	10.7%	5.0%	4.2%	3.7%	2.2%	11.3%	11.6%
LOW2	JDA	32.4%	0.0%	4.6%	10.1%	21.7%	24.4%	22.0%	22.0%	21.7%	27.4%	28.2%	28.7%	30.2%	21.1%	20.7%
LOW3	TDA	27.7%	4.6%	0.0%	5.5%	17.0%	19.7%	17.3%	17.4%	17.0%	22.7%	23.5%	24.0%	25.5%	16.5%	16.1%
LOW4	BON	22.3%	10.1%	5.5%	0.0%	11.6%	14.3%	11.9%	11.9%	11.6%	17.3%	18.1%	18.6%	20.1%	11.0%	10.7%
OTH	ALF	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
OTH	DWR	8.0%	24.4%	19.7%	14.3%	2.7%	0.0%	2.4%	2.4%	2.7%	3.0%	3.8%	4.3%	5.8%	3.3%	3.6%
OTH	HGH	10.4%	22.0%	17.3%	11.9%	0.3%	2.4%	0.0%	0.1%	0.3%	5.4%	6.2%	6.7%	8.2%	0.8%	1.2%
OTH	LIB	10.4%	22.0%	17.4%	11.9%	0.3%	2.4%	0.1%	0.0%	0.3%	5.4%	6.2%	6.7%	8.2%	0.9%	1.3%
OTH	BLK	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
SNK1	LWG	5.0%	27.4%	22.7%	17.3%	5.7%	3.0%	5.4%	5.4%	5.7%	0.0%	0.8%	1.3%	2.8%	6.2%	6.6%
SNK2	LGS	4.2%	28.2%	23.5%	18.1%	6.5%	3.8%	6.2%	6.2%	6.5%	0.8%	0.0%	0.5%	2.0%	7.1%	7.4%
SNK3	LMN	3.7%	28.7%	24.0%	18.6%	7.0%	4.3%	6.7%	6.7%	7.0%	1.3%	0.5%	0.0%	1.5%	7.5%	7.9%
SNK4	IHR	2.2%	30.2%	25.5%	20.1%	8.5%	5.8%	8.2%	8.2%	8.5%	2.8%	2.0%	1.5%	0.0%	9.1%	9.4%
UP1	GCL	11.3%	21.1%	16.5%	11.0%	0.6%	3.3%	0.8%	0.9%	0.6%	6.2%	7.1%	7.5%	9.1%	0.0%	0.4%
UP2	CHJ	11.6%	20.7%	16.1%	10.7%	0.9%	3.6%	1.2%	1.3%	0.9%	6.6%	7.4%	7.9%	9.4%	0.4%	0.0%

Objective & Approach:

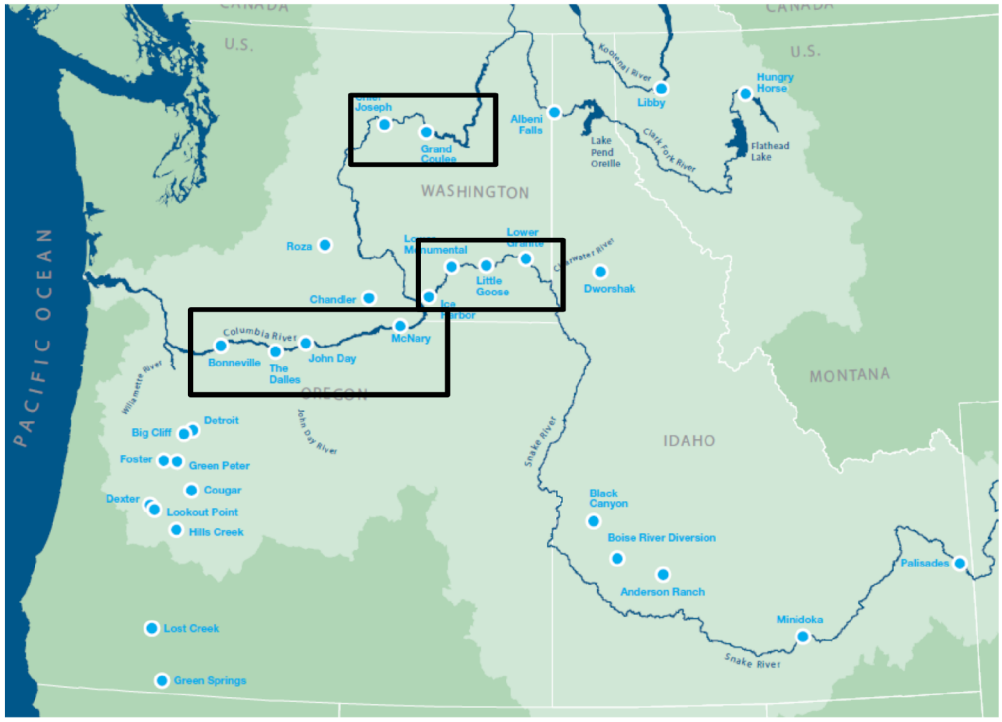
In order to determine which of the big-10 FCRPS resources are electrically similar to one another relative to BPA's internal flowgates, a set of Generation Shift Factors (GSFs) were calculated from a 2019 all lines in service planning case. In the context of any specific flowgate, resources that have very similar GSFs are considered to be electrically similar for that flowgate - in this analysis, if the difference between any two GSFs were less than 10%, the resources were considered to be electrically similar. Three separate aggregations of resources were specifically considered: Upper Columbia (Chief and Coulee), Lower Columbia (Bonneville, The Dalles, John Day, McNary), and the Snake River projects (Ice Harbor, Low Mo, Little Goose, Lower Granite).

Methodology:

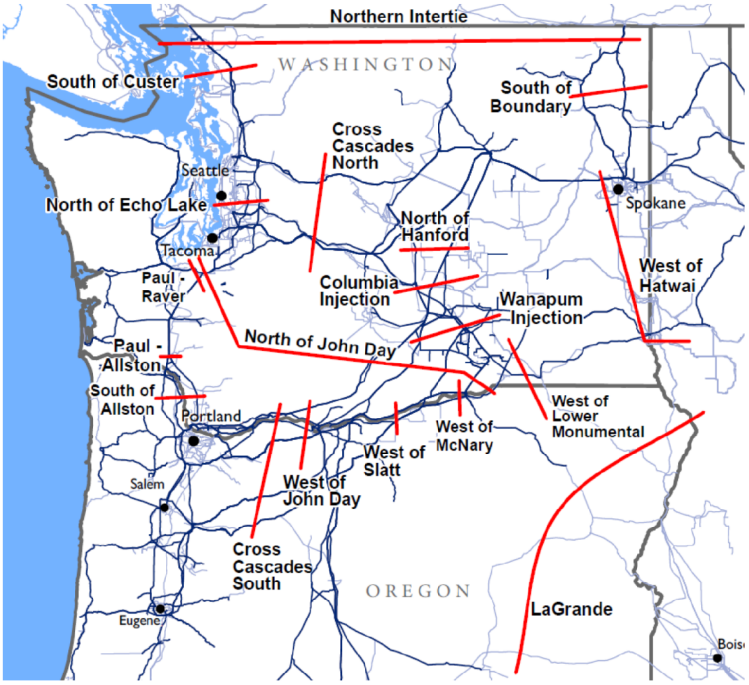
- Used 2019 planning case – all lines in service
- Used Generation Shift Factors (i.e., GSF/PTDFs) - analyzed impacts of each plant relative to one another
- Used 10% threshold
- Outages were not considered
- Not verified – draft results!

Definitions:

- UPPER = Upper Columbia (Chief and Coulee)
- LOWER = Lower Columbia (Bonneville, The Dalles, John Day, McNary)
- SNAKE = Snake River (Ice Harbor, Low Mo, Little Goose, Lower Granite)



Flowgates:



Summary:

ELECTRICALLY SIMMILAR @ 10%				
FLOWGATE	**UPPER**	**LOWER**	**SNAKE**	**NOTES**
CCN	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
CCS	YES	NO	YES	Bonneville much higher than 10% in Lower
NOEL	YES	YES	YES	
NOH	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
NJD	YES	YES	NO	Ice Harbor much higher than 10%
PA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
RP	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOC	YES	YES	YES	
WOJD	YES	NO	YES	
WOLM	YES	YES	NO	Ice Harbor has a large impact (>80%)
WOM	YES	NO	MAYBE	Ice Harbor a little less than 20%
WOS	YES	MAYBE	YES	Impacts range from 5-32%

Based on the preliminary/draft results, Upper Columbia resources can be considered electrically similar. For the Lower Columbia resources, Bonneville and McNary would ideally not be included in an aggregation. However, WOJD is problematic for the Lower Columbia resources in total and doesn't lend itself to any Lower Columbia aggregation - additional analysis will be required to determine if an aggregation can be allowed. For the Snake resources, excluding Ice Harbor from the aggregation would probably be acceptable, pending further analysis.

FLOWGATE:		CROSS CASCADES NORTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.7%	3.5%	14.8%	2.2%	4.6%	3.5%	3.2%	2.2%	4.6%	4.7%	4.7%	3.2%	15.6%	17.9%
LOW2	JDA	1.7%	0.0%	1.8%	13.1%	0.5%	6.3%	5.2%	4.9%	0.5%	6.3%	6.3%	6.4%	4.9%	17.3%	19.6%
LOW3	TDA	3.5%	1.8%	0.0%	11.3%	1.3%	8.1%	7.0%	6.7%	1.3%	8.1%	8.2%	8.2%	6.7%	19.1%	21.4%
LOW4	BON	14.8%	13.1%	11.3%	0.0%	12.8%	19.4%	18.3%	18.0%	12.8%	19.4%	19.4%	19.5%	18.0%	30.4%	32.7%
OTH	ALF	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
OTH	DWR	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.5%	11.0%	13.3%
OTH	HGH	3.5%	5.2%	7.0%	18.3%	5.7%	1.1%	0.0%	0.3%	5.7%	1.1%	1.1%	1.2%	0.3%	12.1%	14.4%
OTH	LIB	3.2%	4.9%	6.7%	18.0%	5.4%	1.4%	0.3%	0.0%	5.4%	1.4%	1.4%	1.5%	0.0%	12.4%	14.7%
OTH	BLK	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
SNK1	LWG	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.4%	11.0%	13.3%
SNK2	LGS	4.7%	6.3%	8.2%	19.4%	6.9%	0.0%	1.1%	1.4%	6.9%	0.0%	0.0%	0.0%	1.5%	11.0%	13.3%
SNK3	LMN	4.7%	6.4%	8.2%	19.5%	6.9%	0.1%	1.2%	1.5%	6.9%	0.1%	0.0%	0.0%	1.5%	10.9%	13.3%
SNK4	IHR	3.2%	4.9%	6.7%	18.0%	5.4%	1.5%	0.3%	0.0%	5.4%	1.4%	1.5%	1.5%	0.0%	12.4%	14.8%
UP1	GCL	15.6%	17.3%	19.1%	30.4%	17.8%	11.0%	12.1%	12.4%	17.8%	11.0%	11.0%	10.9%	12.4%	0.0%	2.3%
UP2	CHJ	17.9%	19.6%	21.4%	32.7%	20.1%	13.3%	14.4%	14.7%	20.1%	13.3%	13.3%	13.3%	14.8%	2.3%	0.0%

FLOWGATE:		CROSS CASCADES SOUTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.1%	2.4%	76.8%	12.8%	8.5%	11.1%	11.3%	12.8%	5.8%	5.1%	4.7%	3.3%	14.0%	15.2%
LOW2	JDA	0.1%	0.0%	2.2%	77.0%	12.9%	8.7%	11.2%	11.5%	12.9%	5.9%	5.2%	4.8%	3.4%	14.1%	15.3%
LOW3	TDA	2.4%	2.2%	0.0%	79.2%	15.1%	10.9%	13.5%	13.7%	15.1%	8.1%	7.4%	7.0%	5.7%	16.3%	17.5%
LOW4	BON	76.8%	77.0%	79.2%	0.0%	64.1%	68.3%	65.7%	65.5%	64.1%	71.1%	71.7%	72.2%	73.5%	62.9%	61.7%
OTH	ALF	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
OTH	DWR	8.5%	8.7%	10.9%	68.3%	4.2%	0.0%	2.6%	2.8%	4.2%	2.8%	3.5%	3.9%	5.2%	5.4%	6.6%
OTH	HGH	11.1%	11.2%	13.5%	65.7%	1.6%	2.6%	0.0%	0.2%	1.6%	5.3%	6.0%	6.4%	7.8%	2.9%	4.1%
OTH	LIB	11.3%	11.5%	13.7%	65.5%	1.4%	2.8%	0.2%	0.0%	1.4%	5.6%	6.2%	6.7%	8.0%	2.6%	3.8%
OTH	BLK	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
SNK1	LWG	5.8%	5.9%	8.1%	71.1%	7.0%	2.8%	5.3%	5.6%	7.0%	0.0%	0.7%	1.1%	2.5%	8.2%	9.4%
SNK2	LGS	5.1%	5.2%	7.4%	71.7%	7.7%	3.5%	6.0%	6.2%	7.7%	0.7%	0.0%	0.4%	1.8%	8.9%	10.1%
SNK3	LMN	4.7%	4.8%	7.0%	72.2%	8.1%	3.9%	6.4%	6.7%	8.1%	1.1%	0.4%	0.0%	1.4%	9.3%	10.5%
SNK4	IHR	3.3%	3.4%	5.7%	73.5%	9.5%	5.2%	7.8%	8.0%	9.5%	2.5%	1.8%	1.4%	0.0%	10.7%	11.9%
UP1	GCL	14.0%	14.1%	16.3%	62.9%	1.2%	5.4%	2.9%	2.6%	1.2%	8.2%	8.9%	9.3%	10.7%	0.0%	1.2%
UP2	CHJ	15.2%	15.3%	17.5%	61.7%	2.4%	6.6%	4.1%	3.8%	2.4%	9.4%	10.1%	10.5%	11.9%	1.2%	0.0%

FLOWGATE:	NORTH OF ECHO LAKE S>N															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.4%	0.4%	0.7%	10.7%	3.2%	5.9%	6.4%	10.7%	1.2%	0.6%	0.3%	0.3%	3.2%	10.3%
LOW2	JDA	0.4%	0.0%	0.0%	0.3%	11.1%	3.6%	6.3%	6.8%	11.1%	1.6%	1.0%	0.7%	0.7%	3.6%	10.7%
LOW3	TDA	0.4%	0.0%	0.0%	0.2%	11.2%	3.7%	6.3%	6.8%	11.2%	1.6%	1.1%	0.8%	0.8%	3.6%	10.7%
LOW4	BON	0.7%	0.3%	0.2%	0.0%	11.4%	3.9%	6.6%	7.1%	11.4%	1.8%	1.3%	1.0%	1.0%	3.9%	10.9%
OTH	ALF	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
OTH	DWR	3.2%	3.6%	3.7%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.1%	2.6%	2.9%	2.9%	0.0%	7.0%
OTH	HGH	5.9%	6.3%	6.3%	6.6%	4.9%	2.7%	0.0%	0.5%	4.9%	4.7%	5.2%	5.6%	5.6%	2.7%	4.4%
OTH	LIB	6.4%	6.8%	6.8%	7.1%	4.3%	3.2%	0.5%	0.0%	4.3%	5.2%	5.8%	6.1%	6.1%	3.2%	3.9%
OTH	BLK	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
SNK1	LWG	1.2%	1.6%	1.6%	1.8%	9.6%	2.1%	4.7%	5.2%	9.6%	0.0%	0.5%	0.8%	0.8%	2.0%	9.1%
SNK2	LGS	0.6%	1.0%	1.1%	1.3%	10.1%	2.6%	5.2%	5.8%	10.1%	0.5%	0.0%	0.3%	0.3%	2.6%	9.6%
SNK3	LMN	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
SNK4	IHR	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
UP1	GCL	3.2%	3.6%	3.6%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.0%	2.6%	2.9%	2.9%	0.0%	7.1%
UP2	CHJ	10.3%	10.7%	10.7%	10.9%	0.5%	7.0%	4.4%	3.9%	0.5%	9.1%	9.6%	9.9%	9.9%	7.1%	0.0%

FLOWGATE:	NORTH OF HANFORD N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.2%	0.1%	12.2%	38.1%	14.8%	29.0%	30.7%	38.1%	1.7%	5.9%	8.4%	1.5%	56.3%	55.6%
LOW2	JDA	4.2%	0.0%	4.1%	16.3%	42.3%	18.9%	33.1%	34.8%	42.3%	2.5%	1.7%	4.2%	5.6%	60.4%	59.7%
LOW3	TDA	0.1%	4.1%	0.0%	12.2%	38.2%	14.8%	29.1%	30.8%	38.2%	1.6%	5.8%	8.3%	1.6%	56.3%	55.6%
LOW4	BON	12.2%	16.3%	12.2%	0.0%	26.0%	2.6%	16.8%	18.5%	26.0%	13.8%	18.0%	20.5%	10.7%	44.1%	43.4%
OTH	ALF	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
OTH	DWR	14.8%	18.9%	14.8%	2.6%	23.4%	0.0%	14.2%	15.9%	23.4%	16.4%	20.6%	23.1%	13.3%	41.5%	40.8%
OTH	HGH	29.0%	33.1%	29.1%	16.8%	9.2%	14.2%	0.0%	1.7%	9.2%	30.7%	34.8%	37.4%	27.5%	27.3%	26.6%
OTH	LIB	30.7%	34.8%	30.8%	18.5%	7.5%	15.9%	1.7%	0.0%	7.5%	32.4%	36.5%	39.0%	29.2%	25.6%	24.9%
OTH	BLK	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
SNK1	LWG	1.7%	2.5%	1.6%	13.8%	39.8%	16.4%	30.7%	32.4%	39.8%	0.0%	4.2%	6.7%	3.2%	57.9%	57.2%
SNK2	LGS	5.9%	1.7%	5.8%	18.0%	44.0%	20.6%	34.8%	36.5%	44.0%	4.2%	0.0%	2.5%	7.3%	62.1%	61.4%
SNK3	LMN	8.4%	4.2%	8.3%	20.5%	46.5%	23.1%	37.4%	39.0%	46.5%	6.7%	2.5%	0.0%	9.8%	64.6%	63.9%
SNK4	IHR	1.5%	5.6%	1.6%	10.7%	36.7%	13.3%	27.5%	29.2%	36.7%	3.2%	7.3%	9.8%	0.0%	54.8%	54.1%
UP1	GCL	56.3%	60.4%	56.3%	44.1%	18.1%	41.5%	27.3%	25.6%	18.1%	57.9%	62.1%	64.6%	54.8%	0.0%	0.7%
UP2	CHJ	55.6%	59.7%	55.6%	43.4%	17.4%	40.8%	26.6%	24.9%	17.4%	57.2%	61.4%	63.9%	54.1%	0.7%	0.0%

FLOWGATE:	NORTH OF JOHN DAY N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.4%	1.2%	4.4%	71.3%	73.3%	69.3%	69.8%	71.3%	81.1%	83.7%	85.3%	0.5%	75.1%	74.5%
LOW2	JDA	4.4%	0.0%	3.2%	8.8%	75.7%	77.7%	73.7%	74.2%	75.7%	85.5%	88.1%	89.7%	4.9%	79.5%	78.9%
LOW3	TDA	1.2%	3.2%	0.0%	5.6%	72.5%	74.5%	70.5%	71.0%	72.5%	82.3%	84.9%	86.5%	1.7%	76.3%	75.7%
LOW4	BON	4.4%	8.8%	5.6%	0.0%	66.9%	68.9%	64.9%	65.4%	66.9%	76.7%	79.3%	80.9%	3.9%	70.7%	70.1%
OTH	ALF	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
OTH	DWR	73.3%	77.7%	74.5%	68.9%	2.0%	0.0%	4.0%	3.5%	2.0%	7.8%	10.4%	11.9%	72.8%	1.7%	1.1%
OTH	HGH	69.3%	73.7%	70.5%	64.9%	2.0%	4.0%	0.0%	0.5%	2.0%	11.8%	14.4%	15.9%	68.8%	5.7%	5.1%
OTH	LIB	69.8%	74.2%	71.0%	65.4%	1.5%	3.5%	0.5%	0.0%	1.5%	11.3%	13.9%	15.4%	69.3%	5.2%	4.6%
OTH	BLK	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
SNK1	LWG	81.1%	85.5%	82.3%	76.7%	9.8%	7.8%	11.8%	11.3%	9.8%	0.0%	2.6%	4.2%	80.6%	6.0%	6.6%
SNK2	LGS	83.7%	88.1%	84.9%	79.3%	12.4%	10.4%	14.4%	13.9%	12.4%	2.6%	0.0%	1.6%	83.2%	8.6%	9.2%
SNK3	LMN	85.3%	89.7%	86.5%	80.9%	13.9%	11.9%	15.9%	15.4%	13.9%	4.2%	1.6%	0.0%	84.7%	10.2%	10.8%
SNK4	IHR	0.5%	4.9%	1.7%	3.9%	70.8%	72.8%	68.8%	69.3%	70.8%	80.6%	83.2%	84.7%	0.0%	74.5%	73.9%
UP1	GCL	75.1%	79.5%	76.3%	70.7%	3.7%	1.7%	5.7%	5.2%	3.7%	6.0%	8.6%	10.2%	74.5%	0.0%	0.6%
UP2	CHJ	74.5%	78.9%	75.7%	70.1%	3.1%	1.1%	5.1%	4.6%	3.1%	6.6%	9.2%	10.8%	73.9%	0.6%	0.0%

FLOWGATE:	PAUL TO ALLSTON N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.8%	3.3%	12.4%	10.7%	6.7%	8.7%	9.0%	10.7%	4.9%	4.4%	4.2%	2.8%	12.5%	13.6%
LOW2	JDA	1.8%	0.0%	1.6%	10.7%	12.5%	8.5%	10.5%	10.8%	12.5%	6.6%	6.2%	6.0%	4.6%	14.3%	15.4%
LOW3	TDA	3.3%	1.6%	0.0%	9.1%	14.1%	10.1%	12.0%	12.4%	14.1%	8.2%	7.8%	7.5%	6.2%	15.9%	16.9%
LOW4	BON	12.4%	10.7%	9.1%	0.0%	23.1%	19.2%	21.1%	21.5%	23.1%	17.3%	16.9%	16.6%	15.2%	24.9%	26.0%
OTH	ALF	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
OTH	DWR	6.7%	8.5%	10.1%	19.2%	4.0%	0.0%	2.0%	2.3%	4.0%	1.9%	2.3%	2.6%	3.9%	5.8%	6.9%
OTH	HGH	8.7%	10.5%	12.0%	21.1%	2.0%	2.0%	0.0%	0.3%	2.0%	3.8%	4.3%	4.5%	5.9%	3.8%	4.9%
OTH	LIB	9.0%	10.8%	12.4%	21.5%	1.7%	2.3%	0.3%	0.0%	1.7%	4.2%	4.6%	4.9%	6.2%	3.5%	4.6%
OTH	BLK	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
SNK1	LWG	4.9%	6.6%	8.2%	17.3%	5.9%	1.9%	3.8%	4.2%	5.9%	0.0%	0.4%	0.7%	2.1%	7.7%	8.7%
SNK2	LGS	4.4%	6.2%	7.8%	16.9%	6.3%	2.3%	4.3%	4.6%	6.3%	0.4%	0.0%	0.3%	1.6%	8.1%	9.2%
SNK3	LMN	4.2%	6.0%	7.5%	16.6%	6.5%	2.6%	4.5%	4.9%	6.5%	0.7%	0.3%	0.0%	1.4%	8.3%	9.4%
SNK4	IHR	2.8%	4.6%	6.2%	15.2%	7.9%	3.9%	5.9%	6.2%	7.9%	2.1%	1.6%	1.4%	0.0%	9.7%	10.8%
UP1	GCL	12.5%	14.3%	15.9%	24.9%	1.8%	5.8%	3.8%	3.5%	1.8%	7.7%	8.1%	8.3%	9.7%	0.0%	1.1%
UP2	CHJ	13.6%	15.4%	16.9%	26.0%	2.9%	6.9%	4.9%	4.6%	2.9%	8.7%	9.2%	9.4%	10.8%	1.1%	0.0%

FLOWGATE:		RAVER TO PAUL N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.3%	2.6%	10.2%	8.2%	5.2%	6.7%	6.9%	8.2%	3.9%	3.6%	3.4%	2.2%	9.8%	10.6%
LOW2	JDA	1.3%	0.0%	1.3%	8.9%	9.5%	6.6%	8.0%	8.2%	9.5%	5.2%	4.9%	4.7%	3.6%	11.1%	12.0%
LOW3	TDA	2.6%	1.3%	0.0%	7.6%	10.8%	7.9%	9.3%	9.5%	10.8%	6.5%	6.2%	6.0%	4.9%	12.4%	13.3%
LOW4	BON	10.2%	8.9%	7.6%	0.0%	18.4%	15.5%	16.9%	17.1%	18.4%	14.1%	13.8%	13.6%	12.5%	20.0%	20.9%
OTH	ALF	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
OTH	DWR	5.2%	6.6%	7.9%	15.5%	2.9%	0.0%	1.4%	1.7%	2.9%	1.4%	1.7%	1.9%	3.0%	4.6%	5.4%
OTH	HGH	6.7%	8.0%	9.3%	16.9%	1.5%	1.4%	0.0%	0.2%	1.5%	2.8%	3.1%	3.3%	4.4%	3.1%	4.0%
OTH	LIB	6.9%	8.2%	9.5%	17.1%	1.3%	1.7%	0.2%	0.0%	1.3%	3.0%	3.3%	3.5%	4.7%	2.9%	3.7%
OTH	BLK	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
SNK1	LWG	3.9%	5.2%	6.5%	14.1%	4.3%	1.4%	2.8%	3.0%	4.3%	0.0%	0.3%	0.5%	1.6%	5.9%	6.8%
SNK2	LGS	3.6%	4.9%	6.2%	13.8%	4.6%	1.7%	3.1%	3.3%	4.6%	0.3%	0.0%	0.2%	1.3%	6.2%	7.1%
SNK3	LMN	3.4%	4.7%	6.0%	13.6%	4.8%	1.9%	3.3%	3.5%	4.8%	0.5%	0.2%	0.0%	1.1%	6.4%	7.3%
SNK4	IHR	2.2%	3.6%	4.9%	12.5%	5.9%	3.0%	4.4%	4.7%	5.9%	1.6%	1.3%	1.1%	0.0%	7.6%	8.4%
UP1	GCL	9.8%	11.1%	12.4%	20.0%	1.6%	4.6%	3.1%	2.9%	1.6%	5.9%	6.2%	6.4%	7.6%	0.0%	0.9%
UP2	CHJ	10.6%	12.0%	13.3%	20.9%	2.5%	5.4%	4.0%	3.7%	2.5%	6.8%	7.1%	7.3%	8.4%	0.9%	0.0%

FLOWGATE:		SOUTH OF ALLSTON N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	2.1%	4.0%	16.0%	13.2%	8.3%	10.7%	11.2%	13.2%	6.0%	5.5%	5.2%	3.5%	15.4%	16.8%
LOW2	JDA	2.1%	0.0%	2.0%	13.9%	15.3%	10.4%	12.8%	13.2%	15.3%	8.1%	7.6%	7.2%	5.6%	17.4%	18.8%
LOW3	TDA	4.0%	2.0%	0.0%	11.9%	17.3%	12.4%	14.8%	15.2%	17.3%	10.1%	9.5%	9.2%	7.5%	19.4%	20.8%
LOW4	BON	16.0%	13.9%	11.9%	0.0%	29.2%	24.3%	26.7%	27.1%	29.2%	22.0%	21.5%	21.2%	19.5%	31.4%	32.7%
OTH	ALF	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
OTH	DWR	8.3%	10.4%	12.4%	24.3%	4.9%	0.0%	2.4%	2.8%	4.9%	2.3%	2.8%	3.2%	4.8%	7.1%	8.4%
OTH	HGH	10.7%	12.8%	14.8%	26.7%	2.5%	2.4%	0.0%	0.4%	2.5%	4.7%	5.2%	5.6%	7.2%	4.7%	6.0%
OTH	LIB	11.2%	13.2%	15.2%	27.1%	2.1%	2.8%	0.4%	0.0%	2.1%	5.1%	5.7%	6.0%	7.7%	4.2%	5.6%
OTH	BLK	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
SNK1	LWG	6.0%	8.1%	10.1%	22.0%	7.2%	2.3%	4.7%	5.1%	7.2%	0.0%	0.5%	0.8%	2.5%	9.4%	10.7%
SNK2	LGS	5.5%	7.6%	9.5%	21.5%	7.7%	2.8%	5.2%	5.7%	7.7%	0.5%	0.0%	0.3%	2.0%	9.9%	11.3%
SNK3	LMN	5.2%	7.2%	9.2%	21.2%	8.1%	3.2%	5.6%	6.0%	8.1%	0.8%	0.3%	0.0%	1.7%	10.2%	11.6%
SNK4	IHR	3.5%	5.6%	7.5%	19.5%	9.7%	4.8%	7.2%	7.7%	9.7%	2.5%	2.0%	1.7%	0.0%	11.9%	13.3%
UP1	GCL	15.4%	17.4%	19.4%	31.4%	2.2%	7.1%	4.7%	4.2%	2.2%	9.4%	9.9%	10.2%	11.9%	0.0%	1.4%
UP2	CHJ	16.8%	18.8%	20.8%	32.7%	3.5%	8.4%	6.0%	5.6%	3.5%	10.7%	11.3%	11.6%	13.3%	1.4%	0.0%

FLOWGATE:		SOUTH OF CUSTER N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.3%	0.4%	0.8%	15.1%	3.6%	7.0%	7.7%	15.1%	1.3%	0.8%	0.5%	0.2%	0.3%	1.5%
LOW2	JDA	0.3%	0.0%	0.1%	0.5%	15.3%	3.8%	7.3%	8.0%	15.3%	1.6%	1.1%	0.7%	0.4%	0.1%	1.2%
LOW3	TDA	0.4%	0.1%	0.0%	0.4%	15.4%	3.9%	7.4%	8.1%	15.4%	1.7%	1.2%	0.8%	0.6%	0.0%	1.1%
LOW4	BON	0.8%	0.5%	0.4%	0.0%	15.9%	4.4%	7.8%	8.5%	15.9%	2.1%	1.6%	1.3%	1.0%	0.5%	0.7%
OTH	ALF	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
OTH	DWR	3.6%	3.8%	3.9%	4.4%	11.5%	0.0%	3.4%	4.1%	11.5%	2.2%	2.8%	3.1%	3.4%	3.9%	5.0%
OTH	HGH	7.0%	7.3%	7.4%	7.8%	8.1%	3.4%	0.0%	0.7%	8.1%	5.7%	6.2%	6.5%	6.8%	7.3%	8.5%
OTH	LIB	7.7%	8.0%	8.1%	8.5%	7.4%	4.1%	0.7%	0.0%	7.4%	6.4%	6.9%	7.2%	7.5%	8.0%	9.2%
OTH	BLK	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
SNK1	LWG	1.3%	1.6%	1.7%	2.1%	13.7%	2.2%	5.7%	6.4%	13.7%	0.0%	0.6%	0.9%	1.2%	1.7%	2.8%
SNK2	LGS	0.8%	1.1%	1.2%	1.6%	14.3%	2.8%	6.2%	6.9%	14.3%	0.6%	0.0%	0.3%	0.6%	1.1%	2.3%
SNK3	LMN	0.5%	0.7%	0.8%	1.3%	14.6%	3.1%	6.5%	7.2%	14.6%	0.9%	0.3%	0.0%	0.3%	0.8%	1.9%
SNK4	IHR	0.2%	0.4%	0.6%	1.0%	14.9%	3.4%	6.8%	7.5%	14.9%	1.2%	0.6%	0.3%	0.0%	0.5%	1.7%
UP1	GCL	0.3%	0.1%	0.0%	0.5%	15.4%	3.9%	7.3%	8.0%	15.4%	1.7%	1.1%	0.8%	0.5%	0.0%	1.1%
UP2	CHJ	1.5%	1.2%	1.1%	0.7%	16.5%	5.0%	8.5%	9.2%	16.5%	2.8%	2.3%	1.9%	1.7%	1.1%	0.0%

FLOWGATE:		WEST OF JOHN DAY E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	22.3%	56.4%	33.2%	10.4%	7.3%	8.7%	9.1%	10.4%	6.0%	5.7%	5.5%	3.1%	12.4%	12.9%
LOW2	JDA	22.3%	0.0%	78.6%	55.4%	32.7%	29.5%	31.0%	31.3%	32.7%	28.2%	27.9%	27.8%	25.3%	34.6%	35.2%
LOW3	TDA	56.4%	78.6%	0.0%	23.2%	46.0%	43.1%	47.6%	47.3%	46.0%	50.4%	50.7%	50.8%	53.3%	44.0%	43.4%
LOW4	BON	33.2%	55.4%	23.2%	0.0%	22.7%	25.9%	24.4%	24.1%	22.7%	27.2%	27.5%	27.6%	30.1%	20.8%	20.2%
OTH	ALF	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
OTH	DWR	7.3%	29.5%	43.1%	25.9%	3.1%	0.0%	1.4%	1.8%	3.1%	1.3%	1.6%	1.8%	4.2%	5.1%	5.6%
OTH	HGH	8.7%	31.0%	47.6%	24.4%	1.7%	1.4%	0.0%	0.3%	1.7%	2.8%	3.0%	3.2%	5.7%	3.6%	4.2%
OTH	LIB	9.1%	31.3%	47.3%	24.1%	1.4%	1.8%	0.3%	0.0%	1.4%	3.1%	3.4%	3.5%	6.0%	3.3%	3.9%
OTH	BLK	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
SNK1	LWG	6.0%	28.2%	50.4%	27.2%	4.4%	1.3%	2.8%	3.1%	4.4%	0.0%	0.3%	0.4%	2.9%	6.4%	7.0%
SNK2	LGS	5.7%	27.9%	50.7%	27.5%	4.7%	1.6%	3.0%	3.4%	4.7%	0.3%	0.0%	0.2%	2.6%	6.7%	7.2%
SNK3	LMN	5.5%	27.8%	50.8%	27.6%	4.9%	1.8%	3.2%	3.5%	4.9%	0.4%	0.2%	0.0%	2.5%	6.8%	7.4%
SNK4	IHR	3.1%	25.3%	53.3%	30.1%	7.3%	4.2%	5.7%	6.0%	7.3%	2.9%	2.6%	2.5%	0.0%	9.3%	9.9%
UP1	GCL	12.4%	34.6%	44.0%	20.8%	2.0%	5.1%	3.6%	3.3%	2.0%	6.4%	6.7%	6.8%	9.3%	0.0%	0.6%
UP2	CHJ	12.9%	35.2%	43.4%	20.2%	2.5%	5.6%	4.2%	3.9%	2.5%	7.0%	7.2%	7.4%	9.9%	0.6%	0.0%

FLOWGATE:	WEST OF LOWER MONUMENTAL E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.1%	1.5%	2.4%	25.0%	30.3%	33.7%	32.2%	25.0%	76.9%	86.0%	90.3%	3.2%	9.0%	8.2%
LOW2	JDA	1.1%	0.0%	0.4%	1.4%	23.9%	29.2%	32.6%	31.2%	23.9%	77.8%	84.9%	89.2%	4.3%	7.9%	7.2%
LOW3	TDA	1.5%	0.4%	0.0%	1.0%	23.5%	29.8%	32.2%	30.8%	23.5%	77.4%	84.5%	88.8%	4.7%	7.5%	6.8%
LOW4	BON	2.4%	1.4%	1.0%	0.0%	22.6%	30.9%	31.3%	29.8%	22.6%	76.4%	83.5%	87.8%	5.6%	6.6%	5.8%
OTH	ALF	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
OTH	DWR	30.3%	29.2%	29.8%	30.9%	28.3%	0.0%	19.6%	21.1%	28.3%	25.6%	32.7%	36.9%	56.5%	44.3%	45.1%
OTH	HGH	33.7%	32.6%	32.2%	31.3%	8.7%	19.6%	0.0%	1.5%	8.7%	45.2%	52.3%	56.6%	36.9%	24.7%	25.5%
OTH	LIB	32.2%	31.2%	30.8%	29.8%	7.2%	21.1%	1.5%	0.0%	7.2%	46.6%	53.7%	58.0%	35.4%	23.2%	24.0%
OTH	BLK	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
SNK1	LWG	76.9%	77.8%	77.4%	76.4%	53.9%	25.6%	45.2%	46.6%	53.9%	0.0%	7.1%	11.4%	82.1%	68.9%	70.6%
SNK2	LGS	86.0%	84.9%	84.5%	83.5%	61.0%	32.7%	52.3%	53.7%	61.0%	7.1%	0.0%	4.3%	89.2%	77.0%	77.7%
SNK3	LMN	90.3%	89.2%	88.8%	87.8%	65.3%	36.9%	56.6%	58.0%	65.3%	11.4%	4.3%	0.0%	93.4%	81.3%	82.0%
SNK4	IHR	3.2%	4.3%	4.7%	5.6%	28.2%	56.5%	36.9%	35.4%	28.2%	82.1%	89.2%	93.4%	0.0%	12.2%	11.4%
UP1	GCL	9.0%	7.9%	7.5%	6.6%	16.0%	44.3%	24.7%	23.2%	16.0%	68.9%	77.0%	81.3%	12.2%	0.0%	0.8%
UP2	CHJ	8.2%	7.2%	6.8%	5.8%	16.8%	45.1%	25.5%	24.0%	16.8%	70.6%	77.7%	82.0%	11.4%	0.8%	0.0%

FLOWGATE:	WEST OF MCNARY E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	72.5%	70.4%	67.4%	52.4%	47.1%	50.9%	51.1%	52.4%	43.6%	42.8%	42.3%	23.8%	55.5%	55.8%
LOW2	JDA	72.5%	0.0%	2.1%	5.1%	20.1%	25.4%	21.6%	21.4%	20.1%	28.9%	29.7%	30.2%	48.7%	17.0%	16.7%
LOW3	TDA	70.4%	2.1%	0.0%	3.0%	18.0%	23.3%	19.5%	19.3%	18.0%	26.8%	27.6%	28.1%	46.6%	14.9%	14.6%
LOW4	BON	67.4%	5.1%	3.0%	0.0%	14.9%	20.3%	16.5%	16.3%	14.9%	23.8%	24.6%	25.1%	43.6%	11.9%	11.6%
OTH	ALF	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
OTH	DWR	47.1%	25.4%	23.3%	20.3%	5.3%	0.0%	3.8%	3.9%	5.3%	3.6%	4.3%	4.8%	23.3%	8.4%	8.7%
OTH	HGH	50.9%	21.6%	19.5%	16.5%	1.5%	3.8%	0.0%	0.2%	1.5%	7.3%	8.1%	8.6%	27.1%	4.6%	4.9%
OTH	LIB	51.1%	21.4%	19.3%	16.3%	1.4%	3.9%	0.2%	0.0%	1.4%	7.5%	8.3%	8.7%	27.3%	4.4%	4.7%
OTH	BLK	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
SNK1	LWG	43.6%	28.9%	26.8%	23.8%	8.9%	3.6%	7.3%	7.5%	8.9%	0.0%	0.8%	1.3%	19.8%	11.9%	12.2%
SNK2	LGS	42.8%	29.7%	27.6%	24.6%	9.6%	4.3%	8.1%	8.3%	9.6%	0.8%	0.0%	0.5%	19.0%	12.7%	13.0%
SNK3	LMN	42.3%	30.2%	28.1%	25.1%	10.1%	4.8%	8.6%	8.7%	10.1%	1.3%	0.5%	0.0%	18.5%	13.2%	13.5%
SNK4	IHR	23.8%	48.7%	46.6%	43.6%	28.6%	23.3%	27.1%	27.3%	28.6%	19.8%	19.0%	18.5%	0.0%	31.7%	32.0%
UP1	GCL	55.5%	17.0%	14.9%	11.9%	3.0%	8.4%	4.6%	4.4%	3.0%	11.9%	12.7%	13.2%	31.7%	0.0%	0.3%
UP2	CHJ	55.8%	16.7%	14.6%	11.6%	3.3%	8.7%	4.9%	4.7%	3.3%	12.2%	13.0%	13.5%	32.0%	0.3%	0.0%

FLOWGATE:		WEST OF SLATT E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	32.4%	27.7%	22.3%	10.7%	8.0%	10.4%	10.4%	10.7%	5.0%	4.2%	3.7%	2.2%	11.3%	11.6%
LOW2	JDA	32.4%	0.0%	4.6%	10.1%	21.7%	24.4%	22.0%	22.0%	21.7%	27.4%	28.2%	28.7%	30.2%	21.1%	20.7%
LOW3	TDA	27.7%	4.6%	0.0%	5.5%	17.0%	19.7%	17.3%	17.4%	17.0%	22.7%	23.5%	24.0%	25.5%	16.5%	16.1%
LOW4	BON	22.3%	10.1%	5.5%	0.0%	11.6%	14.3%	11.9%	11.9%	11.6%	17.3%	18.1%	18.6%	20.1%	11.0%	10.7%
OTH	ALF	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
OTH	DWR	8.0%	24.4%	19.7%	14.3%	2.7%	0.0%	2.4%	2.4%	2.7%	3.0%	3.8%	4.3%	5.8%	3.3%	3.6%
OTH	HGH	10.4%	22.0%	17.3%	11.9%	0.3%	2.4%	0.0%	0.1%	0.3%	5.4%	6.2%	6.7%	8.2%	0.8%	1.2%
OTH	LIB	10.4%	22.0%	17.4%	11.9%	0.3%	2.4%	0.1%	0.0%	0.3%	5.4%	6.2%	6.7%	8.2%	0.9%	1.3%
OTH	BLK	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
SNK1	LWG	5.0%	27.4%	22.7%	17.3%	5.7%	3.0%	5.4%	5.4%	5.7%	0.0%	0.8%	1.3%	2.8%	6.2%	6.6%
SNK2	LGS	4.2%	28.2%	23.5%	18.1%	6.5%	3.8%	6.2%	6.2%	6.5%	0.8%	0.0%	0.5%	2.0%	7.1%	7.4%
SNK3	LMN	3.7%	28.7%	24.0%	18.6%	7.0%	4.3%	6.7%	6.7%	7.0%	1.3%	0.5%	0.0%	1.5%	7.5%	7.9%
SNK4	IHR	2.2%	30.2%	25.5%	20.1%	8.5%	5.8%	8.2%	8.2%	8.5%	2.8%	2.0%	1.5%	0.0%	9.1%	9.4%
UP1	GCL	11.3%	21.1%	16.5%	11.0%	0.6%	3.3%	0.8%	0.9%	0.6%	6.2%	7.1%	7.5%	9.1%	0.0%	0.4%
UP2	CHJ	11.6%	20.7%	16.1%	10.7%	0.9%	3.6%	1.2%	1.3%	0.9%	6.6%	7.4%	7.9%	9.4%	0.4%	0.0%

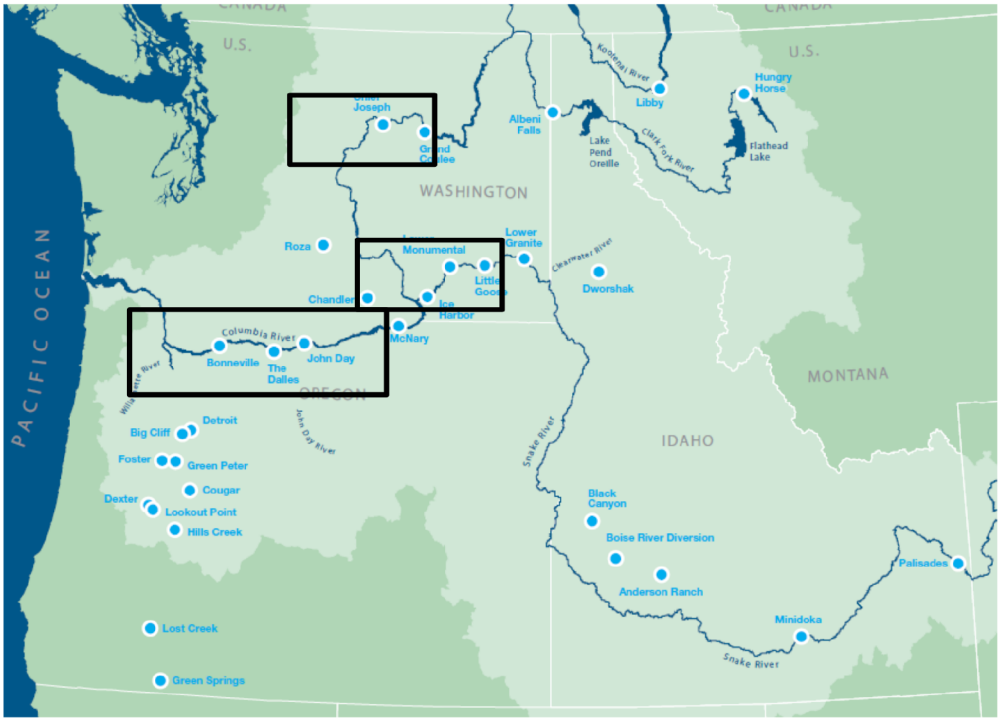
Objective & Approach:

In order to determine which of the big-10 FCRPS resources are electrically similar to one another relative to BPA's internal flowgates, a set of Generation Shift Factors (GSFs) were calculated from a 2019 all lines in service planning case. In the context of any specific flowgate, resources that have very similar GSFs are considered to be electrically similar for that flowgate - in this analysis, if the difference between any two GSFs were less than 10%, the resources were considered to be electrically similar. Three separate aggregations of resources were specifically considered: Upper Columbia (Chief and Coulee), Lower Columbia (Bonneville, The Dalles, John Day, McNary), and the Snake River projects (Ice Harbor, Low Mo, Little Goose, Lower Granite).

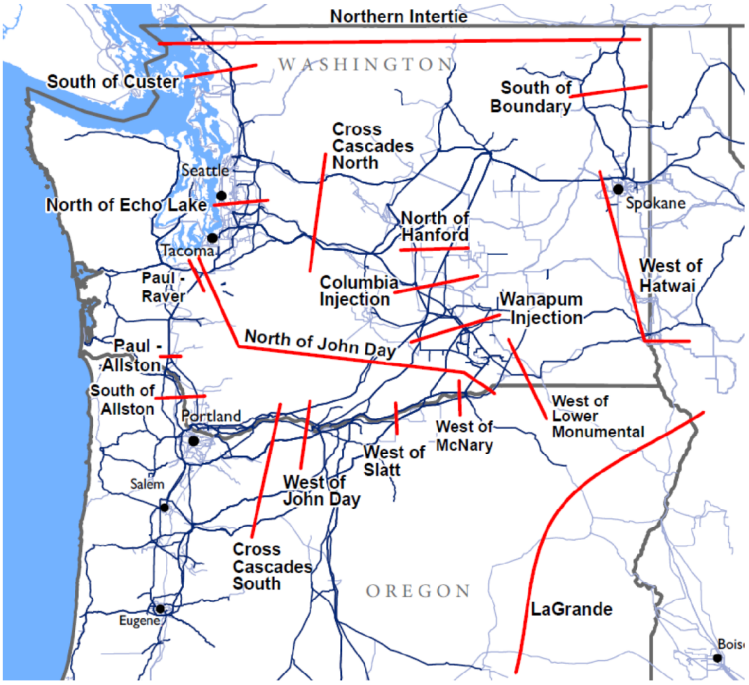
Methodology:

- Used 2019 planning case – all lines in service
- Used Generation Shift Factors (i.e., GSF/PTDFs) - analyzed impacts of each plant relative to one another
- Used 10% threshold
- Outages were not considered
- Not verified – draft results!

Definitions:

- UPPER = Upper Columbia (Chief and Coulee)
- LOWER = Lower Columbia (Bonneville, The Dalles, John Day, McNary)
- SNAKE = Snake River (Ice Harbor, Low Mo, Little Goose, Lower Granite)
- 

Flowgates:



Summary:

ELECTRICALLY SIMMILAR @ 10%				
FLOWGATE	**UPPER**	**LOWER**	**SNAKE**	**NOTES**
CCN	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
CCS	YES	NO	YES	Bonneville much higher than 10% in Lower
NOEL	YES	YES	YES	
NOH	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
NJD	YES	YES	NO	Ice Harbor much higher than 10%
PA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
RP	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOC	YES	YES	YES	
WOJD	YES	NO	YES	
WOLM	YES	YES	NO	Ice Harbor has a large impact (>80%)
WOM	YES	NO	MAYBE	Ice Harbor a little less than 20%
WOS	YES	MAYBE	YES	Impacts range from 5-32%

Based on the preliminary/draft results, Upper Columbia resources can be considered electrically similar. For the Lower Columbia resources, Bonneville and McNary would ideally not be included in an aggregation. However, WOJD is problematic for the Lower Columbia resources in total and doesn't lend itself to any Lower Columbia aggregation - additional analysis will be required to determine if an aggregation can be allowed. For the Snake resources, excluding Ice Harbor from the aggregation would probably be acceptable, pending further analysis.

Congestion/Curtailment Risk:

FLOWGATE:		CROSS CASCADES NORTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.7%	3.5%	14.8%	2.2%	4.6%	3.5%	3.2%	2.2%	4.6%	4.7%	4.7%	3.2%	15.6%	17.9%
LOW2	JDA	1.7%	0.0%	1.8%	13.1%	0.5%	6.3%	5.2%	4.9%	0.5%	6.3%	6.3%	6.4%	4.9%	17.3%	19.6%
LOW3	TDA	3.5%	1.8%	0.0%	11.3%	1.3%	8.1%	7.0%	6.7%	1.3%	8.1%	8.2%	8.2%	6.7%	19.1%	21.4%
LOW4	BON	14.8%	13.1%	11.3%	0.0%	12.8%	19.4%	18.3%	18.0%	12.8%	19.4%	19.4%	19.5%	18.0%	30.4%	32.7%
OTH	ALF	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
OTH	DWR	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.5%	11.0%	13.3%
OTH	HGH	3.5%	5.2%	7.0%	18.3%	5.7%	1.1%	0.0%	0.3%	5.7%	1.1%	1.1%	1.2%	0.3%	12.1%	14.4%
OTH	LIB	3.2%	4.9%	6.7%	18.0%	5.4%	1.4%	0.3%	0.0%	5.4%	1.4%	1.4%	1.5%	0.0%	12.4%	14.7%
OTH	BLK	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
SNK1	LWG	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.4%	11.0%	13.3%
SNK2	LGS	4.7%	6.3%	8.2%	19.4%	6.9%	0.0%	1.1%	1.4%	6.9%	0.0%	0.0%	0.0%	1.5%	11.0%	13.3%
SNK3	LMN	4.7%	6.4%	8.2%	19.5%	6.9%	0.1%	1.2%	1.5%	6.9%	0.1%	0.0%	0.0%	1.5%	10.9%	13.3%
SNK4	IHR	3.2%	4.9%	6.7%	18.0%	5.4%	1.5%	0.3%	0.0%	5.4%	1.4%	1.5%	1.5%	0.0%	12.4%	14.8%
UP1	GCL	15.6%	17.3%	19.1%	30.4%	17.8%	11.0%	12.1%	12.4%	17.8%	11.0%	11.0%	10.9%	12.4%	0.0%	2.3%
UP2	CHJ	17.9%	19.6%	21.4%	32.7%	20.1%	13.3%	14.4%	14.7%	20.1%	13.3%	13.3%	13.3%	14.8%	2.3%	0.0%

FLOWGATE:		CROSS CASCADES SOUTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.1%	2.4%	76.8%	12.8%	8.5%	11.1%	11.3%	12.8%	5.8%	5.1%	4.7%	3.3%	14.0%	15.2%
LOW2	JDA	0.1%	0.0%	2.2%	77.0%	12.9%	8.7%	11.2%	11.5%	12.9%	5.9%	5.2%	4.8%	3.4%	14.1%	15.3%
LOW3	TDA	2.4%	2.2%	0.0%	79.2%	15.1%	10.9%	13.5%	13.7%	15.1%	8.1%	7.4%	7.0%	5.7%	16.3%	17.5%
LOW4	BON	76.8%	77.0%	79.2%	0.0%	64.1%	68.3%	65.7%	65.5%	64.1%	71.1%	71.7%	72.2%	73.5%	62.9%	61.7%
OTH	ALF	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
OTH	DWR	8.5%	8.7%	10.9%	68.3%	4.2%	0.0%	2.6%	2.8%	4.2%	2.8%	3.5%	3.9%	5.2%	5.4%	6.6%
OTH	HGH	11.1%	11.2%	13.5%	65.7%	1.6%	2.6%	0.0%	0.2%	1.6%	5.3%	6.0%	6.4%	7.8%	2.9%	4.1%
OTH	LIB	11.3%	11.5%	13.7%	65.5%	1.4%	2.8%	0.2%	0.0%	1.4%	5.6%	6.2%	6.7%	8.0%	2.6%	3.8%
OTH	BLK	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
SNK1	LWG	5.8%	5.9%	8.1%	71.1%	7.0%	2.8%	5.3%	5.6%	7.0%	0.0%	0.7%	1.1%	2.5%	8.2%	9.4%
SNK2	LGS	5.1%	5.2%	7.4%	71.7%	7.7%	3.5%	6.0%	6.2%	7.7%	0.7%	0.0%	0.4%	1.8%	8.9%	10.1%
SNK3	LMN	4.7%	4.8%	7.0%	72.2%	8.1%	3.9%	6.4%	6.7%	8.1%	1.1%	0.4%	0.0%	1.4%	9.3%	10.5%
SNK4	IHR	3.3%	3.4%	5.7%	73.5%	9.5%	5.2%	7.8%	8.0%	9.5%	2.5%	1.8%	1.4%	0.0%	10.7%	11.9%
UP1	GCL	14.0%	14.1%	16.3%	62.9%	1.2%	5.4%	2.9%	2.6%	1.2%	8.2%	8.9%	9.3%	10.7%	0.0%	1.2%
UP2	CHJ	15.2%	15.3%	17.5%	61.7%	2.4%	6.6%	4.1%	3.8%	2.4%	9.4%	10.1%	10.5%	11.9%	1.2%	0.0%

FLOWGATE:	NORTH OF ECHO LAKE S>N															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.4%	0.4%	0.7%	10.7%	3.2%	5.9%	6.4%	10.7%	1.2%	0.6%	0.3%	0.3%	3.2%	10.3%
LOW2	JDA	0.4%	0.0%	0.0%	0.3%	11.1%	3.6%	6.3%	6.8%	11.1%	1.6%	1.0%	0.7%	0.7%	3.6%	10.7%
LOW3	TDA	0.4%	0.0%	0.0%	0.2%	11.2%	3.7%	6.3%	6.8%	11.2%	1.6%	1.1%	0.8%	0.8%	3.6%	10.7%
LOW4	BON	0.7%	0.3%	0.2%	0.0%	11.4%	3.9%	6.6%	7.1%	11.4%	1.8%	1.3%	1.0%	1.0%	3.9%	10.9%
OTH	ALF	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
OTH	DWR	3.2%	3.6%	3.7%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.1%	2.6%	2.9%	2.9%	0.0%	7.0%
OTH	HGH	5.9%	6.3%	6.3%	6.6%	4.9%	2.7%	0.0%	0.5%	4.9%	4.7%	5.2%	5.6%	5.6%	2.7%	4.4%
OTH	LIB	6.4%	6.8%	6.8%	7.1%	4.3%	3.2%	0.5%	0.0%	4.3%	5.2%	5.8%	6.1%	6.1%	3.2%	3.9%
OTH	BLK	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
SNK1	LWG	1.2%	1.6%	1.6%	1.8%	9.6%	2.1%	4.7%	5.2%	9.6%	0.0%	0.5%	0.8%	0.8%	2.0%	9.1%
SNK2	LGS	0.6%	1.0%	1.1%	1.3%	10.1%	2.6%	5.2%	5.8%	10.1%	0.5%	0.0%	0.3%	0.3%	2.6%	9.6%
SNK3	LMN	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
SNK4	IHR	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
UP1	GCL	3.2%	3.6%	3.6%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.0%	2.6%	2.9%	2.9%	0.0%	7.1%
UP2	CHJ	10.3%	10.7%	10.7%	10.9%	0.5%	7.0%	4.4%	3.9%	0.5%	9.1%	9.6%	9.9%	9.9%	7.1%	0.0%

FLOWGATE:	NORTH OF HANFORD N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.2%	0.1%	12.2%	38.1%	14.8%	29.0%	30.7%	38.1%	1.7%	5.9%	8.4%	1.5%	56.3%	55.6%
LOW2	JDA	4.2%	0.0%	4.1%	16.3%	42.3%	18.9%	33.1%	34.8%	42.3%	2.5%	1.7%	4.2%	5.6%	60.4%	59.7%
LOW3	TDA	0.1%	4.1%	0.0%	12.2%	38.2%	14.8%	29.1%	30.8%	38.2%	1.6%	5.8%	8.3%	1.6%	56.3%	55.6%
LOW4	BON	12.2%	16.3%	12.2%	0.0%	26.0%	2.6%	16.8%	18.5%	26.0%	13.9%	18.0%	20.5%	10.7%	44.1%	43.4%
OTH	ALF	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
OTH	DWR	14.8%	18.9%	14.8%	2.6%	23.4%	0.0%	14.2%	15.9%	23.4%	16.4%	20.6%	23.1%	13.3%	41.5%	40.8%
OTH	HGH	29.0%	33.1%	29.1%	16.8%	9.2%	14.2%	0.0%	1.7%	9.2%	30.7%	34.8%	37.4%	27.5%	27.3%	26.6%
OTH	LIB	30.7%	34.8%	30.8%	18.5%	7.5%	15.9%	1.7%	0.0%	7.5%	32.4%	36.5%	39.0%	29.2%	25.6%	24.9%
OTH	BLK	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
SNK1	LWG	1.7%	2.5%	1.6%	13.8%	39.8%	16.4%	30.7%	32.4%	39.8%	0.0%	4.2%	6.7%	3.2%	57.9%	57.2%
SNK2	LGS	5.9%	1.7%	5.8%	18.0%	44.0%	20.6%	34.8%	36.5%	44.0%	4.2%	0.0%	2.5%	7.3%	62.1%	61.4%
SNK3	LMN	8.4%	4.2%	8.3%	20.5%	46.5%	23.1%	37.4%	39.0%	46.5%	6.7%	2.5%	0.0%	9.8%	64.6%	63.9%
SNK4	IHR	1.5%	5.6%	1.6%	10.7%	36.7%	13.3%	27.5%	29.2%	36.7%	3.2%	7.3%	9.8%	0.0%	54.8%	54.1%
UP1	GCL	56.3%	60.4%	56.3%	44.1%	18.1%	41.5%	27.3%	25.6%	18.1%	57.9%	62.1%	64.6%	54.8%	0.0%	0.7%
UP2	CHJ	55.6%	59.7%	55.6%	43.4%	17.4%	40.8%	26.6%	24.9%	17.4%	57.2%	61.4%	63.9%	54.1%	0.7%	0.0%

FLOWGATE:	NORTH OF JOHN DAY N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.4%	1.2%	4.4%	71.3%	73.3%	69.3%	69.8%	71.3%	81.1%	83.7%	85.3%	0.5%	75.1%	74.5%
LOW2	JDA	4.4%	0.0%	3.2%	8.8%	75.7%	77.7%	73.7%	74.2%	75.7%	85.5%	88.1%	89.7%	4.9%	79.5%	78.9%
LOW3	TDA	1.2%	3.2%	0.0%	5.6%	72.5%	74.5%	70.5%	71.0%	72.5%	82.3%	84.9%	86.5%	1.7%	76.3%	75.7%
LOW4	BON	4.4%	8.8%	5.6%	0.0%	66.9%	68.9%	64.9%	65.4%	66.9%	76.7%	79.3%	80.9%	3.9%	70.7%	70.1%
OTH	ALF	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
OTH	DWR	73.3%	77.7%	74.5%	68.9%	2.0%	0.0%	4.0%	3.5%	2.0%	7.8%	10.4%	11.9%	72.8%	1.7%	1.1%
OTH	HGH	69.3%	73.7%	70.5%	64.9%	2.0%	4.0%	0.0%	0.5%	2.0%	11.8%	14.4%	15.9%	68.8%	5.7%	5.1%
OTH	LIB	69.8%	74.2%	71.0%	65.4%	1.5%	3.5%	0.5%	0.0%	1.5%	11.3%	13.9%	15.4%	69.3%	5.2%	4.6%
OTH	BLK	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
SNK1	LWG	81.1%	85.5%	82.3%	76.7%	9.8%	7.8%	11.8%	11.3%	9.8%	0.0%	2.6%	4.2%	80.6%	6.0%	6.6%
SNK2	LGS	83.7%	88.1%	84.9%	79.3%	12.4%	10.4%	14.4%	13.9%	12.4%	2.6%	0.0%	1.6%	83.2%	8.6%	9.2%
SNK3	LMN	85.3%	89.7%	86.5%	80.9%	13.9%	11.9%	15.9%	15.4%	13.9%	4.2%	1.6%	0.0%	84.7%	10.2%	10.8%
SNK4	IHR	0.5%	4.9%	1.7%	3.9%	70.8%	72.8%	68.8%	69.3%	70.8%	80.6%	83.2%	84.7%	0.0%	74.5%	73.9%
UP1	GCL	75.1%	79.5%	76.3%	70.7%	3.7%	1.7%	5.7%	5.2%	3.7%	6.0%	8.6%	10.2%	74.5%	0.0%	0.6%
UP2	CHJ	74.5%	78.9%	75.7%	70.1%	3.1%	1.1%	5.1%	4.6%	3.1%	6.6%	9.2%	10.8%	73.9%	0.6%	0.0%

FLOWGATE:	PAUL TO ALLSTON N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.8%	3.3%	12.4%	10.7%	6.7%	8.7%	9.0%	10.7%	4.9%	4.4%	4.2%	2.8%	12.5%	13.6%
LOW2	JDA	1.8%	0.0%	1.6%	10.7%	12.5%	8.5%	10.5%	10.8%	12.5%	6.6%	6.2%	6.0%	4.6%	14.3%	15.4%
LOW3	TDA	3.3%	1.6%	0.0%	9.1%	14.1%	10.1%	12.0%	12.4%	14.1%	8.2%	7.8%	7.5%	6.2%	15.9%	16.9%
LOW4	BON	12.4%	10.7%	9.1%	0.0%	23.1%	19.2%	21.1%	21.5%	23.1%	17.3%	16.9%	16.6%	15.2%	24.9%	26.0%
OTH	ALF	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
OTH	DWR	6.7%	8.5%	10.1%	19.2%	4.0%	0.0%	2.0%	2.3%	4.0%	1.9%	2.3%	2.6%	3.9%	5.8%	6.9%
OTH	HGH	8.7%	10.5%	12.0%	21.1%	2.0%	2.0%	0.0%	0.3%	2.0%	3.8%	4.3%	4.5%	5.9%	3.8%	4.9%
OTH	LIB	9.0%	10.8%	12.4%	21.5%	1.7%	2.3%	0.3%	0.0%	1.7%	4.2%	4.6%	4.9%	6.2%	3.5%	4.6%
OTH	BLK	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
SNK1	LWG	4.9%	6.6%	8.2%	17.3%	5.9%	1.9%	3.8%	4.2%	5.9%	0.0%	0.4%	0.7%	2.1%	7.7%	8.7%
SNK2	LGS	4.4%	6.2%	7.8%	16.9%	6.3%	2.3%	4.3%	4.6%	6.3%	0.4%	0.0%	0.3%	1.6%	8.1%	9.2%
SNK3	LMN	4.2%	6.0%	7.5%	16.6%	6.5%	2.6%	4.5%	4.9%	6.5%	0.7%	0.3%	0.0%	1.4%	8.3%	9.4%
SNK4	IHR	2.8%	4.6%	6.2%	15.2%	7.9%	3.9%	5.9%	6.2%	7.9%	2.1%	1.6%	1.4%	0.0%	9.7%	10.8%
UP1	GCL	12.5%	14.3%	15.9%	24.9%	1.8%	5.8%	3.8%	3.5%	1.8%	7.7%	8.1%	8.3%	9.7%	0.0%	1.1%
UP2	CHJ	13.6%	15.4%	16.9%	26.0%	2.9%	6.9%	4.9%	4.6%	2.9%	8.7%	9.2%	9.4%	10.8%	1.1%	0.0%

FLOWGATE:	RAVER TO PAUL N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.3%	2.6%	10.2%	8.2%	5.2%	6.7%	6.9%	8.2%	3.9%	3.6%	3.4%	2.2%	9.8%	10.6%
LOW2	JDA	1.3%	0.0%	1.3%	8.9%	9.5%	6.6%	8.0%	8.2%	9.5%	5.2%	4.9%	4.7%	3.6%	11.1%	12.0%
LOW3	TDA	2.6%	1.3%	0.0%	7.6%	10.8%	7.9%	9.3%	9.5%	10.8%	6.5%	6.2%	6.0%	4.9%	12.4%	13.3%
LOW4	BON	10.2%	8.9%	7.6%	0.0%	18.4%	15.5%	16.9%	17.1%	18.4%	14.1%	13.8%	13.6%	12.5%	20.0%	20.9%
OTH	ALF	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
OTH	DWR	5.2%	6.6%	7.9%	15.5%	2.9%	0.0%	1.4%	1.7%	2.9%	1.4%	1.7%	1.9%	3.0%	4.6%	5.4%
OTH	HGH	6.7%	8.0%	9.3%	16.9%	1.5%	1.4%	0.0%	0.2%	1.5%	2.8%	3.1%	3.3%	4.4%	3.1%	4.0%
OTH	LIB	6.9%	8.2%	9.5%	17.1%	1.3%	1.7%	0.2%	0.0%	1.3%	3.0%	3.3%	3.5%	4.7%	2.9%	3.7%
OTH	BLK	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
SNK1	LWG	3.9%	5.2%	6.5%	14.1%	4.3%	1.4%	2.8%	3.0%	4.3%	0.0%	0.3%	0.5%	1.6%	5.9%	6.8%
SNK2	LGS	3.6%	4.9%	6.2%	13.8%	4.6%	1.7%	3.1%	3.3%	4.6%	0.3%	0.0%	0.2%	1.3%	6.2%	7.1%
SNK3	LMN	3.4%	4.7%	6.0%	13.6%	4.8%	1.9%	3.3%	3.5%	4.8%	0.5%	0.2%	0.0%	1.1%	6.4%	7.3%
SNK4	IHR	2.2%	3.6%	4.9%	12.5%	5.9%	3.0%	4.4%	4.7%	5.9%	1.6%	1.3%	1.1%	0.0%	7.6%	8.4%
UP1	GCL	9.8%	11.1%	12.4%	20.0%	1.6%	4.6%	3.1%	2.9%	1.6%	5.9%	6.2%	6.4%	7.6%	0.0%	0.9%
UP2	CHJ	10.6%	12.0%	13.3%	20.9%	2.5%	5.4%	4.0%	3.7%	2.5%	6.8%	7.1%	7.3%	8.4%	0.9%	0.0%

FLOWGATE:	SOUTH OF ALLSTON N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	2.1%	4.0%	16.0%	13.2%	8.3%	10.7%	11.2%	13.2%	6.0%	5.5%	5.2%	3.5%	15.4%	16.8%
LOW2	JDA	2.1%	0.0%	2.0%	13.9%	15.3%	10.4%	12.8%	13.2%	15.3%	8.1%	7.6%	7.2%	5.6%	17.4%	18.8%
LOW3	TDA	4.0%	2.0%	0.0%	11.9%	17.3%	12.4%	14.8%	15.2%	17.3%	10.1%	9.5%	9.2%	7.5%	19.4%	20.8%
LOW4	BON	16.0%	13.9%	11.9%	0.0%	29.2%	24.3%	26.7%	27.1%	29.2%	22.0%	21.5%	21.2%	19.5%	31.4%	32.7%
OTH	ALF	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
OTH	DWR	8.3%	10.4%	12.4%	24.3%	4.9%	0.0%	2.4%	2.8%	4.9%	2.3%	2.8%	3.2%	4.8%	7.1%	8.4%
OTH	HGH	10.7%	12.8%	14.8%	26.7%	2.5%	2.4%	0.0%	0.4%	2.5%	4.7%	5.2%	5.6%	7.2%	4.7%	6.0%
OTH	LIB	11.2%	13.2%	15.2%	27.1%	2.1%	2.8%	0.4%	0.0%	2.1%	5.1%	5.7%	6.0%	7.7%	4.2%	5.6%
OTH	BLK	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
SNK1	LWG	6.0%	8.1%	10.1%	22.0%	7.2%	2.3%	4.7%	5.1%	7.2%	0.0%	0.5%	0.8%	2.5%	9.4%	10.7%
SNK2	LGS	5.5%	7.6%	9.5%	21.5%	7.7%	2.8%	5.2%	5.7%	7.7%	0.5%	0.0%	0.3%	2.0%	9.9%	11.3%
SNK3	LMN	5.2%	7.2%	9.2%	21.2%	8.1%	3.2%	5.6%	6.0%	8.1%	0.8%	0.3%	0.0%	1.7%	10.2%	11.6%
SNK4	IHR	3.5%	5.6%	7.5%	19.5%	9.7%	4.8%	7.2%	7.7%	9.7%	2.5%	2.0%	1.7%	0.0%	11.9%	13.3%
UP1	GCL	15.4%	17.4%	19.4%	31.4%	2.2%	7.1%	4.7%	4.2%	2.2%	9.4%	9.9%	10.2%	11.9%	0.0%	1.4%
UP2	CHJ	16.8%	18.8%	20.8%	32.7%	3.5%	8.4%	6.0%	5.6%	3.5%	10.7%	11.3%	11.6%	13.3%	1.4%	0.0%

FLOWGATE:		SOUTH OF CUSTER N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.3%	0.4%	0.8%	15.1%	3.6%	7.0%	7.7%	15.1%	1.3%	0.8%	0.5%	0.2%	0.3%	1.5%
LOW2	JDA	0.3%	0.0%	0.1%	0.5%	15.3%	3.8%	7.3%	8.0%	15.3%	1.6%	1.1%	0.7%	0.4%	0.1%	1.2%
LOW3	TDA	0.4%	0.1%	0.0%	0.4%	15.4%	3.9%	7.4%	8.1%	15.4%	1.7%	1.2%	0.8%	0.6%	0.0%	1.1%
LOW4	BON	0.8%	0.5%	0.4%	0.0%	15.9%	4.4%	7.8%	8.5%	15.9%	2.1%	1.6%	1.3%	1.0%	0.5%	0.7%
OTH	ALF	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
OTH	DWR	3.6%	3.8%	3.9%	4.4%	11.5%	0.0%	3.4%	4.1%	11.5%	2.2%	2.8%	3.1%	3.4%	3.9%	5.0%
OTH	HGH	7.0%	7.3%	7.4%	7.8%	8.1%	3.4%	0.0%	0.7%	8.1%	5.7%	6.2%	6.5%	6.8%	7.3%	8.5%
OTH	LIB	7.7%	8.0%	8.1%	8.5%	7.4%	4.1%	0.7%	0.0%	7.4%	6.4%	6.9%	7.2%	7.5%	8.0%	9.2%
OTH	BLK	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
SNK1	LWG	1.3%	1.6%	1.7%	2.1%	13.7%	2.2%	5.7%	6.4%	13.7%	0.0%	0.6%	0.9%	1.2%	1.7%	2.8%
SNK2	LGS	0.8%	1.1%	1.2%	1.6%	14.3%	2.8%	6.2%	6.9%	14.3%	0.6%	0.0%	0.3%	0.6%	1.1%	2.3%
SNK3	LMN	0.5%	0.7%	0.8%	1.3%	14.6%	3.1%	6.5%	7.2%	14.6%	0.9%	0.3%	0.0%	0.3%	0.8%	1.9%
SNK4	IHR	0.2%	0.4%	0.6%	1.0%	14.9%	3.4%	6.8%	7.5%	14.9%	1.2%	0.6%	0.3%	0.0%	0.5%	1.7%
UP1	GCL	0.3%	0.1%	0.0%	0.5%	15.4%	3.9%	7.3%	8.0%	15.4%	1.7%	1.1%	0.8%	0.5%	0.0%	1.1%
UP2	CHJ	1.5%	1.2%	1.1%	0.7%	16.5%	5.0%	8.5%	9.2%	16.5%	2.8%	2.3%	1.9%	1.7%	1.1%	0.0%

FLOWGATE:		WEST OF JOHN DAY E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	22.3%	56.4%	33.2%	10.4%	7.3%	8.7%	9.1%	10.4%	6.0%	5.7%	5.5%	3.1%	12.4%	12.9%
LOW2	JDA	22.3%	0.0%	78.6%	55.4%	32.7%	29.5%	31.0%	31.3%	32.7%	28.2%	27.9%	27.6%	25.3%	34.6%	35.2%
LOW3	TDA	56.4%	78.6%	0.0%	23.2%	46.0%	43.1%	47.6%	47.3%	46.0%	50.4%	50.7%	50.8%	53.3%	44.0%	43.4%
LOW4	BON	33.2%	55.4%	23.2%	0.0%	22.7%	25.9%	24.4%	24.1%	22.7%	27.2%	27.5%	27.6%	30.1%	20.8%	20.2%
OTH	ALF	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
OTH	DWR	7.3%	29.5%	43.1%	25.9%	3.1%	0.0%	1.4%	1.8%	3.1%	1.3%	1.6%	1.8%	4.2%	5.1%	5.6%
OTH	HGH	8.7%	31.0%	47.6%	24.4%	1.7%	1.4%	0.0%	0.3%	1.7%	2.8%	3.0%	3.2%	5.7%	3.6%	4.2%
OTH	LIB	9.1%	31.3%	47.3%	24.1%	1.4%	1.8%	0.3%	0.0%	1.4%	3.1%	3.4%	3.5%	6.0%	3.3%	3.9%
OTH	BLK	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
SNK1	LWG	6.0%	28.2%	50.4%	27.2%	4.4%	1.3%	2.8%	3.1%	4.4%	0.0%	0.3%	0.4%	2.9%	6.4%	7.0%
SNK2	LGS	5.7%	27.9%	50.7%	27.5%	4.7%	1.6%	3.0%	3.4%	4.7%	0.3%	0.0%	0.2%	2.6%	6.7%	7.2%
SNK3	LMN	5.5%	27.6%	50.8%	27.6%	4.9%	1.8%	3.2%	3.5%	4.9%	0.4%	0.2%	0.0%	2.5%	6.8%	7.4%
SNK4	IHR	3.1%	25.3%	53.3%	30.1%	7.3%	4.2%	5.7%	6.0%	7.3%	2.9%	2.6%	2.5%	0.0%	9.3%	9.9%
UP1	GCL	12.4%	34.6%	44.0%	20.8%	2.0%	5.1%	3.6%	3.3%	2.0%	6.4%	6.7%	6.8%	9.3%	0.0%	0.6%
UP2	CHJ	12.9%	35.2%	43.4%	20.2%	2.5%	5.6%	4.2%	3.9%	2.5%	7.0%	7.2%	7.4%	9.9%	0.6%	0.0%

FLOWGATE:	WEST OF LOWER MONUMENTAL E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.1%	1.5%	2.4%	25.0%	30.3%	33.7%	32.2%	25.0%	76.9%	86.0%	90.3%	3.2%	9.0%	8.2%
LOW2	JDA	1.1%	0.0%	0.4%	1.4%	23.9%	29.2%	32.6%	31.2%	23.9%	77.8%	84.9%	89.2%	4.3%	7.9%	7.2%
LOW3	TDA	1.5%	0.4%	0.0%	1.0%	23.5%	29.8%	32.2%	30.8%	23.5%	77.4%	84.5%	88.8%	4.7%	7.5%	6.8%
LOW4	BON	2.4%	1.4%	1.0%	0.0%	22.6%	30.9%	31.3%	29.8%	22.6%	76.4%	83.5%	87.8%	5.6%	6.6%	5.8%
OTH	ALF	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
OTH	DWR	30.3%	29.2%	29.8%	30.9%	28.3%	0.0%	19.6%	21.1%	28.3%	25.6%	32.7%	36.9%	56.5%	44.3%	45.1%
OTH	HGH	33.7%	32.6%	32.2%	31.3%	8.7%	19.6%	0.0%	1.5%	8.7%	45.2%	52.3%	56.6%	36.9%	24.7%	25.5%
OTH	LIB	32.2%	31.2%	30.8%	29.8%	7.2%	21.1%	1.5%	0.0%	7.2%	46.6%	53.7%	58.0%	35.4%	23.2%	24.0%
OTH	BLK	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
SNK1	LWG	76.9%	77.8%	77.4%	76.4%	53.9%	25.6%	45.2%	46.6%	53.9%	0.0%	7.1%	11.4%	82.1%	68.9%	70.6%
SNK2	LGS	86.0%	84.9%	84.5%	83.5%	61.0%	32.7%	52.3%	53.7%	61.0%	7.1%	0.0%	4.3%	89.2%	77.0%	77.7%
SNK3	LMN	90.3%	89.2%	88.8%	87.8%	65.3%	36.9%	56.6%	58.0%	65.3%	11.4%	4.3%	0.0%	93.4%	81.3%	82.0%
SNK4	IHR	3.2%	4.3%	4.7%	5.6%	28.2%	56.5%	36.9%	35.4%	28.2%	82.1%	89.2%	93.4%	0.0%	12.2%	11.4%
UP1	GCL	9.0%	7.9%	7.5%	6.6%	16.0%	44.3%	24.7%	23.2%	16.0%	68.9%	77.0%	81.3%	12.2%	0.0%	0.8%
UP2	CHJ	8.2%	7.2%	6.8%	5.8%	16.8%	45.1%	25.5%	24.0%	16.8%	70.6%	77.7%	82.0%	11.4%	0.8%	0.0%

FLOWGATE:	WEST OF MCNARY E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	72.5%	70.4%	67.4%	52.4%	47.1%	50.9%	51.1%	52.4%	43.6%	42.8%	42.3%	23.8%	55.5%	55.8%
LOW2	JDA	72.5%	0.0%	2.1%	5.1%	20.1%	25.4%	21.6%	21.4%	20.1%	28.9%	29.7%	30.2%	48.7%	17.0%	16.7%
LOW3	TDA	70.4%	2.1%	0.0%	3.0%	18.0%	23.3%	19.5%	19.3%	18.0%	26.8%	27.6%	28.1%	46.6%	14.9%	14.6%
LOW4	BON	67.4%	5.1%	3.0%	0.0%	14.9%	20.3%	16.5%	16.3%	14.9%	23.8%	24.6%	25.1%	43.6%	11.9%	11.6%
OTH	ALF	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
OTH	DWR	47.1%	25.4%	23.3%	20.3%	5.3%	0.0%	3.8%	3.9%	5.3%	3.6%	4.3%	4.8%	23.3%	8.4%	8.7%
OTH	HGH	50.9%	21.6%	19.5%	16.5%	1.5%	3.8%	0.0%	0.2%	1.5%	7.3%	8.1%	8.6%	27.1%	4.6%	4.9%
OTH	LIB	51.1%	21.4%	19.3%	16.3%	1.4%	3.9%	0.2%	0.0%	1.4%	7.5%	8.3%	8.7%	27.3%	4.4%	4.7%
OTH	BLK	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
SNK1	LWG	43.6%	28.9%	26.8%	23.8%	8.9%	3.6%	7.3%	7.5%	8.9%	0.0%	0.8%	1.3%	19.8%	11.9%	12.2%
SNK2	LGS	42.8%	29.7%	27.6%	24.6%	9.6%	4.3%	8.1%	8.3%	9.6%	0.8%	0.0%	0.5%	19.0%	12.7%	13.0%
SNK3	LMN	42.3%	30.2%	28.1%	25.1%	10.1%	4.8%	8.6%	8.7%	10.1%	1.3%	0.5%	0.0%	18.5%	13.2%	13.5%
SNK4	IHR	23.8%	48.7%	46.6%	43.6%	28.6%	23.3%	27.1%	27.3%	28.6%	19.8%	19.0%	18.5%	0.0%	31.7%	32.0%
UP1	GCL	55.5%	17.0%	14.9%	11.9%	3.0%	8.4%	4.6%	4.4%	3.0%	11.9%	12.7%	13.2%	31.7%	0.0%	0.3%
UP2	CHJ	55.8%	16.7%	14.6%	11.6%	3.3%	8.7%	4.9%	4.7%	3.3%	12.2%	13.0%	13.5%	32.0%	0.3%	0.0%

FLOWGATE:	WEST OF SLATT E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	32.4%	27.7%	22.3%	10.7%	8.0%	10.4%	10.4%	10.7%	5.0%	4.2%	3.7%	2.2%	11.3%	11.6%
LOW2	JDA	32.4%	0.0%	4.6%	10.1%	21.7%	24.4%	22.0%	22.0%	21.7%	27.4%	28.2%	28.7%	30.2%	21.1%	20.7%
LOW3	TDA	27.7%	4.6%	0.0%	5.5%	17.0%	19.7%	17.3%	17.4%	17.0%	22.7%	23.5%	24.0%	25.5%	16.5%	16.1%
LOW4	BON	22.3%	10.1%	5.5%	0.0%	11.6%	14.3%	11.9%	11.9%	11.6%	17.3%	18.1%	18.6%	20.1%	11.0%	10.7%
OTH	ALF	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
OTH	DWR	8.0%	24.4%	19.7%	14.3%	2.7%	0.0%	2.4%	2.4%	2.7%	3.0%	3.8%	4.3%	5.8%	3.3%	3.6%
OTH	HGH	10.4%	22.0%	17.3%	11.9%	0.3%	2.4%	0.0%	0.1%	0.3%	5.4%	6.2%	6.7%	8.2%	0.8%	1.2%
OTH	LIB	10.4%	22.0%	17.4%	11.9%	0.3%	2.4%	0.1%	0.0%	0.3%	5.4%	6.2%	6.7%	8.2%	0.9%	1.3%
OTH	BLK	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
SNK1	LWG	5.0%	27.4%	22.7%	17.3%	5.7%	3.0%	5.4%	5.4%	5.7%	0.0%	0.8%	1.3%	2.8%	6.2%	6.6%
SNK2	LGS	4.2%	28.2%	23.5%	18.1%	6.5%	3.8%	6.2%	6.2%	6.5%	0.8%	0.0%	0.5%	2.0%	7.1%	7.4%
SNK3	LMN	3.7%	28.7%	24.0%	18.6%	7.0%	4.3%	6.7%	6.7%	7.0%	1.3%	0.5%	0.0%	1.5%	7.5%	7.9%
SNK4	IHR	2.2%	30.2%	25.5%	20.1%	8.5%	5.8%	8.2%	8.2%	8.5%	2.8%	2.0%	1.5%	0.0%	9.1%	9.4%
UP1	GCL	11.3%	21.1%	16.5%	11.0%	0.6%	3.3%	0.8%	0.9%	0.6%	6.2%	7.1%	7.5%	9.1%	0.0%	0.4%
UP2	CHJ	11.6%	20.7%	16.1%	10.7%	0.9%	3.6%	1.2%	1.3%	0.9%	6.6%	7.4%	7.9%	9.4%	0.4%	0.0%

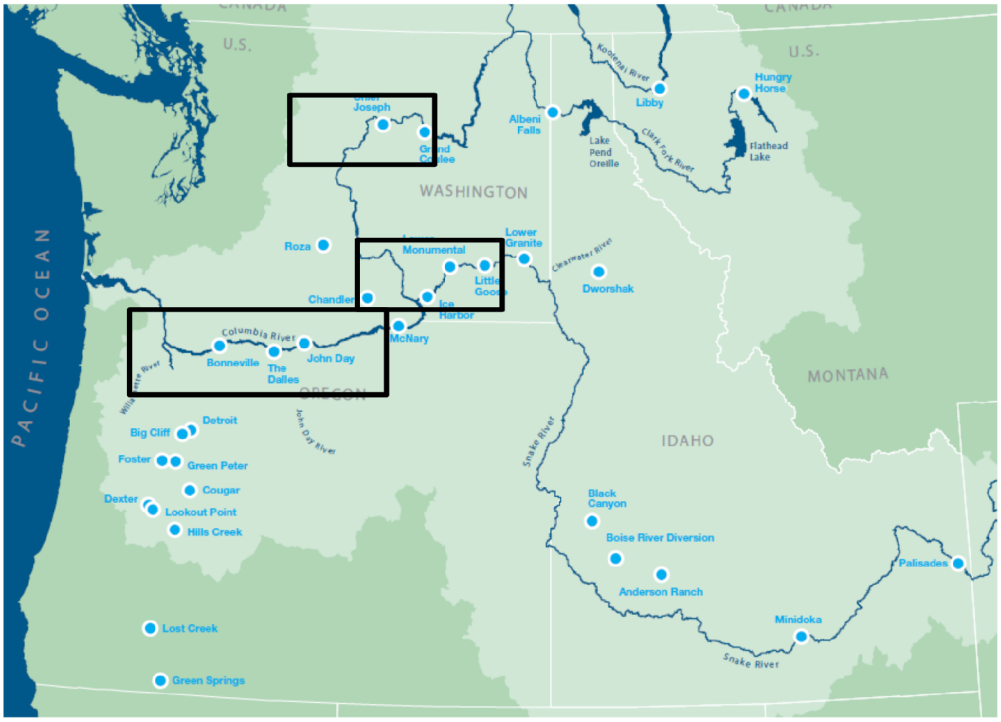
Objective & Approach:

In order to determine which of the big-10 FCRPS resources are electrically similar to one another relative to BPA's internal flowgates, a set of Generation Shift Factors (GSFs) were generated from a 2019 all lines in service planning case. In the context of any specific flowgate, resources that have very similar GSFs are considered to be electrically similar for that flowgate - in this analysis, if the difference between any two GSFs were less than 10%, the resources considered to be electrically similar. Three separate aggregations of resources were specifically considered: Upper Columbia (Chief and Coulee), Lower Columbia (Bonneville, The Dalles, John Day, McNary), and the Snake River projects (Ice Harbor, Low Mo, Little Goose, Lower Granite).

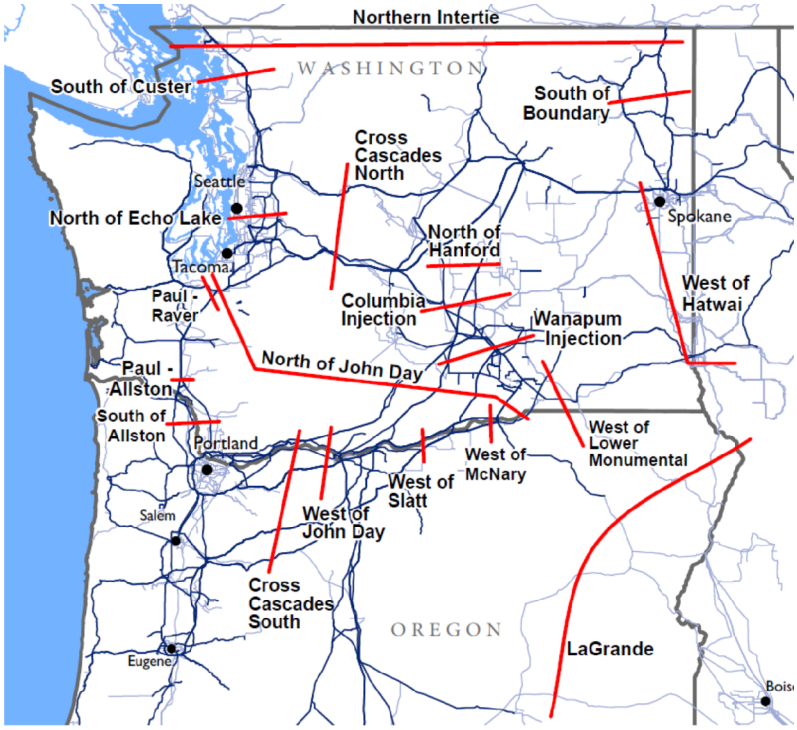
Methodology:

- Used 2019 planning case – all lines in service
- Used Generation Shift Factors (i.e., GSF/PTDFs) - analyzed impacts of each plant relative to one another
- Used 10% threshold
- Outages were not considered
- Not verified – draft results!

Definitions:

- UPPER = Upper Columbia (Chief and Coulee)
- LOWER = Lower Columbia (Bonneville, The Dalles, John Day, McNary)
- SNAKE = Snake River (Ice Harbor, Low Mo, Little Goose, Lower Granite)
- 

Flowgates:



Summary:

ELECTRICALLY SIMMILAR @ 10%				
FLOWGATE	**UPPER**	**LOWER**	**SNAKE**	**NOTES**
CCN	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
CCS	YES	NO	YES	Bonneville much higher than 10% in Lower
NOEL	YES	YES	YES	
NOH	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
NJD	YES	YES	NO	Ice Harbor much higher than 10%
PA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
RP	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOA	YES	MAYBE	YES	Bonneville slightly above 10% in Lower
SOC	YES	YES	YES	
WOJD	YES	NO	YES	
WOLM	YES	YES	NO	Ice Harbor has a large impact (>80%)
WOM	YES	NO	MAYBE	Ice Harbor a little less than 20%
WOS	YES	MAYBE	YES	Impacts range from 5-32%

Upper Columbia resources can be considered electrically similar. For the Lower Columbia resources, Bonneville and McNary would ideally not be included in an aggregation. However, WOJD is problematic for the Lower Columbia resources in total and doesn't lend itself to any Lower Columbia aggregation - additional analysis will be required to determine if an aggregation can be allowed. For the Snake resources, excluding Ice Harbor from the aggregation would probably be acceptable.

Congestion/Curtailment Risk:

FLOWGATE:		CROSS CASCADES NORTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.7%	3.5%	14.8%	2.2%	4.6%	3.5%	3.2%	2.2%	4.6%	4.7%	4.7%	3.2%	15.6%	17.9%
LOW2	JDA	1.7%	0.0%	1.8%	13.1%	0.5%	6.3%	5.2%	4.9%	0.5%	6.3%	6.3%	6.4%	4.9%	17.3%	19.6%
LOW3	TDA	3.5%	1.8%	0.0%	11.3%	1.3%	8.1%	7.0%	6.7%	1.3%	8.1%	8.2%	8.2%	6.7%	19.1%	21.4%
LOW4	BON	14.8%	13.1%	11.3%	0.0%	12.8%	19.4%	18.3%	18.0%	12.8%	19.4%	19.4%	19.5%	18.0%	30.4%	32.7%
OTH	ALF	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
OTH	DWR	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.5%	11.0%	13.3%
OTH	HGH	3.5%	5.2%	7.0%	18.3%	5.7%	1.1%	0.0%	0.3%	5.7%	1.1%	1.1%	1.2%	0.3%	12.1%	14.4%
OTH	LIB	3.2%	4.9%	6.7%	18.0%	5.4%	1.4%	0.3%	0.0%	5.4%	1.4%	1.4%	1.5%	0.0%	12.4%	14.7%
OTH	BLK	2.2%	0.5%	1.3%	12.8%	0.0%	6.8%	5.7%	5.4%	0.0%	6.8%	6.9%	6.9%	5.4%	17.8%	20.1%
SNK1	LWG	4.6%	6.3%	8.1%	19.4%	6.8%	0.0%	1.1%	1.4%	6.8%	0.0%	0.0%	0.1%	1.4%	11.0%	13.3%
SNK2	LGS	4.7%	6.3%	8.2%	19.4%	6.9%	0.0%	1.1%	1.4%	6.9%	0.0%	0.0%	0.0%	1.5%	11.0%	13.3%
SNK3	LMN	4.7%	6.4%	8.2%	19.5%	6.9%	0.1%	1.2%	1.5%	6.9%	0.1%	0.0%	0.0%	1.5%	10.9%	13.3%
SNK4	IHR	3.2%	4.9%	6.7%	18.0%	5.4%	1.5%	0.3%	0.0%	5.4%	1.4%	1.5%	1.5%	0.0%	12.4%	14.8%
UP1	GCL	15.6%	17.3%	19.1%	30.4%	17.8%	11.0%	12.1%	12.4%	17.8%	11.0%	11.0%	10.9%	12.4%	0.0%	2.3%
UP2	CHJ	17.9%	19.6%	21.4%	32.7%	20.1%	13.3%	14.4%	14.7%	20.1%	13.3%	13.3%	13.3%	14.8%	2.3%	0.0%

FLOWGATE:		CROSS CASCADES SOUTH E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.1%	2.4%	76.8%	12.8%	8.5%	11.1%	11.3%	12.8%	5.8%	5.1%	4.7%	3.3%	14.0%	15.2%
LOW2	JDA	0.1%	0.0%	2.2%	77.0%	12.9%	8.7%	11.2%	11.5%	12.9%	5.9%	5.2%	4.8%	3.4%	14.1%	15.3%
LOW3	TDA	2.4%	2.2%	0.0%	79.2%	15.1%	10.9%	13.5%	13.7%	15.1%	8.1%	7.4%	7.0%	5.7%	16.3%	17.5%
LOW4	BON	76.8%	77.0%	79.2%	0.0%	64.1%	68.3%	65.7%	65.5%	64.1%	71.1%	71.7%	72.2%	73.5%	62.9%	61.7%
OTH	ALF	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
OTH	DWR	8.5%	8.7%	10.9%	68.3%	4.2%	0.0%	2.6%	2.8%	4.2%	2.8%	3.5%	3.9%	5.2%	5.4%	6.6%
OTH	HGH	11.1%	11.2%	13.5%	65.7%	1.6%	2.6%	0.0%	0.2%	1.6%	5.3%	6.0%	6.4%	7.8%	2.9%	4.1%
OTH	LIB	11.3%	11.5%	13.7%	65.5%	1.4%	2.8%	0.2%	0.0%	1.4%	5.6%	6.2%	6.7%	8.0%	2.6%	3.8%
OTH	BLK	12.8%	12.9%	15.1%	64.1%	0.0%	4.2%	1.6%	1.4%	0.0%	7.0%	7.7%	8.1%	9.5%	1.2%	2.4%
SNK1	LWG	5.8%	5.9%	8.1%	71.1%	7.0%	2.8%	5.3%	5.6%	7.0%	0.0%	0.7%	1.1%	2.5%	8.2%	9.4%
SNK2	LGS	5.1%	5.2%	7.4%	71.7%	7.7%	3.5%	6.0%	6.2%	7.7%	0.7%	0.0%	0.4%	1.8%	8.9%	10.1%
SNK3	LMN	4.7%	4.8%	7.0%	72.2%	8.1%	3.9%	6.4%	6.7%	8.1%	1.1%	0.4%	0.0%	1.4%	9.3%	10.5%
SNK4	IHR	3.3%	3.4%	5.7%	73.5%	9.5%	5.2%	7.8%	8.0%	9.5%	2.5%	1.8%	1.4%	0.0%	10.7%	11.9%
UP1	GCL	14.0%	14.1%	16.3%	62.9%	1.2%	5.4%	2.9%	2.6%	1.2%	8.2%	8.9%	9.3%	10.7%	0.0%	1.2%
UP2	CHJ	15.2%	15.3%	17.5%	61.7%	2.4%	6.6%	4.1%	3.8%	2.4%	9.4%	10.1%	10.5%	11.9%	1.2%	0.0%

FLOWGATE:	NORTH OF ECHO LAKE S>N															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.4%	0.4%	0.7%	10.7%	3.2%	5.9%	6.4%	10.7%	1.2%	0.6%	0.3%	0.3%	3.2%	10.3%
LOW2	JDA	0.4%	0.0%	0.0%	0.3%	11.1%	3.6%	6.3%	6.8%	11.1%	1.6%	1.0%	0.7%	0.7%	3.6%	10.7%
LOW3	TDA	0.4%	0.0%	0.0%	0.2%	11.2%	3.7%	6.3%	6.8%	11.2%	1.6%	1.1%	0.8%	0.8%	3.6%	10.7%
LOW4	BON	0.7%	0.3%	0.2%	0.0%	11.4%	3.9%	6.6%	7.1%	11.4%	1.8%	1.3%	1.0%	1.0%	3.9%	10.9%
OTH	ALF	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
OTH	DWR	3.2%	3.6%	3.7%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.1%	2.6%	2.9%	2.9%	0.0%	7.0%
OTH	HGH	5.9%	6.3%	6.3%	6.6%	4.9%	2.7%	0.0%	0.5%	4.9%	4.7%	5.2%	5.6%	5.6%	2.7%	4.4%
OTH	LIB	6.4%	6.8%	6.8%	7.1%	4.3%	3.2%	0.5%	0.0%	4.3%	5.2%	5.8%	6.1%	6.1%	3.2%	3.9%
OTH	BLK	10.7%	11.1%	11.2%	11.4%	0.0%	7.5%	4.9%	4.3%	0.0%	9.6%	10.1%	10.4%	10.4%	7.5%	0.5%
SNK1	LWG	1.2%	1.6%	1.6%	1.8%	9.6%	2.1%	4.7%	5.2%	9.6%	0.0%	0.5%	0.8%	0.8%	2.0%	9.1%
SNK2	LGS	0.6%	1.0%	1.1%	1.3%	10.1%	2.6%	5.2%	5.8%	10.1%	0.5%	0.0%	0.3%	0.3%	2.6%	9.6%
SNK3	LMN	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
SNK4	IHR	0.3%	0.7%	0.8%	1.0%	10.4%	2.9%	5.6%	6.1%	10.4%	0.8%	0.3%	0.0%	0.0%	2.9%	9.9%
UP1	GCL	3.2%	3.6%	3.6%	3.9%	7.5%	0.0%	2.7%	3.2%	7.5%	2.0%	2.6%	2.9%	2.9%	0.0%	7.1%
UP2	CHJ	10.3%	10.7%	10.7%	10.9%	0.5%	7.0%	4.4%	3.9%	0.5%	9.1%	9.6%	9.9%	9.9%	7.1%	0.0%

FLOWGATE:	NORTH OF HANFORD N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.2%	0.1%	12.2%	38.1%	14.8%	29.0%	30.7%	38.1%	1.7%	5.9%	8.4%	1.5%	56.3%	55.6%
LOW2	JDA	4.2%	0.0%	4.1%	16.3%	42.3%	18.9%	33.1%	34.8%	42.3%	2.5%	1.7%	4.2%	5.6%	60.4%	59.7%
LOW3	TDA	0.1%	4.1%	0.0%	12.2%	38.2%	14.8%	29.1%	30.8%	38.2%	1.6%	5.8%	8.3%	1.6%	56.3%	55.6%
LOW4	BON	12.2%	16.3%	12.2%	0.0%	26.0%	2.6%	16.8%	18.5%	26.0%	13.8%	18.0%	20.5%	10.7%	44.1%	43.4%
OTH	ALF	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
OTH	DWR	14.8%	18.9%	14.8%	2.6%	23.4%	0.0%	14.2%	15.9%	23.4%	16.4%	20.6%	23.1%	13.3%	41.5%	40.8%
OTH	HGH	29.0%	33.1%	29.1%	16.8%	9.2%	14.2%	0.0%	1.7%	9.2%	30.7%	34.8%	37.4%	27.5%	27.3%	26.6%
OTH	LIB	30.7%	34.8%	30.8%	18.5%	7.5%	15.9%	1.7%	0.0%	7.5%	32.4%	36.5%	39.0%	29.2%	25.6%	24.9%
OTH	BLK	38.1%	42.3%	38.2%	26.0%	0.0%	23.4%	9.2%	7.5%	0.0%	39.8%	44.0%	46.5%	36.7%	18.1%	17.4%
SNK1	LWG	1.7%	2.5%	1.6%	13.8%	39.8%	16.4%	30.7%	32.4%	39.8%	0.0%	4.2%	6.7%	3.2%	57.9%	57.2%
SNK2	LGS	5.9%	1.7%	5.8%	18.0%	44.0%	20.6%	34.8%	36.5%	44.0%	4.2%	0.0%	2.5%	7.3%	62.1%	61.4%
SNK3	LMN	8.4%	4.2%	8.3%	20.5%	46.5%	23.1%	37.4%	39.0%	46.5%	6.7%	2.5%	0.0%	9.8%	64.6%	63.9%
SNK4	IHR	1.5%	5.6%	1.6%	10.7%	36.7%	13.3%	27.5%	29.2%	36.7%	3.2%	7.3%	9.8%	0.0%	54.8%	54.1%
UP1	GCL	56.3%	60.4%	56.3%	44.1%	18.1%	41.5%	27.3%	25.6%	18.1%	57.9%	62.1%	64.6%	54.8%	0.0%	0.7%
UP2	CHJ	55.6%	59.7%	55.6%	43.4%	17.4%	40.8%	26.6%	24.9%	17.4%	57.2%	61.4%	63.9%	54.1%	0.7%	0.0%

FLOWGATE:	NORTH OF JOHN DAY N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	4.4%	1.2%	4.4%	71.3%	73.3%	69.3%	69.8%	71.3%	81.1%	83.7%	85.3%	0.5%	75.1%	74.5%
LOW2	JDA	4.4%	0.0%	3.2%	8.8%	75.7%	77.7%	73.7%	74.2%	75.7%	85.5%	88.1%	89.7%	4.9%	79.5%	78.9%
LOW3	TDA	1.2%	3.2%	0.0%	5.6%	72.5%	74.5%	70.5%	71.0%	72.5%	82.3%	84.9%	86.5%	1.7%	76.3%	75.7%
LOW4	BON	4.4%	8.8%	5.6%	0.0%	66.9%	68.9%	64.9%	65.4%	66.9%	76.7%	79.3%	80.9%	3.9%	70.7%	70.1%
OTH	ALF	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
OTH	DWR	73.3%	77.7%	74.5%	68.9%	2.0%	0.0%	4.0%	3.5%	2.0%	7.8%	10.4%	11.9%	72.8%	1.7%	1.1%
OTH	HGH	69.3%	73.7%	70.5%	64.9%	2.0%	4.0%	0.0%	0.5%	2.0%	11.8%	14.4%	15.9%	68.8%	5.7%	5.1%
OTH	LIB	69.8%	74.2%	71.0%	65.4%	1.5%	3.5%	0.5%	0.0%	1.5%	11.3%	13.9%	15.4%	69.3%	5.2%	4.6%
OTH	BLK	71.3%	75.7%	72.5%	66.9%	0.0%	2.0%	2.0%	1.5%	0.0%	9.8%	12.4%	13.9%	70.8%	3.7%	3.1%
SNK1	LWG	81.1%	85.5%	82.3%	76.7%	9.8%	7.8%	11.8%	11.3%	9.8%	0.0%	2.6%	4.2%	80.6%	6.0%	6.6%
SNK2	LGS	83.7%	88.1%	84.9%	79.3%	12.4%	10.4%	14.4%	13.9%	12.4%	2.6%	0.0%	1.6%	83.2%	8.6%	9.2%
SNK3	LMN	85.3%	89.7%	86.5%	80.9%	13.9%	11.9%	15.9%	15.4%	13.9%	4.2%	1.6%	0.0%	84.7%	10.2%	10.8%
SNK4	IHR	0.5%	4.9%	1.7%	3.9%	70.8%	72.8%	68.8%	69.3%	70.8%	80.6%	83.2%	84.7%	0.0%	74.5%	73.9%
UP1	GCL	75.1%	79.5%	76.3%	70.7%	3.7%	1.7%	5.7%	5.2%	3.7%	6.0%	8.6%	10.2%	74.5%	0.0%	0.6%
UP2	CHJ	74.5%	78.9%	75.7%	70.1%	3.1%	1.1%	5.1%	4.6%	3.1%	6.6%	9.2%	10.8%	73.9%	0.6%	0.0%

FLOWGATE:	PAUL TO ALLSTON N>S														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.8%	3.3%	12.4%	10.7%	6.7%	8.7%	9.0%	10.7%	4.9%	4.4%	4.2%	2.8%	12.5%	13.6%
LOW2	JDA	1.8%	0.0%	1.6%	10.7%	12.5%	8.5%	10.5%	10.8%	12.5%	6.6%	6.2%	6.0%	4.6%	14.3%	15.4%
LOW3	TDA	3.3%	1.6%	0.0%	9.1%	14.1%	10.1%	12.0%	12.4%	14.1%	8.2%	7.8%	7.5%	6.2%	15.9%	16.9%
LOW4	BON	12.4%	10.7%	9.1%	0.0%	23.1%	19.2%	21.1%	21.5%	23.1%	17.3%	16.9%	16.6%	15.2%	24.9%	26.0%
OTH	ALF	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
OTH	DWR	6.7%	8.5%	10.1%	19.2%	4.0%	0.0%	2.0%	2.3%	4.0%	1.9%	2.3%	2.6%	3.9%	5.8%	6.9%
OTH	HGH	8.7%	10.5%	12.0%	21.1%	2.0%	2.0%	0.0%	0.3%	2.0%	3.8%	4.3%	4.5%	5.9%	3.8%	4.9%
OTH	LIB	9.0%	10.8%	12.4%	21.5%	1.7%	2.3%	0.3%	0.0%	1.7%	4.2%	4.6%	4.9%	6.2%	3.5%	4.6%
OTH	BLK	10.7%	12.5%	14.1%	23.1%	0.0%	4.0%	2.0%	1.7%	0.0%	5.9%	6.3%	6.5%	7.9%	1.8%	2.9%
SNK1	LWG	4.9%	6.6%	8.2%	17.3%	5.9%	1.9%	3.8%	4.2%	5.9%	0.0%	0.4%	0.7%	2.1%	7.7%	8.7%
SNK2	LGS	4.4%	6.2%	7.8%	16.9%	6.3%	2.3%	4.3%	4.6%	6.3%	0.4%	0.0%	0.3%	1.6%	8.1%	9.2%
SNK3	LMN	4.2%	6.0%	7.5%	16.6%	6.5%	2.6%	4.5%	4.9%	6.5%	0.7%	0.3%	0.0%	1.4%	8.3%	9.4%
SNK4	IHR	2.8%	4.6%	6.2%	15.2%	7.9%	3.9%	5.9%	6.2%	7.9%	2.1%	1.6%	1.4%	0.0%	9.7%	10.8%
UP1	GCL	12.5%	14.3%	15.9%	24.9%	1.8%	5.8%	3.8%	3.5%	1.8%	7.7%	8.1%	8.3%	9.7%	0.0%	1.1%
UP2	CHJ	13.6%	15.4%	16.9%	26.0%	2.9%	6.9%	4.9%	4.6%	2.9%	8.7%	9.2%	9.4%	10.8%	1.1%	0.0%

FLOWGATE:	RAVER TO PAUL N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.3%	2.6%	10.2%	8.2%	5.2%	6.7%	6.9%	8.2%	3.9%	3.6%	3.4%	2.2%	9.8%	10.6%
LOW2	JDA	1.3%	0.0%	1.3%	8.9%	9.5%	6.6%	8.0%	8.2%	9.5%	5.2%	4.9%	4.7%	3.6%	11.1%	12.0%
LOW3	TDA	2.6%	1.3%	0.0%	7.6%	10.8%	7.9%	9.3%	9.5%	10.8%	6.5%	6.2%	6.0%	4.9%	12.4%	13.3%
LOW4	BON	10.2%	8.9%	7.6%	0.0%	18.4%	15.5%	16.9%	17.1%	18.4%	14.1%	13.8%	13.6%	12.5%	20.0%	20.9%
OTH	ALF	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
OTH	DWR	5.2%	6.6%	7.9%	15.5%	2.9%	0.0%	1.4%	1.7%	2.9%	1.4%	1.7%	1.9%	3.0%	4.6%	5.4%
OTH	HGH	6.7%	8.0%	9.3%	16.9%	1.5%	1.4%	0.0%	0.2%	1.5%	2.8%	3.1%	3.3%	4.4%	3.1%	4.0%
OTH	LIB	6.9%	8.2%	9.5%	17.1%	1.3%	1.7%	0.2%	0.0%	1.3%	3.0%	3.3%	3.5%	4.7%	2.9%	3.7%
OTH	BLK	8.2%	9.5%	10.8%	18.4%	0.0%	2.9%	1.5%	1.3%	0.0%	4.3%	4.6%	4.8%	5.9%	1.6%	2.5%
SNK1	LWG	3.9%	5.2%	6.5%	14.1%	4.3%	1.4%	2.8%	3.0%	4.3%	0.0%	0.3%	0.5%	1.6%	5.9%	6.8%
SNK2	LGS	3.6%	4.9%	6.2%	13.8%	4.6%	1.7%	3.1%	3.3%	4.6%	0.3%	0.0%	0.2%	1.3%	6.2%	7.1%
SNK3	LMN	3.4%	4.7%	6.0%	13.6%	4.8%	1.9%	3.3%	3.5%	4.8%	0.5%	0.2%	0.0%	1.1%	6.4%	7.3%
SNK4	IHR	2.2%	3.6%	4.9%	12.5%	5.9%	3.0%	4.4%	4.7%	5.9%	1.6%	1.3%	1.1%	0.0%	7.6%	8.4%
UP1	GCL	9.8%	11.1%	12.4%	20.0%	1.6%	4.6%	3.1%	2.9%	1.6%	5.9%	6.2%	6.4%	7.6%	0.0%	0.9%
UP2	CHJ	10.6%	12.0%	13.3%	20.9%	2.5%	5.4%	4.0%	3.7%	2.5%	6.8%	7.1%	7.3%	8.4%	0.9%	0.0%

FLOWGATE:	SOUTH OF ALLSTON N>S															
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	2.1%	4.0%	16.0%	13.2%	8.3%	10.7%	11.2%	13.2%	6.0%	5.5%	5.2%	3.5%	15.4%	16.8%
LOW2	JDA	2.1%	0.0%	2.0%	13.9%	15.3%	10.4%	12.8%	13.2%	15.3%	8.1%	7.6%	7.2%	5.6%	17.4%	18.8%
LOW3	TDA	4.0%	2.0%	0.0%	11.9%	17.3%	12.4%	14.8%	15.2%	17.3%	10.1%	9.5%	9.2%	7.5%	19.4%	20.8%
LOW4	BON	16.0%	13.9%	11.9%	0.0%	29.2%	24.3%	26.7%	27.1%	29.2%	22.0%	21.5%	21.2%	19.5%	31.4%	32.7%
OTH	ALF	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
OTH	DWR	8.3%	10.4%	12.4%	24.3%	4.9%	0.0%	2.4%	2.8%	4.9%	2.3%	2.8%	3.2%	4.8%	7.1%	8.4%
OTH	HGH	10.7%	12.8%	14.8%	26.7%	2.5%	2.4%	0.0%	0.4%	2.5%	4.7%	5.2%	5.6%	7.2%	4.7%	6.0%
OTH	LIB	11.2%	13.2%	15.2%	27.1%	2.1%	2.8%	0.4%	0.0%	2.1%	5.1%	5.7%	6.0%	7.7%	4.2%	5.6%
OTH	BLK	13.2%	15.3%	17.3%	29.2%	0.0%	4.9%	2.5%	2.1%	0.0%	7.2%	7.7%	8.1%	9.7%	2.2%	3.5%
SNK1	LWG	6.0%	8.1%	10.1%	22.0%	7.2%	2.3%	4.7%	5.1%	7.2%	0.0%	0.5%	0.8%	2.5%	9.4%	10.7%
SNK2	LGS	5.5%	7.6%	9.5%	21.5%	7.7%	2.8%	5.2%	5.7%	7.7%	0.5%	0.0%	0.3%	2.0%	9.9%	11.3%
SNK3	LMN	5.2%	7.2%	9.2%	21.2%	8.1%	3.2%	5.6%	6.0%	8.1%	0.8%	0.3%	0.0%	1.7%	10.2%	11.6%
SNK4	IHR	3.5%	5.6%	7.5%	19.5%	9.7%	4.8%	7.2%	7.7%	9.7%	2.5%	2.0%	1.7%	0.0%	11.9%	13.3%
UP1	GCL	15.4%	17.4%	19.4%	31.4%	2.2%	7.1%	4.7%	4.2%	2.2%	9.4%	9.9%	10.2%	11.9%	0.0%	1.4%
UP2	CHJ	16.8%	18.8%	20.8%	32.7%	3.5%	8.4%	6.0%	5.6%	3.5%	10.7%	11.3%	11.6%	13.3%	1.4%	0.0%

FLOWGATE:		SOUTH OF CUSTER N>S														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	0.3%	0.4%	0.8%	15.1%	3.6%	7.0%	7.7%	15.1%	1.3%	0.8%	0.5%	0.2%	0.3%	1.5%
LOW2	JDA	0.3%	0.0%	0.1%	0.5%	15.3%	3.8%	7.3%	8.0%	15.3%	1.6%	1.1%	0.7%	0.4%	0.1%	1.2%
LOW3	TDA	0.4%	0.1%	0.0%	0.4%	15.4%	3.9%	7.4%	8.1%	15.4%	1.7%	1.2%	0.8%	0.6%	0.0%	1.1%
LOW4	BON	0.8%	0.5%	0.4%	0.0%	15.9%	4.4%	7.8%	8.5%	15.9%	2.1%	1.6%	1.3%	1.0%	0.5%	0.7%
OTH	ALF	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
OTH	DWR	3.6%	3.8%	3.9%	4.4%	11.5%	0.0%	3.4%	4.1%	11.5%	2.2%	2.8%	3.1%	3.4%	3.9%	5.0%
OTH	HGH	7.0%	7.3%	7.4%	7.8%	8.1%	3.4%	0.0%	0.7%	8.1%	5.7%	6.2%	6.5%	6.8%	7.3%	8.5%
OTH	LIB	7.7%	8.0%	8.1%	8.5%	7.4%	4.1%	0.7%	0.0%	7.4%	6.4%	6.9%	7.2%	7.5%	8.0%	9.2%
OTH	BLK	15.1%	15.3%	15.4%	15.9%	0.0%	11.5%	8.1%	7.4%	0.0%	13.7%	14.3%	14.6%	14.9%	15.4%	16.5%
SNK1	LWG	1.3%	1.6%	1.7%	2.1%	13.7%	2.2%	5.7%	6.4%	13.7%	0.0%	0.6%	0.9%	1.2%	1.7%	2.8%
SNK2	LGS	0.8%	1.1%	1.2%	1.6%	14.3%	2.8%	6.2%	6.9%	14.3%	0.6%	0.0%	0.3%	0.6%	1.1%	2.3%
SNK3	LMN	0.5%	0.7%	0.8%	1.3%	14.6%	3.1%	6.5%	7.2%	14.6%	0.9%	0.3%	0.0%	0.3%	0.8%	1.9%
SNK4	IHR	0.2%	0.4%	0.6%	1.0%	14.9%	3.4%	6.8%	7.5%	14.9%	1.2%	0.6%	0.3%	0.0%	0.5%	1.7%
UP1	GCL	0.3%	0.1%	0.0%	0.5%	15.4%	3.9%	7.3%	8.0%	15.4%	1.7%	1.1%	0.8%	0.5%	0.0%	1.1%
UP2	CHJ	1.5%	1.2%	1.1%	0.7%	16.5%	5.0%	8.5%	9.2%	16.5%	2.8%	2.3%	1.9%	1.7%	1.1%	0.0%

FLOWGATE:		WEST OF JOHN DAY E>W														
PERCENT:		10.0%														
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	22.3%	56.4%	33.2%	10.4%	7.3%	8.7%	9.1%	10.4%	6.0%	5.7%	5.5%	3.1%	12.4%	12.9%
LOW2	JDA	22.3%	0.0%	78.6%	55.4%	32.7%	29.5%	31.0%	31.3%	32.7%	28.2%	27.9%	27.6%	25.3%	34.6%	35.2%
LOW3	TDA	56.4%	78.6%	0.0%	23.2%	46.0%	43.1%	47.6%	47.3%	46.0%	50.4%	50.7%	50.8%	53.3%	44.0%	43.4%
LOW4	BON	33.2%	55.4%	23.2%	0.0%	22.7%	25.9%	24.4%	24.1%	22.7%	27.2%	27.5%	27.6%	30.1%	20.8%	20.2%
OTH	ALF	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
OTH	DWR	7.3%	29.5%	43.1%	25.9%	3.1%	0.0%	1.4%	1.8%	3.1%	1.3%	1.6%	1.8%	4.2%	5.1%	5.6%
OTH	HGH	8.7%	31.0%	47.6%	24.4%	1.7%	1.4%	0.0%	0.3%	1.7%	2.8%	3.0%	3.2%	5.7%	3.6%	4.2%
OTH	LIB	9.1%	31.3%	47.3%	24.1%	1.4%	1.8%	0.3%	0.0%	1.4%	3.1%	3.4%	3.5%	6.0%	3.3%	3.9%
OTH	BLK	10.4%	32.7%	46.0%	22.7%	0.0%	3.1%	1.7%	1.4%	0.0%	4.4%	4.7%	4.9%	7.3%	2.0%	2.5%
SNK1	LWG	6.0%	28.2%	50.4%	27.2%	4.4%	1.3%	2.8%	3.1%	4.4%	0.0%	0.3%	0.4%	2.9%	6.4%	7.0%
SNK2	LGS	5.7%	27.9%	50.7%	27.5%	4.7%	1.6%	3.0%	3.4%	4.7%	0.3%	0.0%	0.2%	2.6%	6.7%	7.2%
SNK3	LMN	5.5%	27.6%	50.8%	27.6%	4.9%	1.8%	3.2%	3.5%	4.9%	0.4%	0.2%	0.0%	2.5%	6.8%	7.4%
SNK4	IHR	3.1%	25.3%	53.3%	30.1%	7.3%	4.2%	5.7%	6.0%	7.3%	2.9%	2.6%	2.5%	0.0%	9.3%	9.9%
UP1	GCL	12.4%	34.6%	44.0%	20.8%	2.0%	5.1%	3.6%	3.3%	2.0%	6.4%	6.7%	6.8%	9.3%	0.0%	0.6%
UP2	CHJ	12.9%	35.2%	43.4%	20.2%	2.5%	5.6%	4.2%	3.9%	2.5%	7.0%	7.2%	7.4%	9.9%	0.6%	0.0%

FLOWGATE:	WEST OF LOWER MONUMENTAL E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	1.1%	1.5%	2.4%	25.0%	30.3%	33.7%	32.2%	25.0%	76.9%	86.0%	90.3%	3.2%	9.0%	8.2%
LOW2	JDA	1.1%	0.0%	0.4%	1.4%	23.9%	29.2%	32.6%	31.2%	23.9%	77.8%	84.9%	89.2%	4.3%	7.9%	7.2%
LOW3	TDA	1.5%	0.4%	0.0%	1.0%	23.5%	29.8%	32.2%	30.8%	23.5%	77.4%	84.5%	88.8%	4.7%	7.5%	6.8%
LOW4	BON	2.4%	1.4%	1.0%	0.0%	22.6%	30.9%	31.3%	29.8%	22.6%	76.4%	83.5%	87.8%	5.6%	6.6%	5.8%
OTH	ALF	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
OTH	DWR	30.3%	29.2%	29.8%	30.9%	28.3%	0.0%	19.6%	21.1%	28.3%	25.6%	32.7%	36.9%	56.5%	44.3%	45.1%
OTH	HGH	33.7%	32.6%	32.2%	31.3%	8.7%	19.6%	0.0%	1.5%	8.7%	45.2%	52.3%	56.6%	36.9%	24.7%	25.5%
OTH	LIB	32.2%	31.2%	30.8%	29.8%	7.2%	21.1%	1.5%	0.0%	7.2%	46.6%	53.7%	58.0%	35.4%	23.2%	24.0%
OTH	BLK	25.0%	23.9%	23.5%	22.6%	0.0%	28.3%	8.7%	7.2%	0.0%	53.9%	61.0%	65.3%	28.2%	16.0%	16.8%
SNK1	LWG	76.9%	77.8%	77.4%	76.4%	53.9%	25.6%	45.2%	46.6%	53.9%	0.0%	7.1%	11.4%	82.1%	68.9%	70.6%
SNK2	LGS	86.0%	84.9%	84.5%	83.5%	61.0%	32.7%	52.3%	53.7%	61.0%	7.1%	0.0%	4.3%	89.2%	77.0%	77.7%
SNK3	LMN	90.3%	89.2%	88.8%	87.8%	65.3%	36.9%	56.6%	58.0%	65.3%	11.4%	4.3%	0.0%	93.4%	81.3%	82.0%
SNK4	IHR	3.2%	4.3%	4.7%	5.6%	28.2%	56.5%	36.9%	35.4%	28.2%	82.1%	89.2%	93.4%	0.0%	12.2%	11.4%
UP1	GCL	9.0%	7.9%	7.5%	6.6%	16.0%	44.3%	24.7%	23.2%	16.0%	68.9%	77.0%	81.3%	12.2%	0.0%	0.8%
UP2	CHJ	8.2%	7.2%	6.8%	5.8%	16.8%	45.1%	25.5%	24.0%	16.8%	70.6%	77.7%	82.0%	11.4%	0.8%	0.0%

FLOWGATE:	WEST OF MCNARY E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	72.5%	70.4%	67.4%	52.4%	47.1%	50.9%	51.1%	52.4%	43.6%	42.8%	42.3%	23.8%	55.5%	55.8%
LOW2	JDA	72.5%	0.0%	2.1%	5.1%	20.1%	25.4%	21.6%	21.4%	20.1%	28.9%	29.7%	30.2%	48.7%	17.0%	16.7%
LOW3	TDA	70.4%	2.1%	0.0%	3.0%	18.0%	23.3%	19.5%	19.3%	18.0%	26.8%	27.6%	28.1%	46.6%	14.9%	14.6%
LOW4	BON	67.4%	5.1%	3.0%	0.0%	14.9%	20.3%	16.5%	16.3%	14.9%	23.8%	24.6%	25.1%	43.6%	11.9%	11.6%
OTH	ALF	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
OTH	DWR	47.1%	25.4%	23.3%	20.3%	5.3%	0.0%	3.8%	3.9%	5.3%	3.6%	4.3%	4.8%	23.3%	8.4%	8.7%
OTH	HGH	50.9%	21.6%	19.5%	16.5%	1.5%	3.8%	0.0%	0.2%	1.5%	7.3%	8.1%	8.6%	27.1%	4.6%	4.9%
OTH	LIB	51.1%	21.4%	19.3%	16.3%	1.4%	3.9%	0.2%	0.0%	1.4%	7.5%	8.3%	8.7%	27.3%	4.4%	4.7%
OTH	BLK	52.4%	20.1%	18.0%	14.9%	0.0%	5.3%	1.5%	1.4%	0.0%	8.9%	9.6%	10.1%	28.6%	3.0%	3.3%
SNK1	LWG	43.6%	28.9%	26.8%	23.8%	8.9%	3.6%	7.3%	7.5%	8.9%	0.0%	0.8%	1.3%	19.8%	11.9%	12.2%
SNK2	LGS	42.8%	29.7%	27.6%	24.6%	9.6%	4.3%	8.1%	8.3%	9.6%	0.8%	0.0%	0.5%	19.0%	12.7%	13.0%
SNK3	LMN	42.3%	30.2%	28.1%	25.1%	10.1%	4.8%	8.6%	8.7%	10.1%	1.3%	0.5%	0.0%	18.5%	13.2%	13.5%
SNK4	IHR	23.8%	48.7%	46.6%	43.6%	28.6%	23.3%	27.1%	27.3%	28.6%	19.8%	19.0%	18.5%	0.0%	31.7%	32.0%
UP1	GCL	55.5%	17.0%	14.9%	11.9%	3.0%	8.4%	4.6%	4.4%	3.0%	11.9%	12.7%	13.2%	31.7%	0.0%	0.3%
UP2	CHJ	55.8%	16.7%	14.6%	11.6%	3.3%	8.7%	4.9%	4.7%	3.3%	12.2%	13.0%	13.5%	32.0%	0.3%	0.0%

FLOWGATE:	WEST OF SLATT E>W														
PERCENT:		10.0%													
		LOW1	LOW2	LOW3	LOW4	OTH	OTH	OTH	OTH	OTH	SNK1	SNK2	SNK3	SNK4	UP1	UP2
		MCN	JDA	TDA	BON	ALF	DWR	HGH	LIB	BLK	LWG	LGS	LMN	IHR	GCL	CHJ
LOW1	MCN	0.0%	32.4%	27.7%	22.3%	10.7%	8.0%	10.4%	10.4%	10.7%	5.0%	4.2%	3.7%	2.2%	11.3%	11.6%
LOW2	JDA	32.4%	0.0%	4.6%	10.1%	21.7%	24.4%	22.0%	22.0%	21.7%	27.4%	28.2%	28.7%	30.2%	21.1%	20.7%
LOW3	TDA	27.7%	4.6%	0.0%	5.5%	17.0%	19.7%	17.3%	17.4%	17.0%	22.7%	23.5%	24.0%	25.5%	16.5%	16.1%
LOW4	BON	22.3%	10.1%	5.5%	0.0%	11.6%	14.3%	11.9%	11.9%	11.6%	17.3%	18.1%	18.6%	20.1%	11.0%	10.7%
OTH	ALF	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
OTH	DWR	8.0%	24.4%	19.7%	14.3%	2.7%	0.0%	2.4%	2.4%	2.7%	3.0%	3.8%	4.3%	5.8%	3.3%	3.6%
OTH	HGH	10.4%	22.0%	17.3%	11.9%	0.3%	2.4%	0.0%	0.1%	0.3%	5.4%	6.2%	6.7%	8.2%	0.8%	1.2%
OTH	LIB	10.4%	22.0%	17.4%	11.9%	0.3%	2.4%	0.1%	0.0%	0.3%	5.4%	6.2%	6.7%	8.2%	0.9%	1.3%
OTH	BLK	10.7%	21.7%	17.0%	11.6%	0.0%	2.7%	0.3%	0.3%	0.0%	5.7%	6.5%	7.0%	8.5%	0.6%	0.9%
SNK1	LWG	5.0%	27.4%	22.7%	17.3%	5.7%	3.0%	5.4%	5.4%	5.7%	0.0%	0.8%	1.3%	2.8%	6.2%	6.6%
SNK2	LGS	4.2%	28.2%	23.5%	18.1%	6.5%	3.8%	6.2%	6.2%	6.5%	0.8%	0.0%	0.5%	2.0%	7.1%	7.4%
SNK3	LMN	3.7%	28.7%	24.0%	18.6%	7.0%	4.3%	6.7%	6.7%	7.0%	1.3%	0.5%	0.0%	1.5%	7.5%	7.9%
SNK4	IHR	2.2%	30.2%	25.5%	20.1%	8.5%	5.8%	8.2%	8.2%	8.5%	2.8%	2.0%	1.5%	0.0%	9.1%	9.4%
UP1	GCL	11.3%	21.1%	16.5%	11.0%	0.6%	3.3%	0.8%	0.9%	0.6%	6.2%	7.1%	7.5%	9.1%	0.0%	0.4%
UP2	CHJ	11.6%	20.7%	16.1%	10.7%	0.9%	3.6%	1.2%	1.3%	0.9%	6.6%	7.4%	7.9%	9.4%	0.4%	0.0%

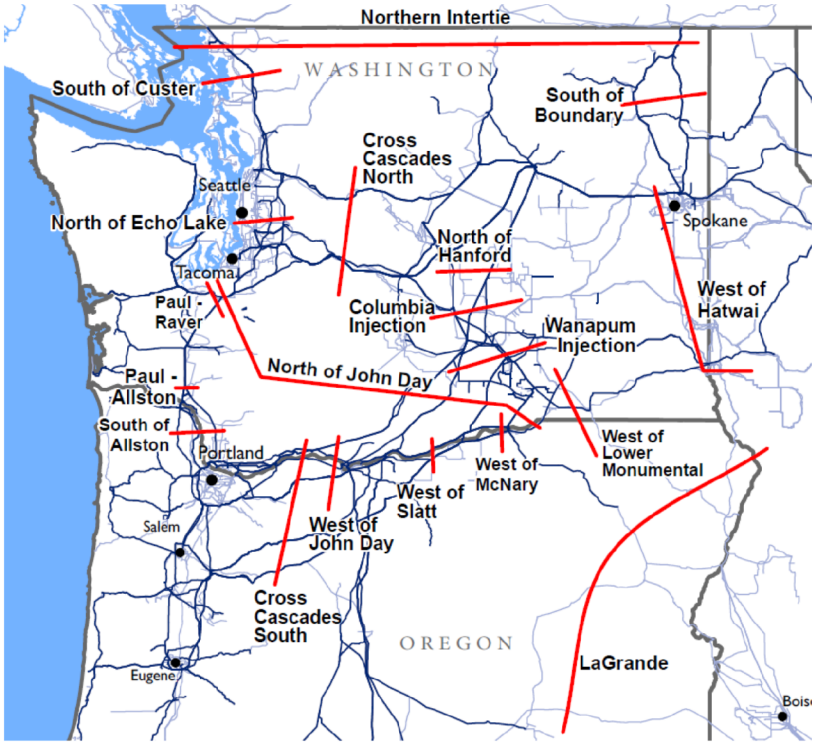
Objective & Approach:

Provide a high-level assessment of the risk of congestion on BPA internal flowgates

Methodology:

- Analyzed historical in-hour curtailments events between 2008 and present.
- Analyzed excursion minutes (flows > TTC) for CY2015 – FY2018 (YTD)
- Note: SOL Methodology changed 4/2017 where curtailments no longer occur when actual flows exceed the TTC
  - SOL must be exceeded on an element (thermal)
  - RTCA used as a real-time tool
  - Still curtail when MaxTTC or SSOL is reached
- Results have not been peer reviewed – draft results!

Flowgates:



Summary:

- The number and duration of actual flows exceeding TTC has been increasing
- The number curtailments has been decreasing
- Trends are likely due to new SOL methodology that went into effect on 4/1/2017
- Overall risk of curtailments is fairly low on most flowgates
- These trends may or may not continue – hard to predict the future!
- Very few N-1 contingencies recently – curtailments may be higher when they occur since we are running the system tighter.

Curtailment Trends:

CURTAILMENT EVENTS - ALL PRIORITIES (1,2,6,7)											
Row Labels	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
NJD			4	4	11		21		2	2	44
NOEL						12	5	17		3	37
NOH				3							3
NOH_SN		11		1	7	1					20
P-A		2									2
R-P			1	4	1				7		13
SOA	11	1		3		2	2				19
SOA_SN	3	2		1		3					9
SOC								1	21		22
WOCN		1	4			1					6
WOJD					4				6		10
WOM					5		3				8
WOM - MAIN-GRID									2		2
WOMSG								4			4
Grand Total	14	17	9	16	28	19	31	22	38	5	199

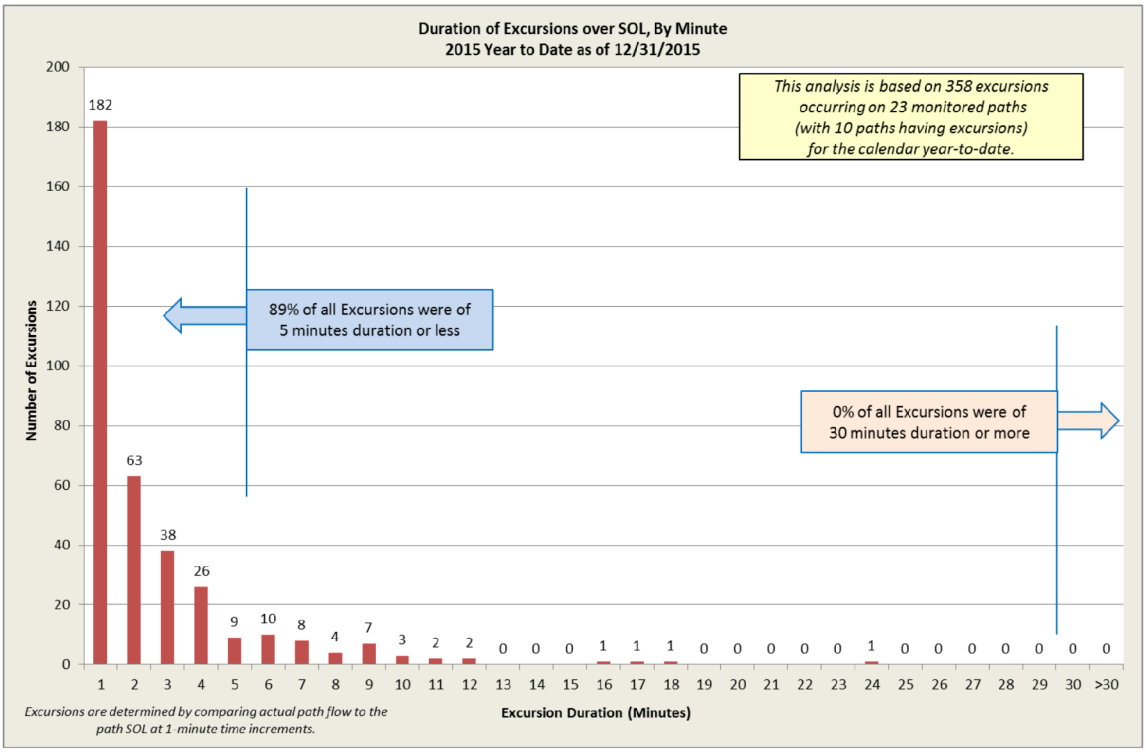
CURTAILMENT EVENTS - FIRM (7)											
Row Labels	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
NJD					11		21		2	2	36
NOEL						12	5	17		3	37
NOH											
NOH_SN					7	1					8
P-A											
R-P				2	1				7		10
SOA						2	2				4
SOA_SN						3					3
SOC								1	21		22
WOCN			2			1					3
WOJD					4				6		10
WOM					5		3				8
WOM - MAIN-GRID									2		2
WOMSG								4			4
Grand Total			2	2	28	19	31	22	38	5	147

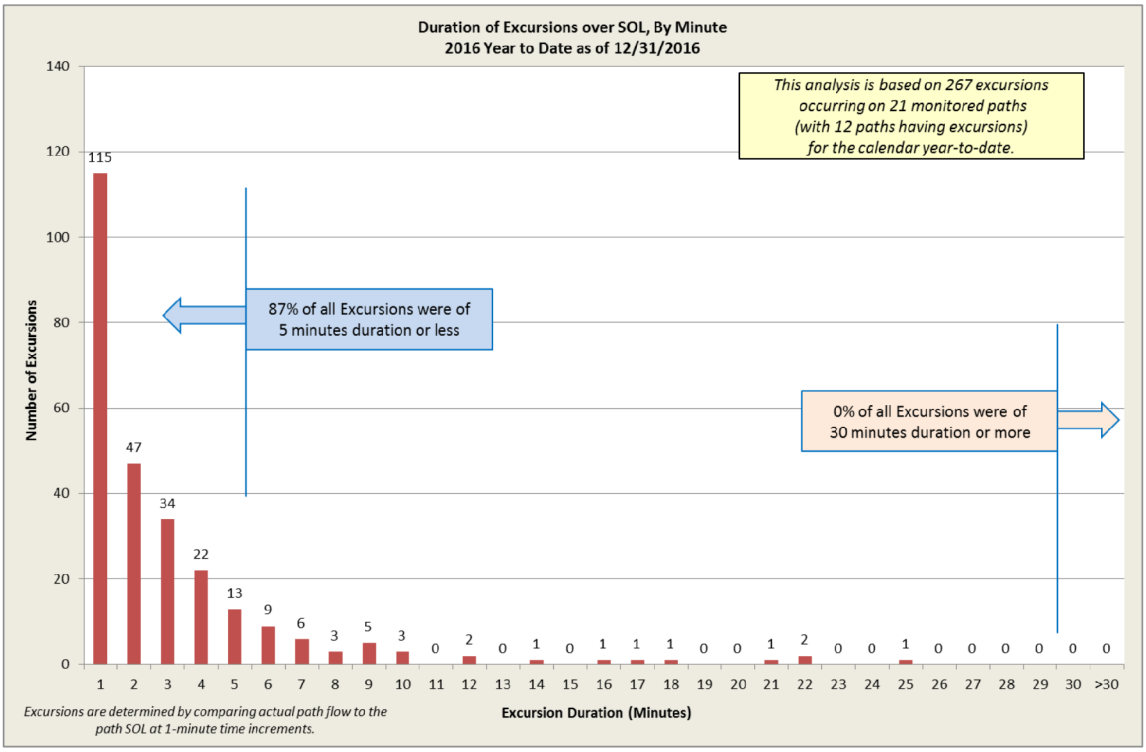
MWs CURTAILED - ALL PRIORITIES											
FLOWGATE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand

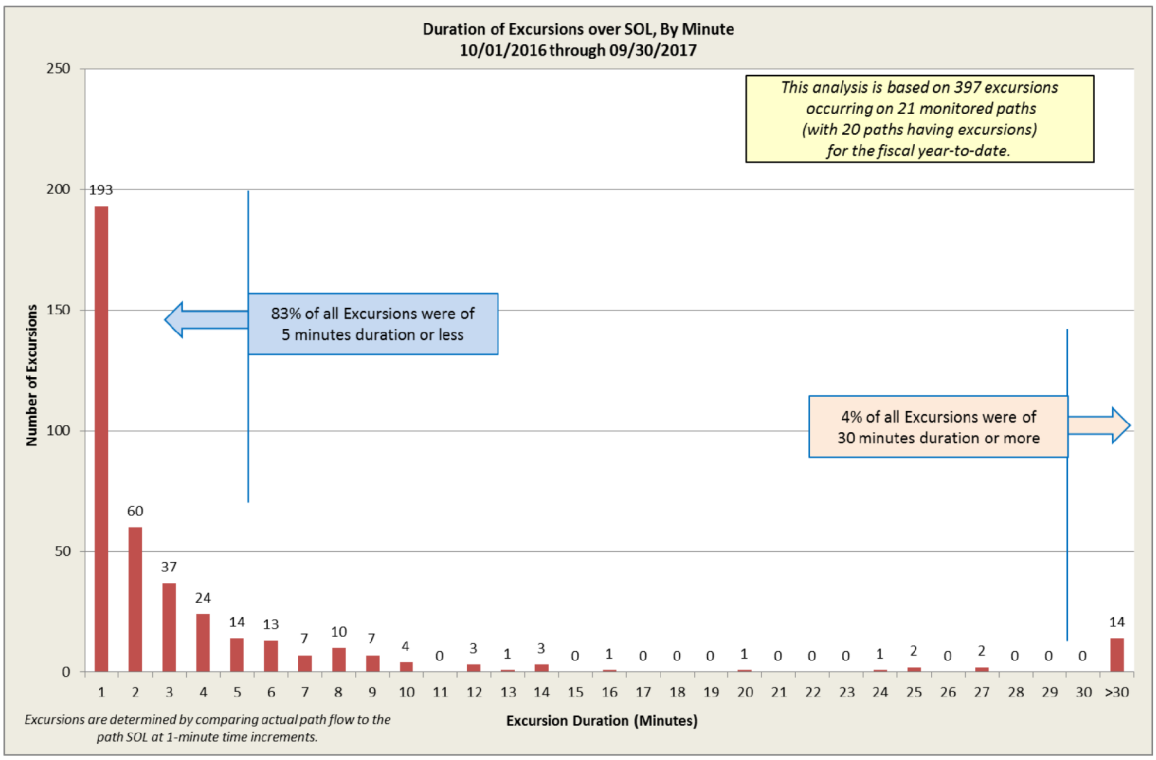
											Total
NJD			1814	930	2649		6862		632	318	**13205**
NOEL						2193	1468	4469		997	**9127**
NOH				1325							**1325**
NOH_SN		6612		215	4889	317					**12033**
P-A		1598									**1598**
R-P			709	4028	621				3232		**8590**
SOA	5369	739		1539		797	1683				**10127**
SOA_SN	1599	719		491		1830					**4639**
SOC								133	6720		**6853**
WOCN		346	2618			1298					**4262**
WOJD					1294				3388		**4682**
WOM					12590		468				**13058**
WOM - MAIN-GRID									3011		**3011**
WOMSG								1044			**1044**
Grand Total	**6968**	**10014**	**5141**	**8528**	**22043**	**6435**	**10481**	**5646**	**16983**	**1315**	**93554**

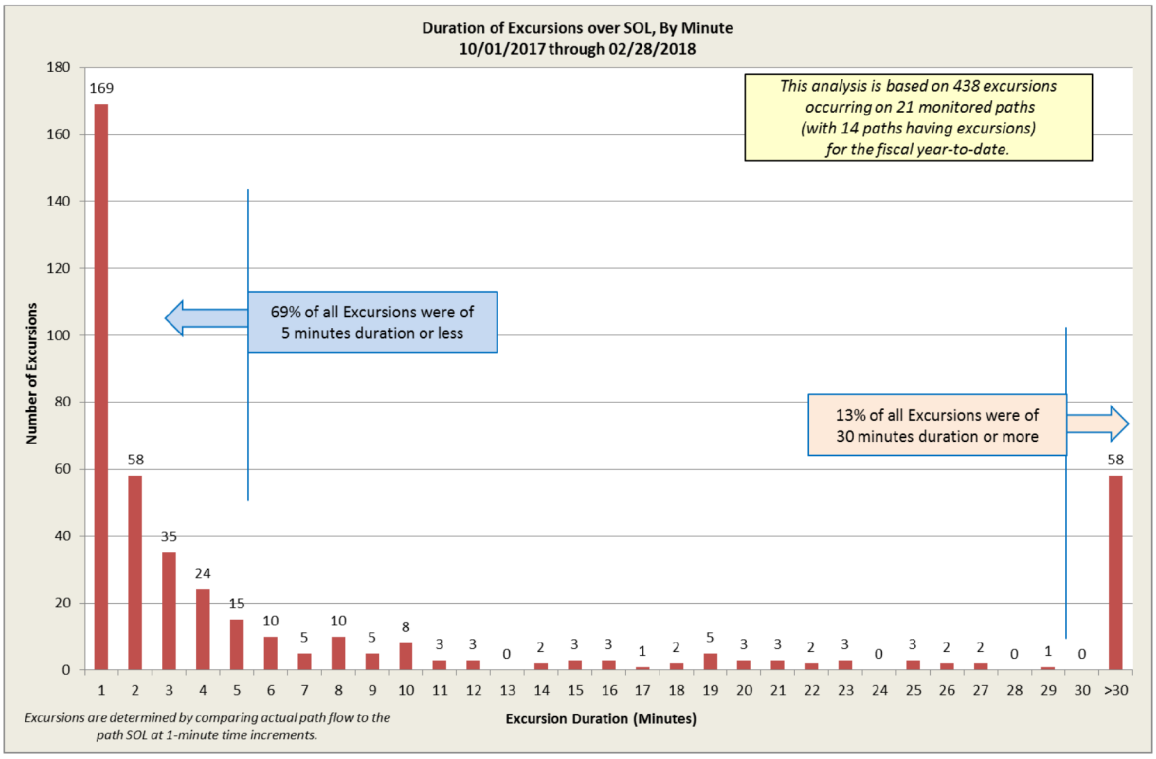
** In the graph above, this shows the total number of MWs that were requested during a curtailment. All curtailments are sub-hourly, but multiple curtailments could occur during the same hour.

Duration of Excursions:






Duration of Excursions over SOL, By Minute
10/01/2016 through 09/30/2017
This analysis is based on 397 excursions occurring on 21 monitored paths (with 20 paths having excursions) for the fiscal year-to-date.
83% of all Excursions were of 5 minutes duration or less
4% of all Excursions were of 30 minutes duration or more
Number of Excursions
Excursion Duration (Minutes)
Excursions are determined by comparing actual path flow to the path SOL at 1-minute time increments.


Duration of Excursions over SOL, By Minute
10/01/2017 through 02/28/2018
This analysis is based on 438 excursions occurring on 21 monitored paths (with 14 paths having excursions) for the fiscal year-to-date.
69% of all Excursions were of 5 minutes duration or less
13% of all Excursions were of 30 minutes duration or more
Number of Excursions
Excursion Duration (Minutes)
Excursions are determined by comparing actual path flow to the path SOL at 1-minute time increments.

Excursion Minutes Trends:

Note: FY2018 numbers are YTD (~3/5/2018)

EXCURSION MINUTES (>TTC)					
PATH	CY2015	CY2016	FY2017	FY2018	Grand Total
AC INTERTIE (COI)	148	205	178	24	**555**
COLUMBIA INJECTION			14		**14**
DC INTERTIE (PDCI)	18				**18**
JOHN DAY WIND	16	2	3	6	**27**
MONTANA-NORTHWEST		1	1		**2**
NORTH-OF-ECHOLAKE	34	2	25	377	**438**
NORTH-OF-HANFORD	1	3	3		**7**
NORTH-OF-JOHN-DAY		8	25	1	**34**
NORTHWEST-BC	108	9	77	14	**208**
PAUL-ALLSTON			3	1	**4**
RAVER-PAUL	1	2	6	1	**10**
ROCK CREEK WIND			3		**3**
SOUTH-OF-ALLSTON	2		2		**4**
SOUTH-OF-BOUNDARY	14	9	15		**38**
SOUTH-OF-CUSTER	16	18	14	2	**50**
WEST-OF-CASCADES-NORTH			3	1	**4**
WEST-OF-CASCADES-SOUTH		2	2	1	**5**
WEST-OF-HATWAI			6	1	**7**
WEST-OF-JOHN-DAY		6	10	3	**19**
WEST-OF-LOWER-MONUMENTAL			3	2	**5**
WEST-OF-SLATT			4	4	**8**
Grand Total	**358**	**267**	**397**	**438**	**1460**

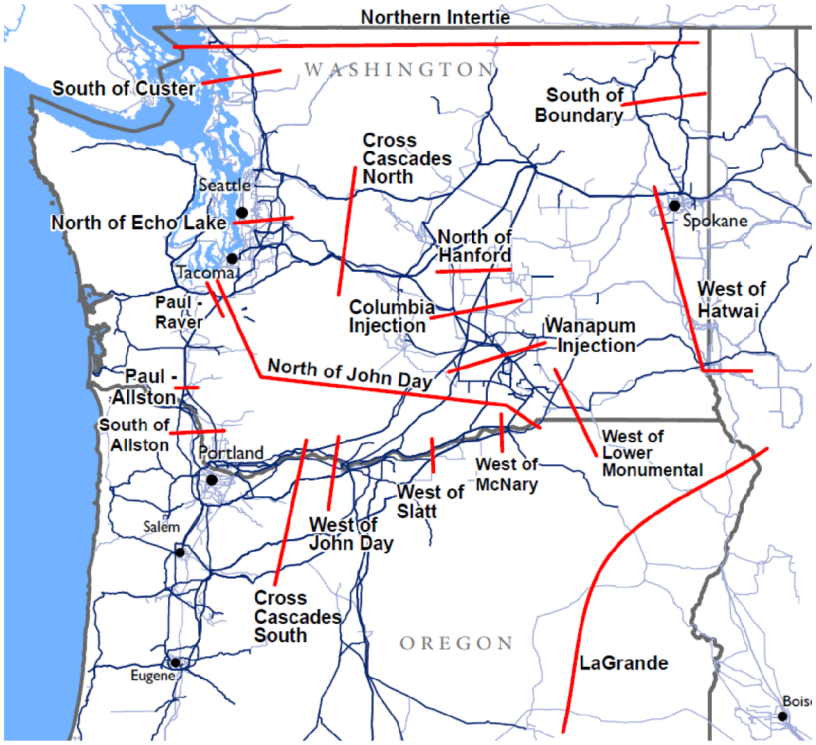
Objective & Approach:

Provide a high-level assessment of the risk of congestion on BPA internal flowgates

Methodology:

- Analyzed historical in-hour curtailments events between 2008 and present.
- Analyzed excursion minutes (flows > TTC) for CY2015 – FY2018 (YTD)
- Note: SOL Methodology changed 4/2017 where curtailments no longer occur when actual flows exceed the TTC
  - SOL must be exceeded on an element (thermal)
  - RTCA used as a real-time tool
  - Still curtail when MaxTTC or SSOL is reached
- Results have not been peer reviewed – draft results!

Flowgates:



Summary:

- The number and duration of actual flows exceeding TTC has been increasing
- The number curtailments has been decreasing
- Trends are likely due to new SOL methodology that went into effect on 4/1/2017
- Overall risk of curtailments is fairly low on most flowgates
- These trends may or may not continue – hard to predict the future!
- Very few N-1 contingencies recently – curtailments may be higher when they occur since we are running the system tighter.

Curtailment Trends:

CURTAILMENT EVENTS - ALL PRIORITIES (1,2,6,7)											
Row Labels	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
NJD			4	4	11		21		2	2	44
NOEL						12	5	17		3	37
NOH				3							3
NOH_SN		11		1	7	1					20
P-A		2									2
R-P			1	4	1				7		13
SOA	11	1		3		2	2				19
SOA_SN	3	2		1		3					9
SOC								1	21		22
WOCN		1	4			1					6
WOJD					4				6		10
WOM					5		3				8
WOM - MAIN-GRID									2		2
WOMSG								4			4
Grand Total	14	17	9	16	28	19	31	22	38	5	199

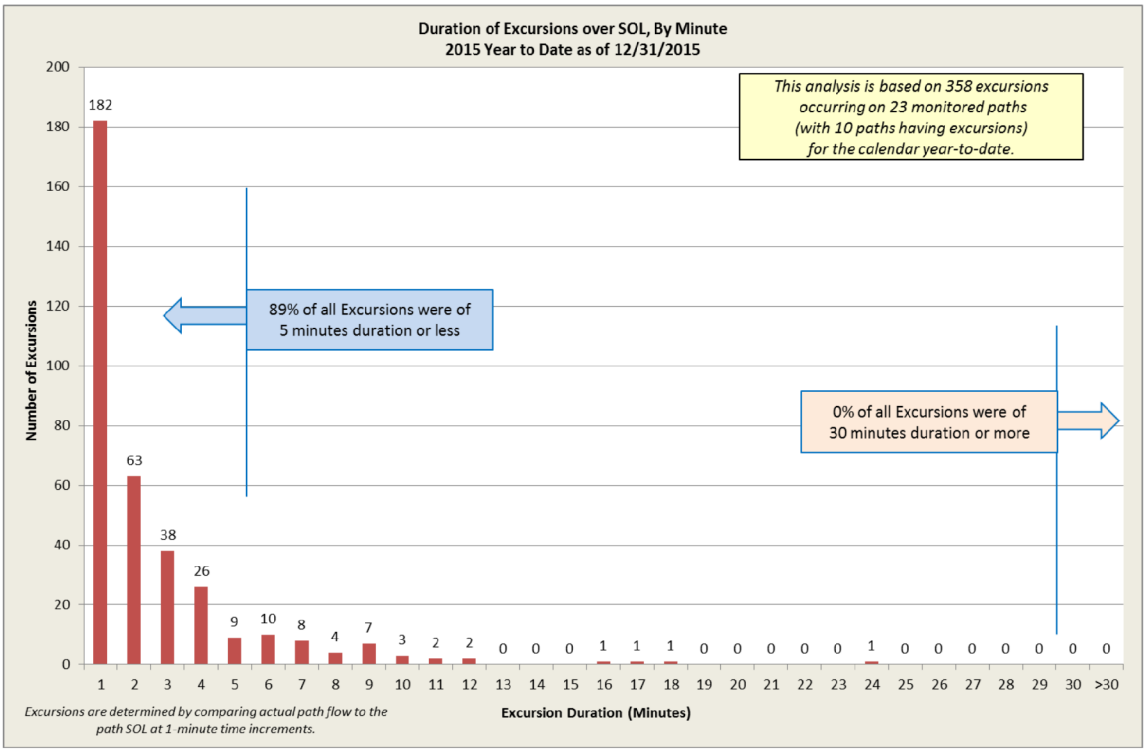
CURTAILMENT EVENTS - FIRM (7)											
Row Labels	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
NJD					11		21		2	2	36
NOEL						12	5	17		3	37
NOH											
NOH_SN					7	1					8
P-A											
R-P				2	1				7		10
SOA						2	2				4
SOA_SN						3					3
SOC								1	21		22
WOCN			2			1					3
WOJD					4				6		10
WOM					5		3				8
WOM - MAIN-GRID									2		2
WOMSG								4			4
Grand Total			2	2	28	19	31	22	38	5	147

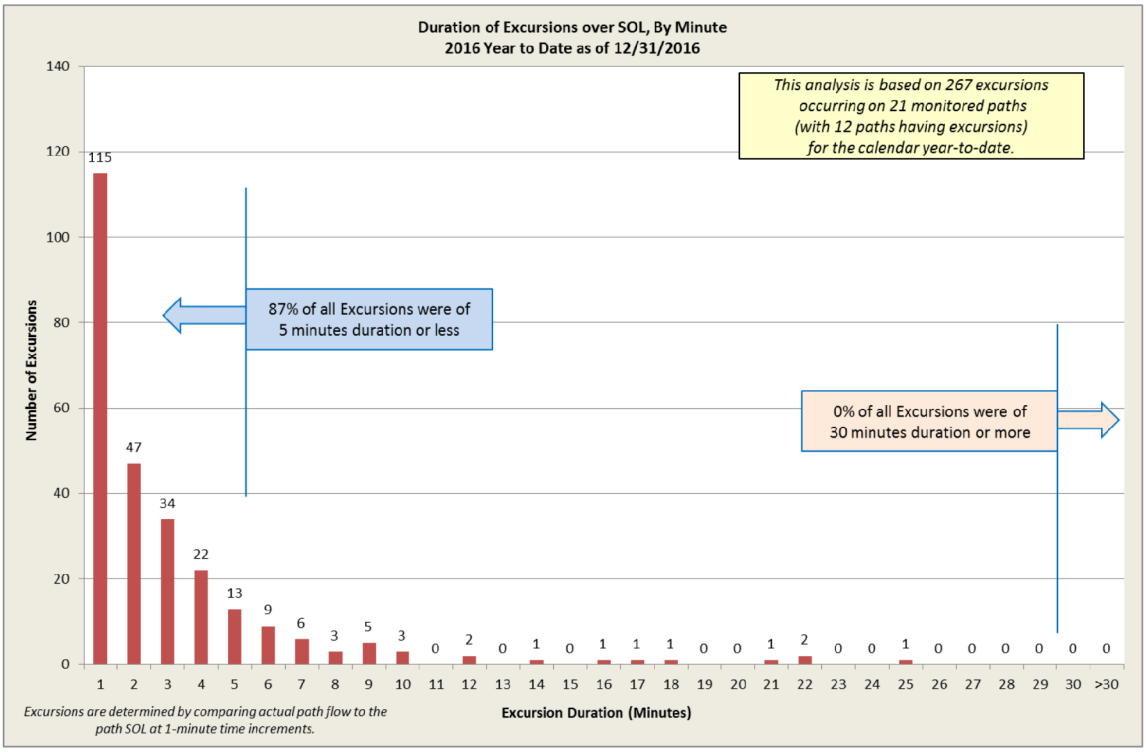
MWs CURTAILED - ALL PRIORITIES											
FLOWGATE	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand

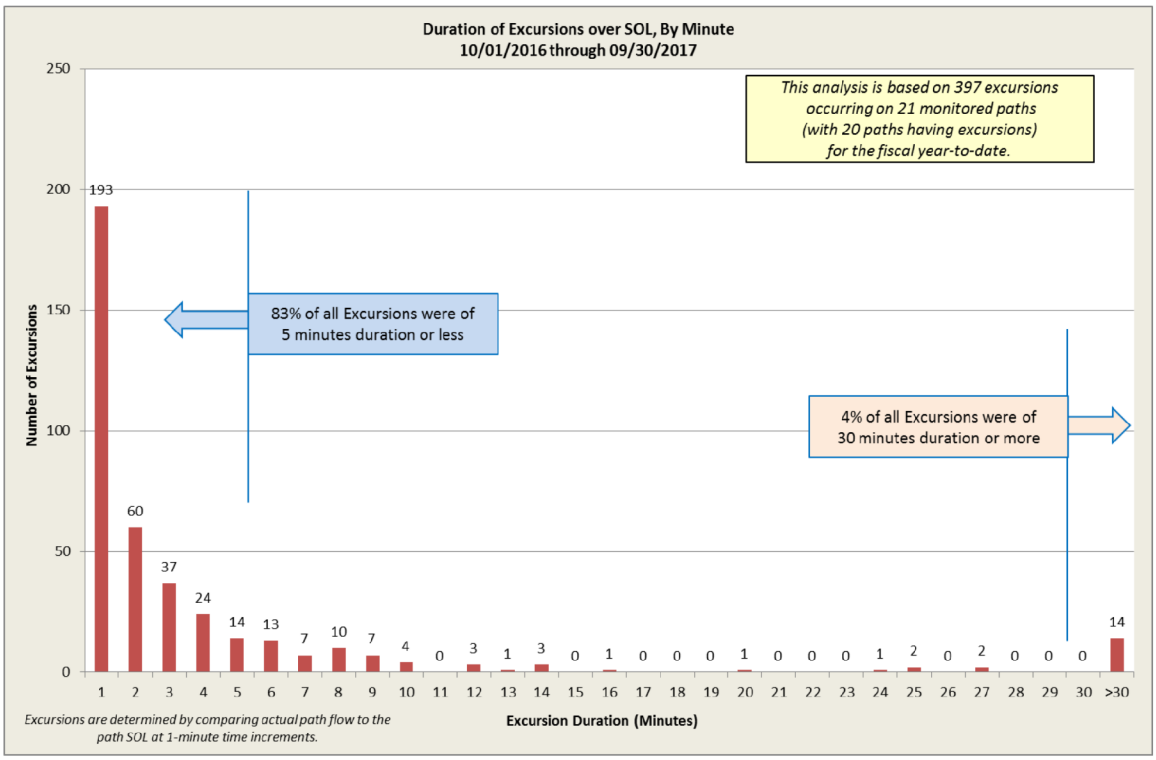
											Total
NJD			1814	930	2649		6862		632	318	**13205**
NOEL						2193	1468	4469		997	**9127**
NOH				1325							**1325**
NOH_SN		6612		215	4889	317					**12033**
P-A		1598									**1598**
R-P			709	4028	621				3232		**8590**
SOA	5369	739		1539		797	1683				**10127**
SOA_SN	1599	719		491		1830					**4639**
SOC								133	6720		**6853**
WOCN		346	2618			1298					**4262**
WOJD					1294				3388		**4682**
WOM					12590		468				**13058**
WOM - MAIN-GRID									3011		**3011**
WOMSG								1044			**1044**
Grand Total	**6968**	**10014**	**5141**	**8528**	**22043**	**6435**	**10481**	**5646**	**16983**	**1315**	**93554**

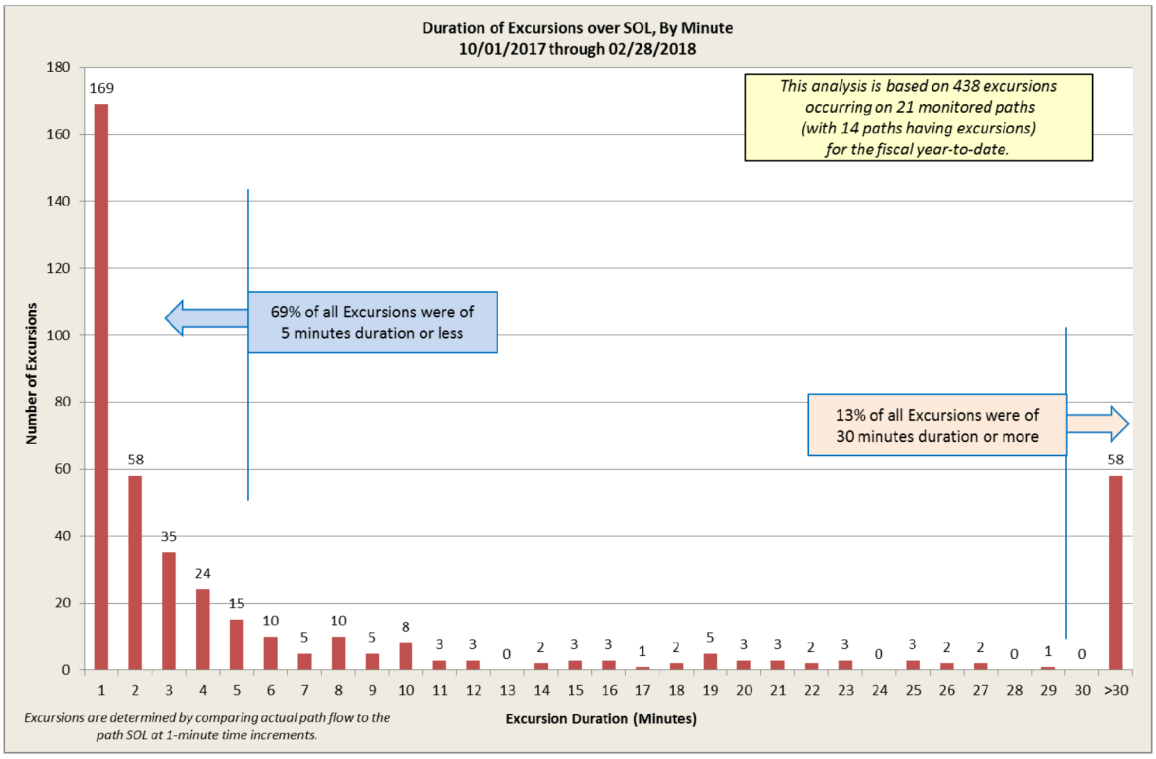
** In the graph above, this shows the total number of MWs that were requested during a curtailment. All curtailments are sub-hourly, but multiple curtailments could occur during the same hour.

Duration of Excursions:






Duration of Excursions over SOL, By Minute
10/01/2016 through 09/30/2017
This analysis is based on 397 excursions occurring on 21 monitored paths (with 20 paths having excursions) for the fiscal year-to-date.
83% of all Excursions were of 5 minutes duration or less
4% of all Excursions were of 30 minutes duration or more
Number of Excursions
Excursion Duration (Minutes)
Excursions are determined by comparing actual path flow to the path SOL at 1-minute time increments.


Duration of Excursions over SOL, By Minute
10/01/2017 through 02/28/2018
This analysis is based on 438 excursions occurring on 21 monitored paths (with 14 paths having excursions) for the fiscal year-to-date.
69% of all Excursions were of 5 minutes duration or less
13% of all Excursions were of 30 minutes duration or more
Number of Excursions
Excursion Duration (Minutes)
Excursions are determined by comparing actual path flow to the path SOL at 1-minute time increments.

Excursion Minutes Trends:

Note: FY2018 numbers are YTD (~3/5/2018)

EXCURSION MINUTES (>TTC)					
PATH	CY2015	CY2016	FY2017	FY2018	Grand Total
AC INTERTIE (COI)	148	205	178	24	**555**
COLUMBIA INJECTION			14		**14**
DC INTERTIE (PDCI)	18				**18**
JOHN DAY WIND	16	2	3	6	**27**
MONTANA-NORTHWEST		1	1		**2**
NORTH-OF-ECHOLAKE	34	2	25	377	**438**
NORTH-OF-HANFORD	1	3	3		**7**
NORTH-OF-JOHN-DAY		8	25	1	**34**
NORTHWEST-BC	108	9	77	14	**208**
PAUL-ALLSTON			3	1	**4**
RAVER-PAUL	1	2	6	1	**10**
ROCK CREEK WIND			3		**3**
SOUTH-OF-ALLSTON	2		2		**4**
SOUTH-OF-BOUNDARY	14	9	15		**38**
SOUTH-OF-CUSTER	16	18	14	2	**50**
WEST-OF-CASCADES-NORTH			3	1	**4**
WEST-OF-CASCADES-SOUTH		2	2	1	**5**
WEST-OF-HATWAI			6	1	**7**
WEST-OF-JOHN-DAY		6	10	3	**19**
WEST-OF-LOWER-MONUMENTAL			3	2	**5**
WEST-OF-SLATT			4	4	**8**
Grand Total	**358**	**267**	**397**	**438**	**1460**



3-Agency EIM Discussion

Federal Columbia River Power System

May 6, 2019

9am – 11am

Steve Kerns
Business Transformation Office
Grid Modernization - EIM Director – EIM Core Team Lead

Agnes Lut
Business Transformation Office
EIM – Grid Mod Stakeholder Engagement Lead and Liaison to USACE & USBR – EIM Core Team

Todd Kochheiser
Transmission Operations
EIM Core Team

BPA HQ conf room 160E/W
Call in #
503-230-4000
Passcode: (b)(2)

BPA-2020-00700-F0194

USBR EIM Questions from 4/29/19

1. What is the collaboration plan and coordination structure planned for federal partners to stay organized as BPA enters the EIM?

2. Where is the funding source to support the EIM effort? Also keep in mind that if/when BPA decides to join the EIM, there will be additional projects to support.

3. Has there been any research/study conducted to determine staffing impacts to Grand Coulee once BPA enters the EIM? For example, it is expected there will be changes to outage coordination, network equipment and increase in forced outages. Have these changes been considered?

4. What is the impact of the 5-minute market to unit availability determination and dispatching changes? Increased generator wear and tear? Any other impacts to note?

5. What is BPA's plan for the costs/penalties associated with the EIM market? Are these costs going to be transferred to the irrigation districts?

6. What assumptions were made (if any) for Grand Coulee's operations for the cost/benefit analysis?

USBR EIM Questions from 4/29/19

1. What is the collaboration plan and coordination structure planned for federal partners to stay organized as BPA enters the EIM?

Coordination and communication during the EIM implementation phase will be critical if BPA signs the EIM Implementation Agreement with the CAISO this summer. BPA will lead this effort, and the Three Agency Coordination Plan will continue to be used to facilitate this work. BPA will continue to have weekly Monday check-ins with USBR and USACE, and continue with the 3-Agency EIM meetings.

One are of additional EIM-related work is improving the coordination between BPA and the hydro projects on how generator units should be loaded for 1-3 future hours. This information will inform the operations for each of the Big-10 projects that would participate in the market. This work would need to be completed before the end of end of Q-3, before start of Milestone 4. In addition, collaboration between BPA and the Corps will be necessary to supply information required in the Master file.

USBR EIM Questions from 4/29/19

2. Where is the funding source to support the EIM effort? Also keep in mind that if/when BPA decides to join the EIM, there will be additional projects to support.

The funding source for the EIM effort is a mix of expense included in the Grid Modernization Initiative budget and existing planned capital budget that will be reprioritized.

USBR EIM Questions from 4/29/19

3. Has there been any research/study conducted to determine staffing impacts to Grand Coulee once BPA enters the EIM? For example, it is expected there will be changes to outage coordination, network equipment and increase in forced outages. Have these changes been considered?

BPA has not conducted a study to determine staffing impacts to Grand Coulee or any other federal project if BPA enters into the EIM. However, BPA does not anticipate that any additional staffing will be required from USBR or USACE in order for BPA to participate in the EIM.

USBR EIM Questions from 4/29/19

4. What is the impact of the 5-minute market to unit availability determination and dispatching changes? Increased generator wear and tear? Any other impacts to note?

In the updated cost benefit analysis we modeled three years, 2016-2018, of hydro operations and constrained the model to only bidding in the existing spinning capacity to limit start / stops. Our business case for joining the EIM is expected to be net positive with this restriction in place. Should BPA join the EIM, BPA will be responsible for the development of bidding strategies. BPA will rely on the Corps to evaluate whether or not these strategies are resulting in additional wear-and-tear and will adjust our bidding strategy accordingly.

USBR EIM Questions from 4/29/19

5. What is BPA's plan for the costs/penalties associated with the EIM market? Are these costs going to be transferred to the irrigation districts?

If BPA signs the EIM Implementation Agreement this summer then allocation of credits and debits (*e.g.,* uplift and imbalance charges) associated with BPA's EIM participation need to go through BPA's rate case, BP-22. Any determination of debits and credits transferred to irrigation districts would be decided during this phase of the process. This will be a public process that includes stakeholder engagement with the USBR and the irrigation districts.

The EIM does not have any penalties associated with it, but rather debits and credits as discussed above.

USBR EIM Questions from 4/29/19

6. What assumptions were made (if any) for Grand Coulee's operations for the cost/benefit analysis?

BPA's cost benefit analysis, being released in May, modeled that only the current spin capacity would be bid into the EIM and will maintain daily energy neutrality (so that EIM dispatch impacts on hydraulic management of the FCRPS is minimized). BPA would not be bidding in capacity required for regulation. BPA will be presenting its updated cost benefit analysis at the May 15 EIM Stakeholder Meeting.

USACE EIM Questions from 5/6/19

1. How does BPA plan on changing generation dispatch to COE Operating Projects for EIM participation?
2. What differences in generator operation at Big 10 plants does BPA envision as a result of EIM participation? I.e. how much can we actually vary from current operations due to the myriad of constraints that we operate under (ESA, BiOp, water management, etc.)? (Use of current level of extraneous spinning reserves only, which would be identified through Grid Mod initiatives?)
3. Does BPA envision differences how each of the 3 aggregated nodes (LCR, Snake, UCR) would participate in the EIM?
4. Does the difference in price for generation at different Operating Projects affect which aggregated nodes (and which Projects within each of the nodes) will be called upon for 5 min dispatch?
5. How will EIM participation affect slow rolling units for fish (10 minutes before it hits the grid)?
6. What does BPA need from the COE in order to join the EIM other than completion of COE actions related to Grid Mod initiatives? E.g. a team to participate in Master File database creation during milestone 3 of the BPA-CAISO implementation process.
7. Please confirm that there are no direct costs to the COE to join EIM (BPA is solely responsible for the milestone payments to CAISO).
8. How does BPA envision involvement in the EIM will change unit start/stops and/or ramp rates for participating resources?

USACE EIM Questions from 5/6/19

9. How will EIM participation affect outage scheduling? Could participation in the 5 min market necessitate “last minute” renegotiation to change the start or stop times of scheduled / approved outages?
10. Are there rough zone or turbine limits to consider for EIM participation?
11. How will EIM participation affect running units with respect to the 1% limits turbine efficiency limits?
12. How many plant set points will be required for EIM participation at each Operating Project?
13. What new instrumentation at Operating Projects will be necessary for EIM participation? Are new instrumentation requirements being identified and addressed through Grid Mod initiatives?
14. Will the COE need to develop a calibration program for new or existing instrumentation? If so, when will that be required?
15. Will EIM introduce any new penalties for not having enough spinning reserve or shutdown reserves?
16. Does this change our regulatory compliance with WECC in any way? E.g. compliance issues related to spinning reserves?
17. Please confirm Milestone dates for EIM implementation.
18. What will the Corps' role be in shaping BPA's bid curve and/or utilizing that to recoup the costs of additional component degradation that might result from 5 min dispatch?

USACE EIM Questions from 5/6/19

19. Grid Mod, BPA's high side metering initiative: have decisions been made for Ice Harbor and Bonneville First Powerhouse on where meters will be installed? COE is still getting some requests for info from BPA Transmission and we are unclear if BPA is still considering installing high side meters on COE property or if the information requests have to do with cost/benefit analysis and justification for installation on BPA property.
20. Master File database ownership: BPA-ISO Implementation Agreement alludes to Master File as owned by the ISO. If BPA and COE join the EIM, does the COE retain the right to update the Master File database for its generation assets when / as it deems necessary?
21. During spill season, currently it is reported that at operating projects operating to hourly spill amounts set based as a percent of total outflow, BPA sets spill levels at most projects twice an hour, and hourly at The Dalles. Required tolerance of these operations is plus or minus 1 percent. Several of the Federal dams maintain the +/- 1% while also providing system reserves. We have been assured that these operations will not change if BPA enters the EIM. We request a plain language explanation for the Technical Management Team (TMT) of how BPA will manage within hour variability to achieve hourly spill requirements. Is the current adaptive management approach (i.e., TMT) adequate for evaluating unintended consequences of EIM?

USACE EIM Questions from 5/6/19

21. During spill season, currently it is reported that at operating projects operating to hourly spill amounts set based as a percent of total outflow, BPA sets spill levels at most projects twice an hour, and hourly at The Dalles. Required tolerance of these operations is plus or minus 1 percent. Several of the Federal dams maintain the +/- 1% while also providing system reserves. We have been assured that these operations will not change if BPA enters the EIM. We request a plain language explanation for the Technical Management Team (TMT) of how BPA will manage within hour variability to achieve hourly spill requirements. Is the current adaptive management approach (i.e., TMT) adequate for evaluating unintended consequences of EIM?

Yes, the current adaptive management approach is adequate for evaluating unintended consequences of EIM participation. BPA's power marketing services and activities and power demand changes would be conducted consistent with the 2019 NOAA Fisheries CRS Biological Opinion and would be within existing operating constraints and normal operating limits of FCRPS projects.

USACE EIM Questions from 5/6/19

20. Master File database ownership: BPA-ISO Implementation Agreement alludes to Master File as owned by the ISO. If BPA and COE join the EIM, does the COE retain the right to update the Master File database for its generation assets when / as it deems necessary?

BPA would be the entity joining the EIM since it is a market, not USACE or USBR. BPA's role is to market and transmit the power generated by the FCRPS projects in accordance with Bonneville's statutory directives to meet power customer loads and provide an adequate, efficient, economical, and reliable power supply.

The Master File can be updated as necessary with 2-3 days for the change to take place. If immediate change to generator operation is needed an outage card may be submitted. BPA would be the facilitator of the change to the Master File.

USACE EIM Questions from 5/6/19

19. Grid Mod, BPA's high side metering initiative: have decisions been made for Ice Harbor and Bonneville First Powerhouse on where meters will be installed? COE is still getting some requests for info from BPA Transmission and we are unclear if BPA is still considering installing high side meters on COE property or if the information requests have to do with cost/benefit analysis and justification for installation on BPA property.

BPA is still considering high-side metering for both BON and IHR. We need additional information to identify and evaluate a path forward. BPA has identified technically preferable options for both BON and IHR high-side metering that does not include installation of equipment at USACE facilities.

The additional requests USACE has received encompass both high-side metering for Grid Modernization and data required for participation in the EIM should BPA make that decision. The Phase 1A requests below will assist with cost and preferred option identification and evaluation for recommendations to BPA Executives.

BON and IHR identification and evaluation of metering options – includes high-side metering by BPA and or low-side metering upgrades by USACE

BPA requested and received an update to the low-side metering from USACE covering material and installation only

BPA will be requesting IHR (Ice Harbor) Phase 1A scoping of requirements for low-side metering upgrade with

BPA will be requesting BON (Bonneville) Phase 1A scoping of requirements for low-side metering upgrade

BPA requests USACE to continue maintenance and replacement of existing assets as needed/scheduled

Also supports EIM data requirements for Settlement Quality Meter Data (SQMD)

BPA has already requested for BON and IHR metering inventory data and confirmation of metering one-line on 3/22/2019 (see attached email)

- This request is a resource draw for USACE
  - BPA has requested data required for the SQMD (settlement quality meter data) that includes:
    - Meter: Model & Manufacturer
    - CT/PT ratio
    - CT/PT accuracy
  - BPA requires all the information in the purple cells, although with any adjustment factors or calculations done in GDACS
  - BPA's estimate is approximately 24 hours per meter for data collection and documentation
    - Includes travel time to and from sites as required
- BPA did not provide a due date for the response – we would like to know when USACE will be able to respond to the request
- BPA is currently planning to engage all federal NPRs for a data call to complete required SQMDs
  - No schedule has been identified for this data call
  - Likely targeting late FY19 to start consistent with the target schedule for the ROD by the Administrator



3-Agency EIM Discussion

Federal Columbia River Power System

May 6, 2019

9am – 11am

Steve Kerns
Business Transformation Office
Grid Modernization - EIM Director – EIM Core Team Lead

Agnes Lut
Business Transformation Office
EIM – Grid Mod Stakeholder Engagement Lead and Liaison to USACE & USBR – EIM Core Team

Todd Kochheiser
Transmission Operations
EIM Core Team

BPA HQ conf room 160E/W
Call in #
503-230-4000
Passcode: (b)(2) *updated*

BPA-2020-00700-F0208

Agenda

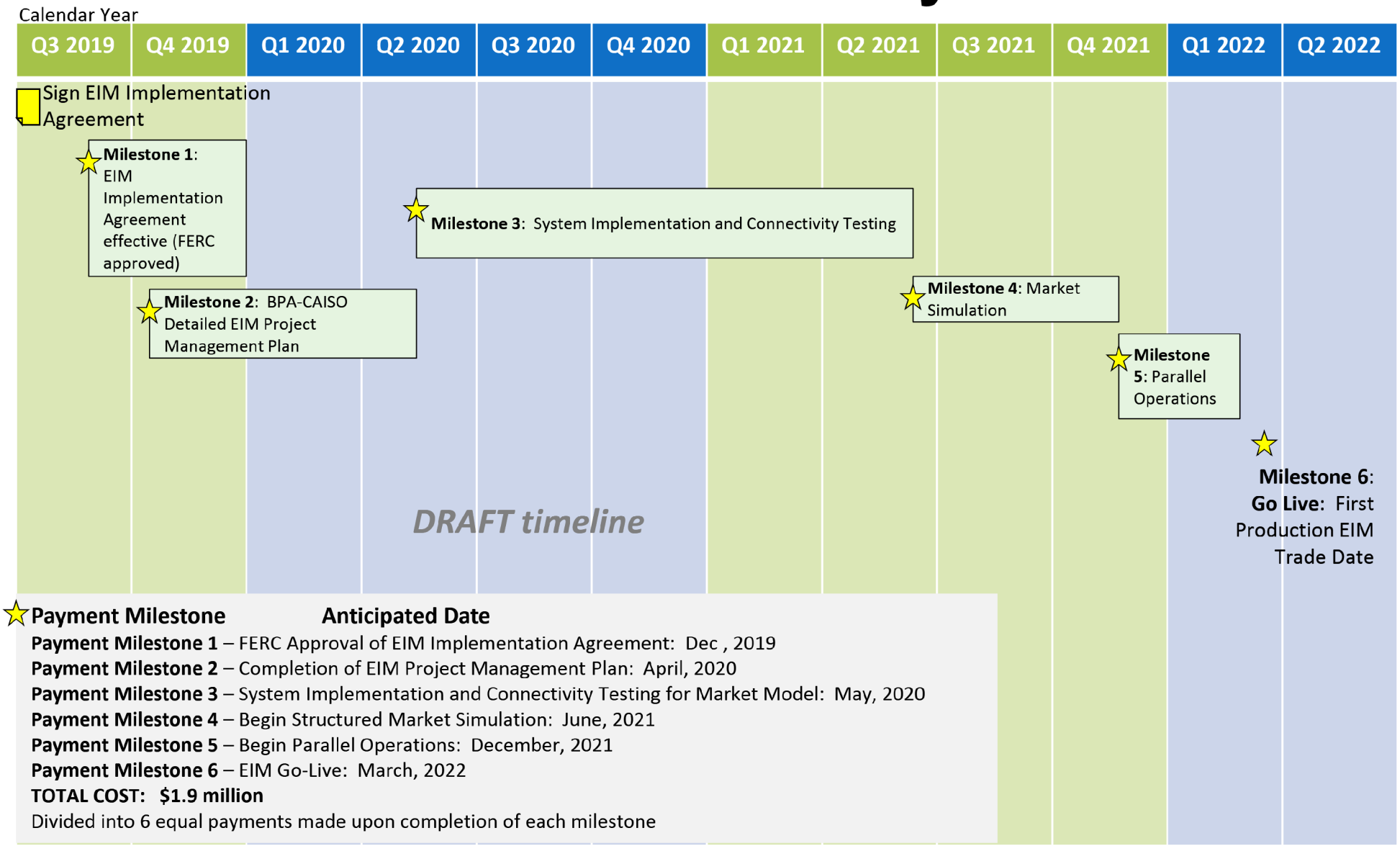
9-10 am

1. Timeline Review
2. EIM Cost Benefit Analysis Update
3. EIM Schedules / Bids / Timing

10-11am

Question / Answer and Discussion

CAISO EIM Milestones and Payment Schedule



Payment Milestone **Anticipated Date**

Payment Milestone 1 – FERC Approval of EIM Implementation Agreement: Dec , 2019
Payment Milestone 2 – Completion of EIM Project Management Plan: April, 2020
Payment Milestone 3 – System Implementation and Connectivity Testing for Market Model: May, 2020
Payment Milestone 4 – Begin Structured Market Simulation: June, 2021
Payment Milestone 5 – Begin Parallel Operations: December, 2021
Payment Milestone 6 – EIM Go-Live: March, 2022
TOTAL COST: $1.9 million
Divided into 6 equal payments made upon completion of each milestone

EIM Cost Benefit Analysis Update

- In 2017, BPA performed an initial Cost/Benefit Analysis for joining the EIM that indicated the following:
  - ~$10M in annual dispatch benefits, net of ongoing costs and opportunity cost
  - A variety of qualitative Transmission benefits
  - ~$35M in startup costs

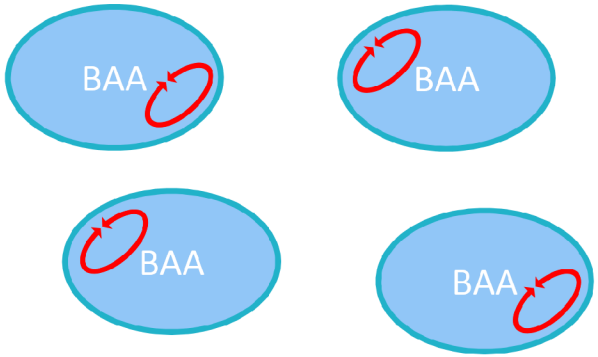
- We're updating the business case to achieve multiple objectives
  - Utilize an approach consistent with almost all potential and current EIM participants
  - Evaluate benefits in multiple scenarios
  - Refresh market assumptions and cost estimates
  - Flesh out Transmission benefits, potentially quantifying some of them
  - Provide more comprehensive support for an EIM-related ROD

- Steps taken to date
  - Contracted with E3 to perform an "industry standard" Benefits Analysis
  - Reviewing and updating cost estimates provided by Utilicast in 2017

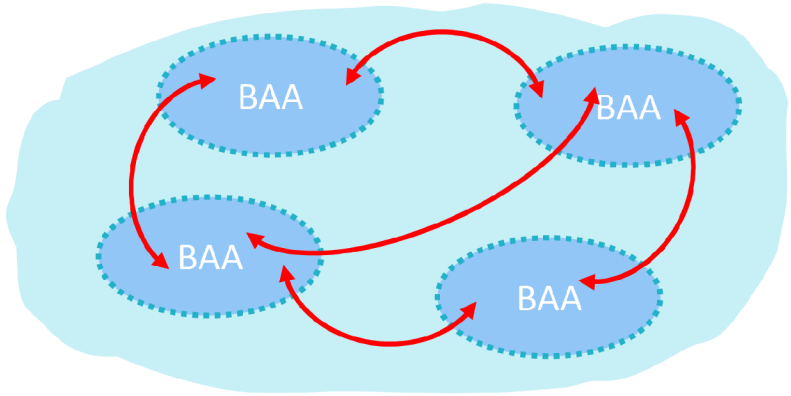
- Expected timeline at upcoming EIM stakeholder meetings:
  - May 2019: Share draft results and request feedback
  - June 2019: Discuss customer comments

EIM Summary

Without EIM:
Each BA must balance loads and resources within its borders.



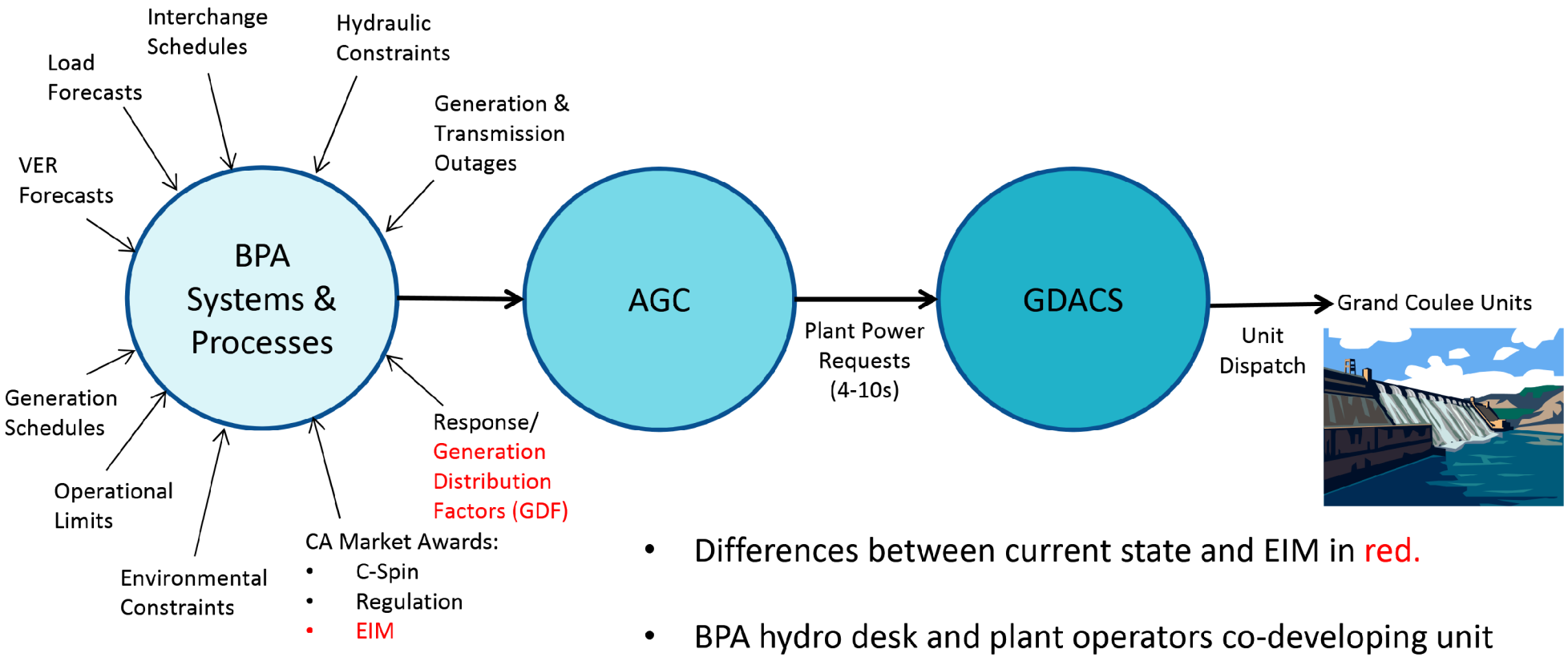
With EIM:
The market informs BPA hydro duty schedulers of dispatches across BAAs to balance demand



EIM Benefits

- Reduce costs by serving imbalance and load from most economic resources
- Enhances reliability by improving system visibility and responsiveness to planned and unplanned events
- Results in more efficient dispatch of resources within/between BAAs
- Leverages geographical diversity of loads and resources in the market footprint
- Congestion Management

Current State vs EIM Operations



- Differences between current state and EIM in red.
- BPA hydro desk and plant operators co-developing unit loading plans to inform market bidding will enhance the value.
- We don't anticipate any changes to GDACS will be necessary to join the EIM.

FCRPS Generation Projects

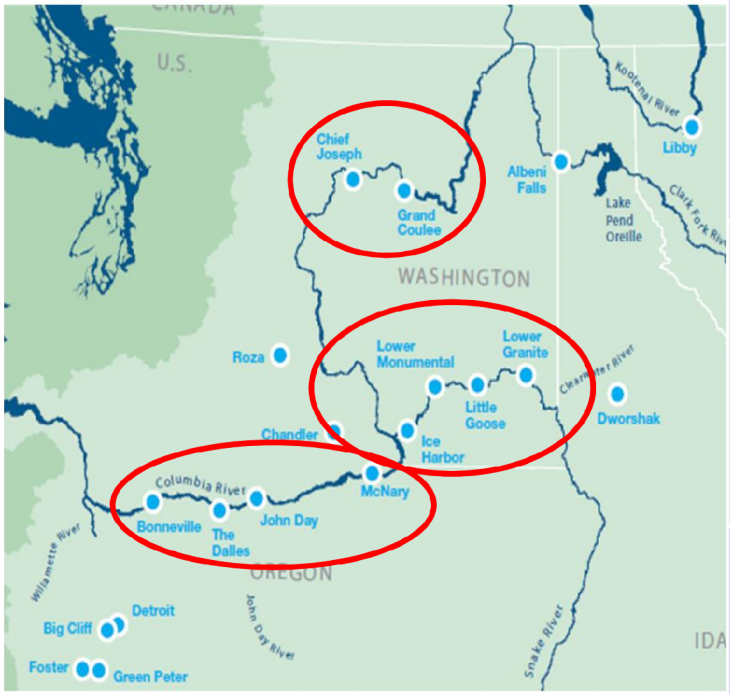


- **Big 10 Projects**: Grand Coulee, Chief Joseph, McNary, John Day, The Dalles, Bonneville, Lower Granite, Little Goose, Lower Monumental, and Ice Harbor.

- **Non-Big 10 Projects**: include headwater projects, Willamette projects, Palisades, Upper Snake projects, and CGS.

EIM Generation Participation

Comparison of FCRPS Participation Alternatives :



Participation Alternative	Pro	Con
One Aggregate	• Most similar to current way of optimizing FCRPS	• The least efficient congestion relief • Lack of additional revenue associated with differential LMPs
Three Aggregates	• More efficient congestion relief • Additional revenue associated with differential LMPs	• May not fully realize congestion relief and revenue benefits
Project Level	• Most efficient congestion relief • Additional revenue associated with differential LMPs	• More complexity, which increases the risk that BPA may, through its bids, operate the FCRPS less efficiently.

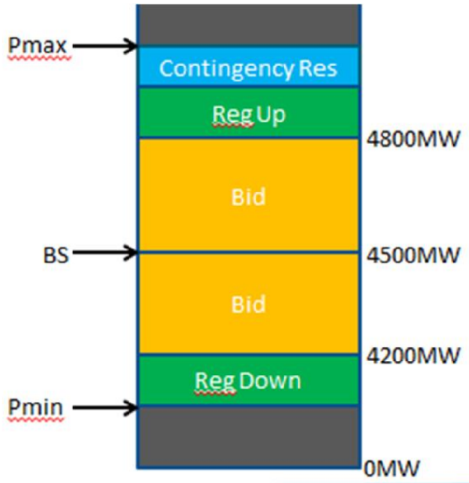
EIM Generation Participation

Traditional APR Setup:

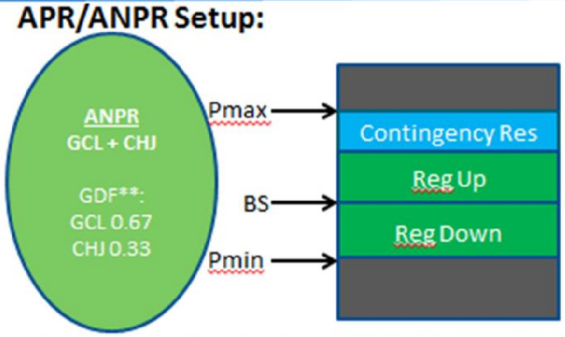


*GDF is calculated based on Base Point. GDF controls the distribution of MW for both BS and bid range.

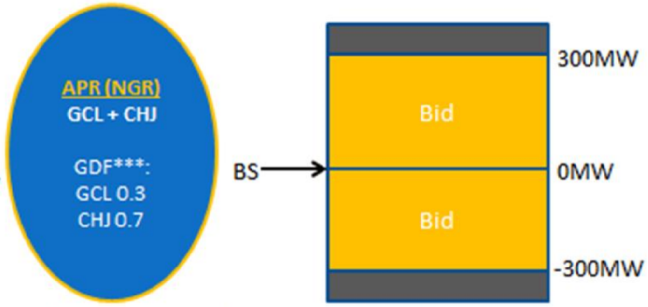
	BP (MW)	GDF
GCL	3000	3000/4500 = 0.67
CHJ	1500	1500/4500 = 0.33
SUM	4500	1



APR/ANPR Setup:



**Controls the distribution of MW for BS (input to EIM network model)



***Controls the distribution of MW for bid range

Base Schedule

- Generation and Interchange must equal Load.

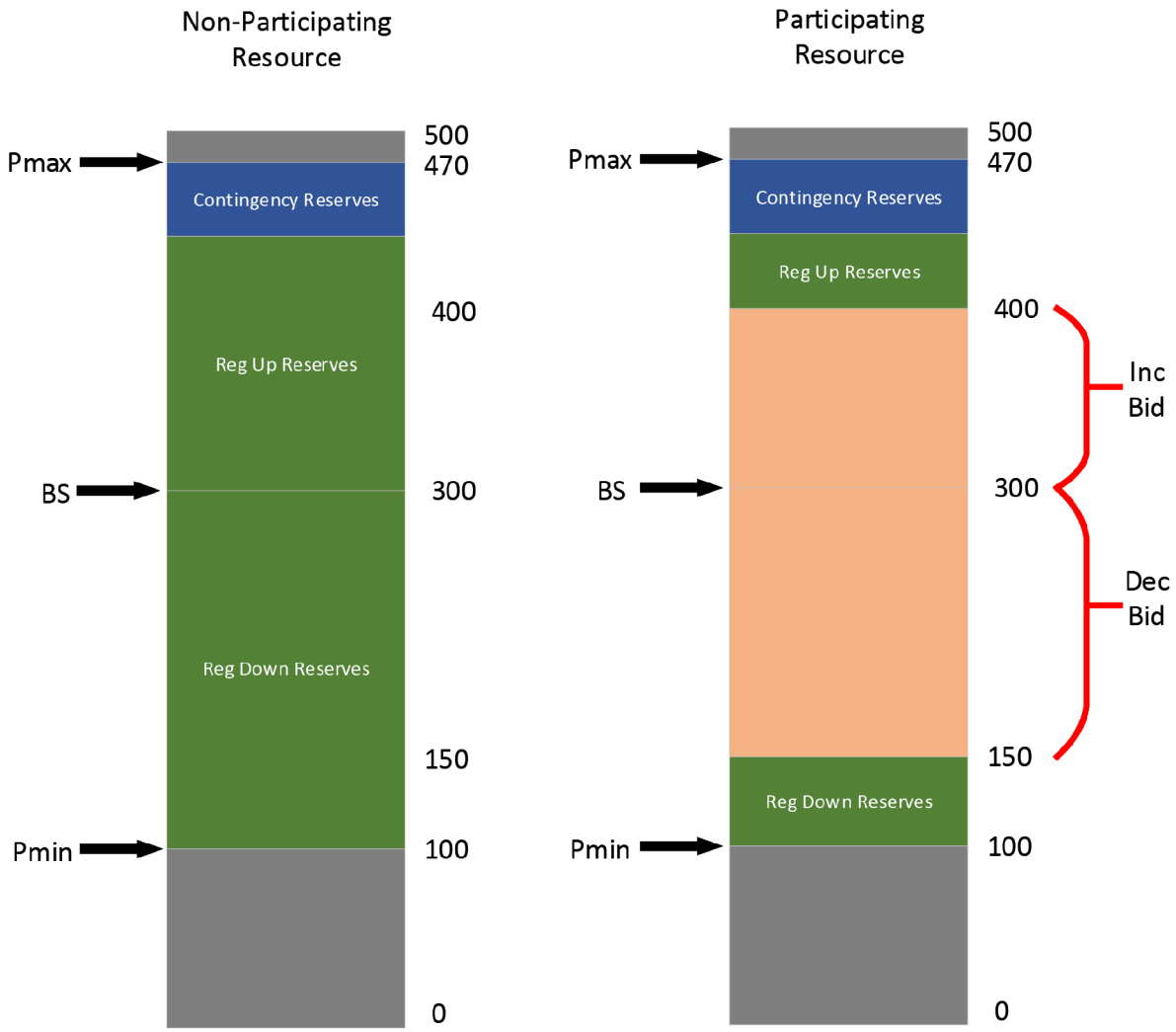
$$G + I = L$$

- Submitted T-75, T-55, and T-40 ahead of the hour.
- Solely used as initial starting points of units and to pass hourly sufficiency tests.

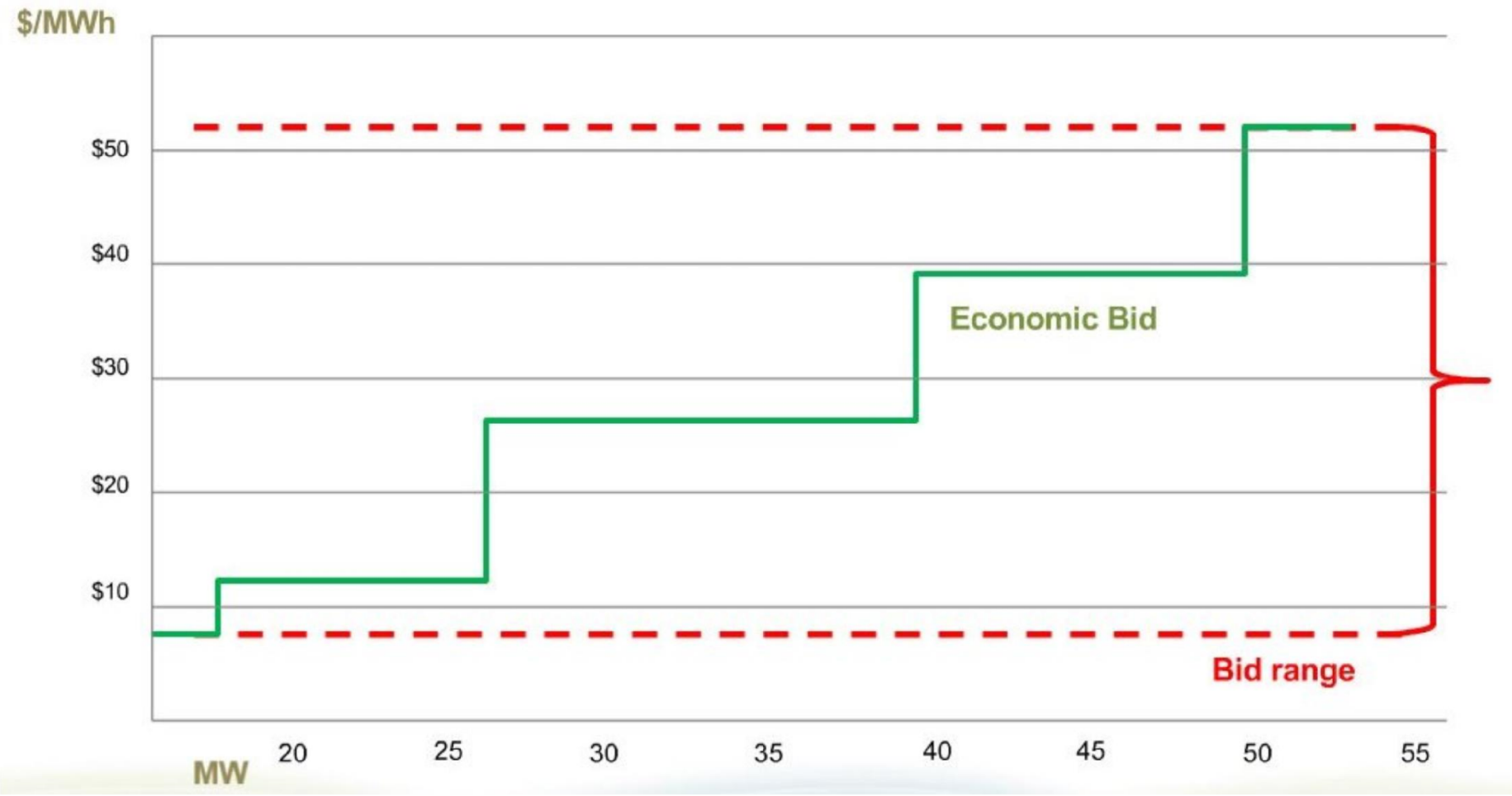


Bids

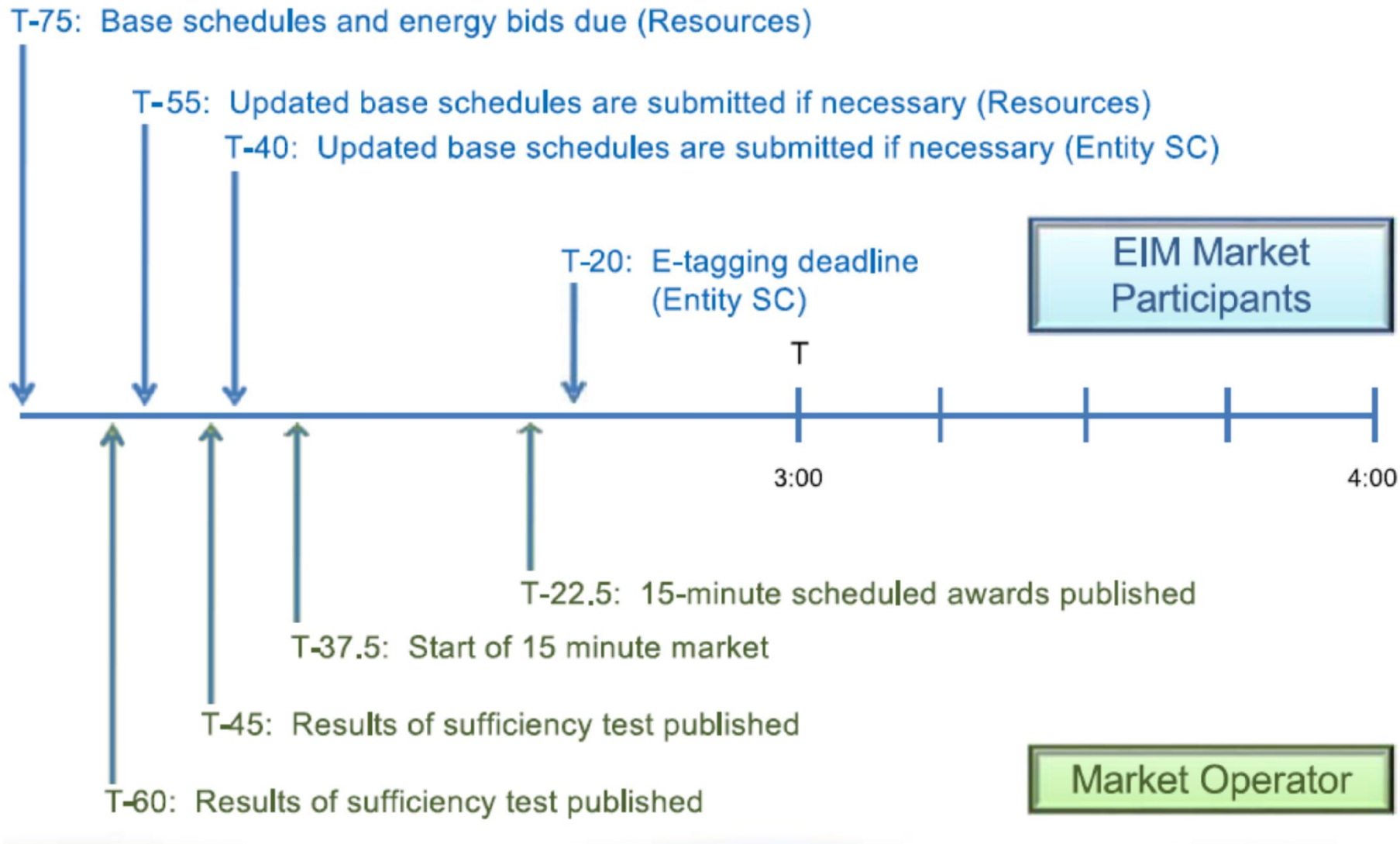
- Non-Participating vs Participating Resources
- Bids submitted by T-75
  - Cannot change bid after T-75
  - Locked for 135 minutes



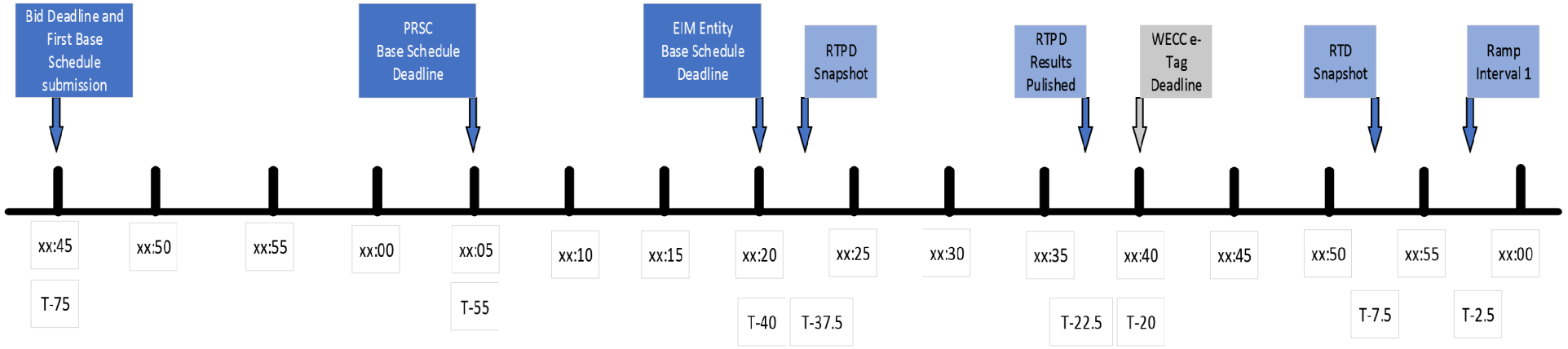
Bids


$/MWh
$50
$40
$30
$20
$10
Economic Bid
Bid range
20
25
30
35
40
45
50
55
MW

Base Schedule Timing



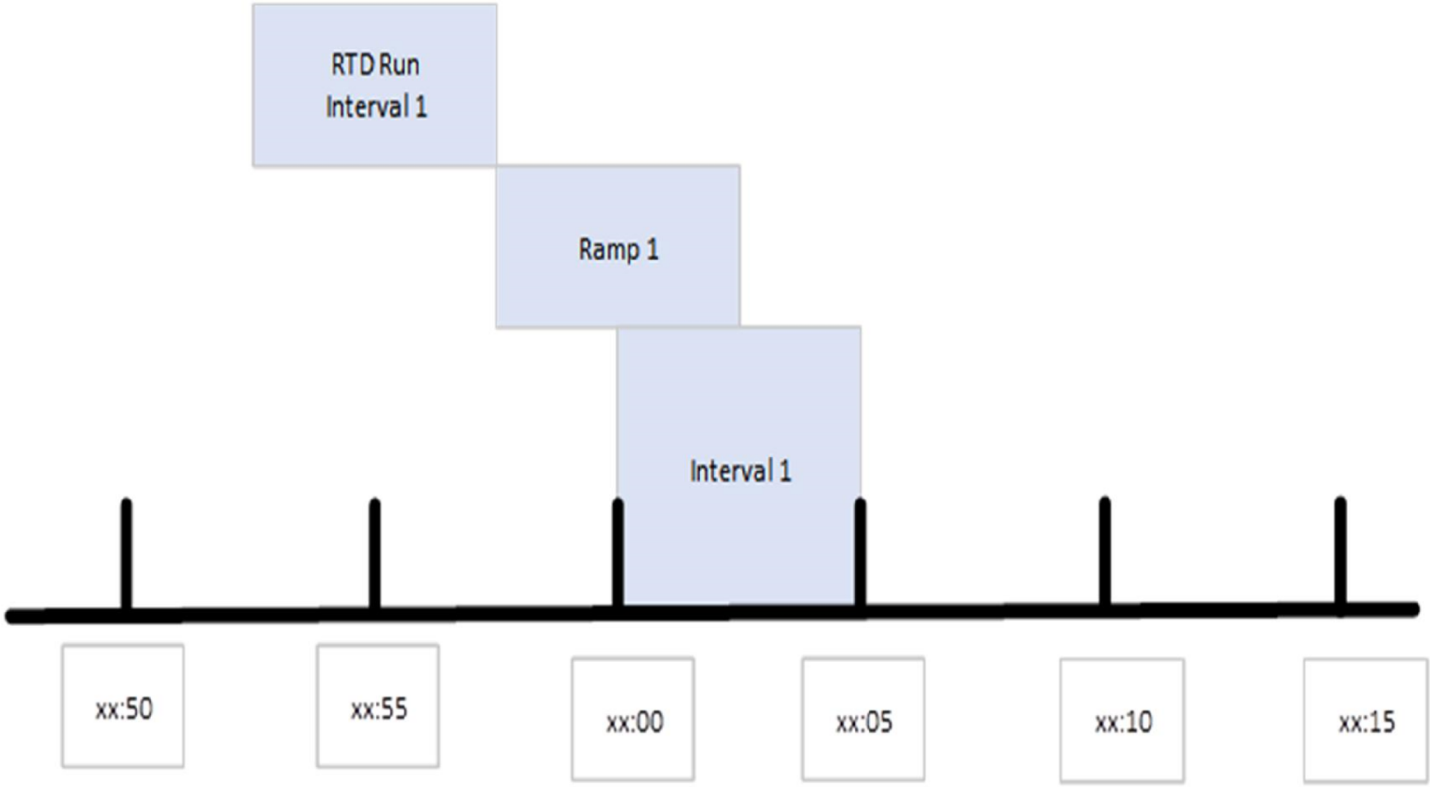
Base Schedule Timing



- Bids are locked 75 minutes before the hour
- Participants' Base Schedules deadline is 55 minutes before the hour
- EIM Entity's Base Schedules deadline is 40 minutes before the hour

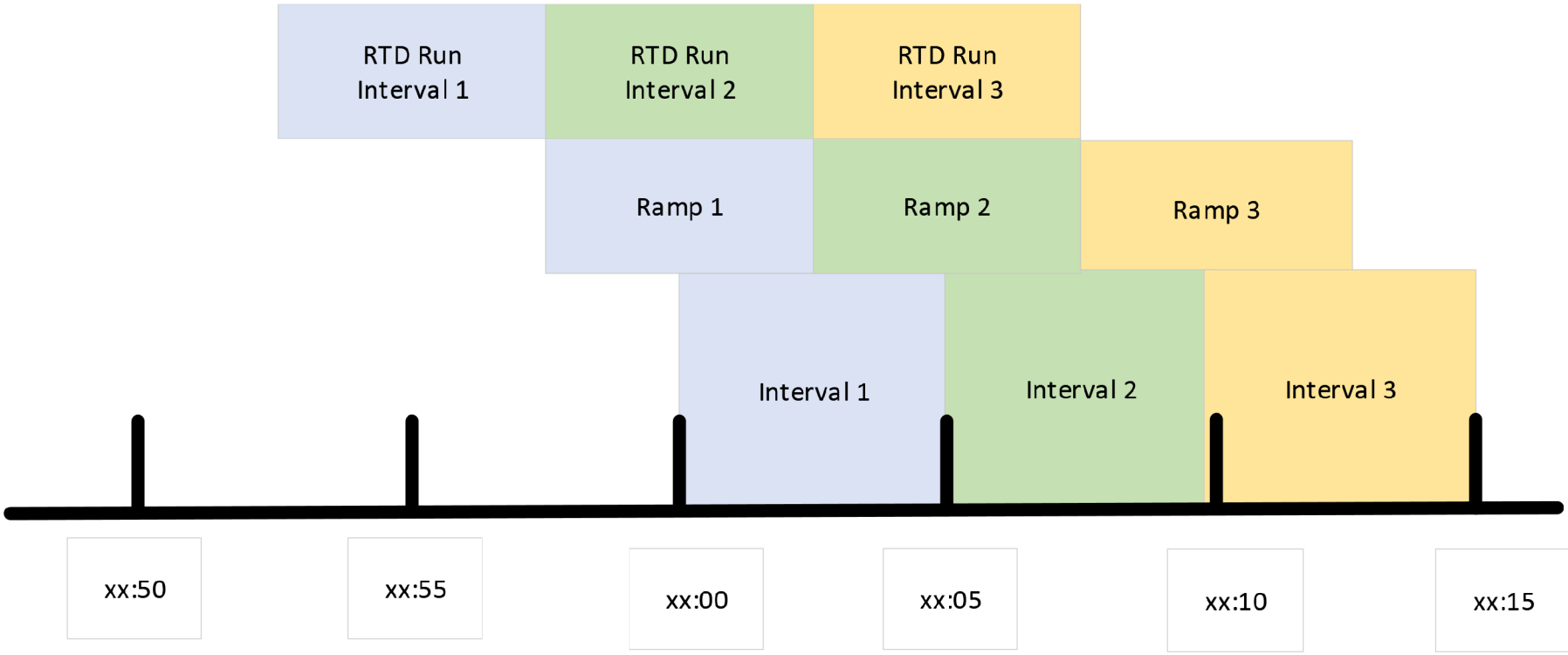
Used for proof that market is not performing BAL compliance for the Entity BA

One RTD 5-Minute Run

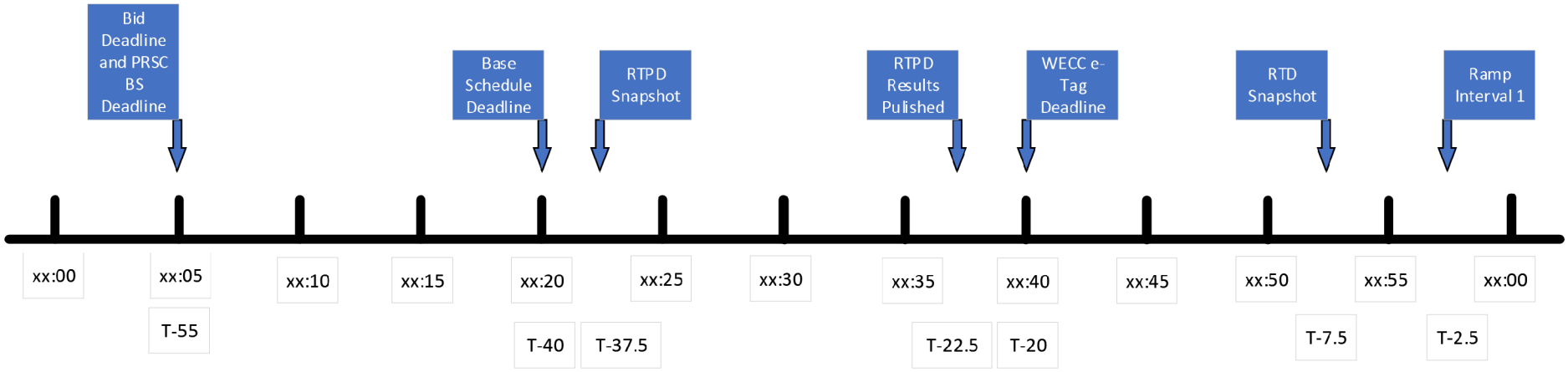


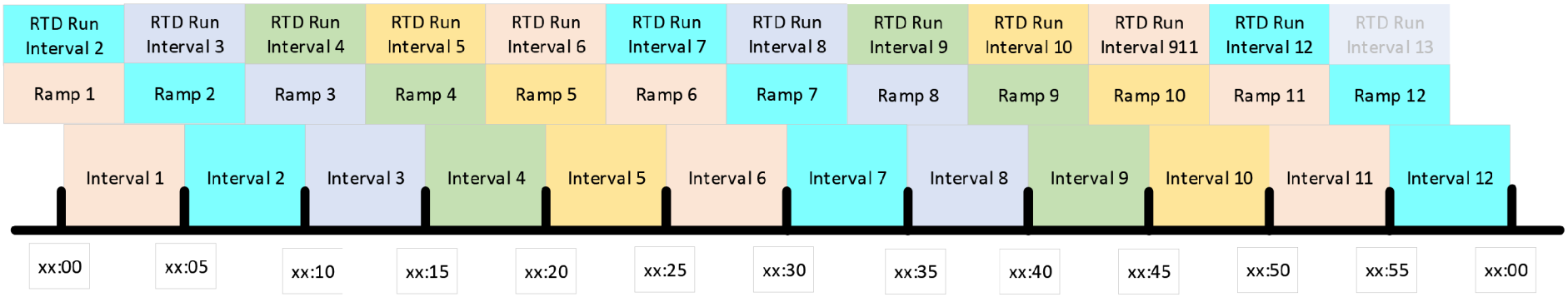
- Market begins calculation 7.5 minutes prior to the 5-minute market interval and publishes results 1-2 minutes prior to ramp
- Solution provides the target for the middle of the interval that resources are expected to ramp to (i.e., Dispatch/Desired Operating Target or DOT)

Continuous RTDs



Within the Hour





Next Steps

- Schedule next 3-Agency EIM meeting
  - BPA would like us to meet bi-weekly, and to have more regular check-ins
  - May 20th 9-10:30 am OR June 3rd 9-11am
- Continue weekly Monday morning EIM coordination call with Florence, Coleman, Shawn, John and Agnes.
- Build EIM Knowledge
  - Targeting Go-live in early 2022
  - Federal Resource Participation will be aggregated into three zones
  - No changes to GDACS are required for participation
  - BPA hydro desk and plant operators co-developing unit loading plans to inform market bidding will enhance the value of market participation

Appendix

USACE EIM Questions from 4/1/19

- We talked about these at the April 1, 2019 meeting, but BPA would like to provide written responses to the questions submitted to date:
  1. What are the impacts to operations staff (including dispatch communication) if BPA enters the EIM 5-minute dispatch market?
  2. What are the impacts to generators (particularly start/stop) if BPA enters the EIM market?
  3. What are the cyber security compliance issues?
  4. How does the increased revenue from EIM feed the increases in O&M & asset capital costs?
  5. Will BPA still get an EIM benefit if generator start/stops are kept as is (as a starting point until O&M, capital, & compliance impacts are understood)?
  6. In the long term, how integral is centralized dispatch/control to the benefits of EIM?
  7. If BPA takes the next step forward with EIM this summer, what is the Corps/Reclamation support required for the 6 EIM projects that will start at that time? What are key milestone dates for the Corps to note?

USACE EIM Questions from 4/1/19

1. **What are the impacts to operations staff (including *plant* dispatch communication) if BPA enters the EIM 5-minute dispatch market?**

BPA hydro duty schedulers and dispatchers would continue current coordination and communication with dam operators (plant dispatchers). However, the EIM will require increased coordination and communication to understand the plant capability. Prior to the hour, before you bid (T-75), BPA will want to make sure that the bidding strategy accurately reflects the expected capability of the plant. The real-time communications, within hour, would change very little and primarily consist of AGC to GDACS communications, similar to today.

USACE EIM Questions from 4/1/19

2. What are the impacts to generators (particularly start/stop) if BPA enters the EIM market?

Impacts to generators would be controlled by BPA's bid strategy and how the hydro resources are modeled in the market. Should BPA join the EIM, BPA will be responsible for the development of bidding strategies. BPA will work with USACE and USBR to evaluate whether or not these strategies are resulting in unnecessary additional wear-and-tear and may adjust our bidding strategy accordingly. The Master File would define operational characteristics including ramp rates and operating limits that may be static or driven by seasonal constraints. The Master File is updated annually, and as needed with 2-3 days notice if long term de-rates occur. For immediate unit changes, outage cards can also be used to further limit capabilities.

BPA's cost benefit analysis, to be released in May, accounts for bidding in only the current spin capacity of the Big-10, and did not assume additional starts / stops of units.

USACE EIM Questions from 4/1/19

3. What are the cyber security compliance issues?

BPA's EIM participation is not expected to have any additional cyber security compliance issues for USACE and USBR.

4. How does the increased revenue from EIM feed the increases in O&M & asset capital costs?

The cost of doing business will be reflected in BPA's EIM bids into the market, as BPA's current market participation does today. Revenue from this market will support keeping BPA's rates low and maintain BPA's sound business model that will ensure a long term funding stream for O&M and capital programs.

All the EIM benefits don't necessarily got to BPA, some will go directly to participating units within the BPA BA.

USACE EIM Questions from 4/1/19

5. **Will BPA still get an EIM benefit if generator start/stops are kept as is (as a starting point until O&M, capital, & compliance impacts are understood)?**

Yes. BPA's cost benefit analysis, being released in May, modeled that only the current spin capacity would be bid into the EIM. BPA would not be bidding in capacity required for regulation. BPA will be presenting its updated cost benefit analysis at the May 15 EIM Stakeholder Meeting.

6. **In the long term, how integral is centralized dispatch/control to the benefits of EIM?**

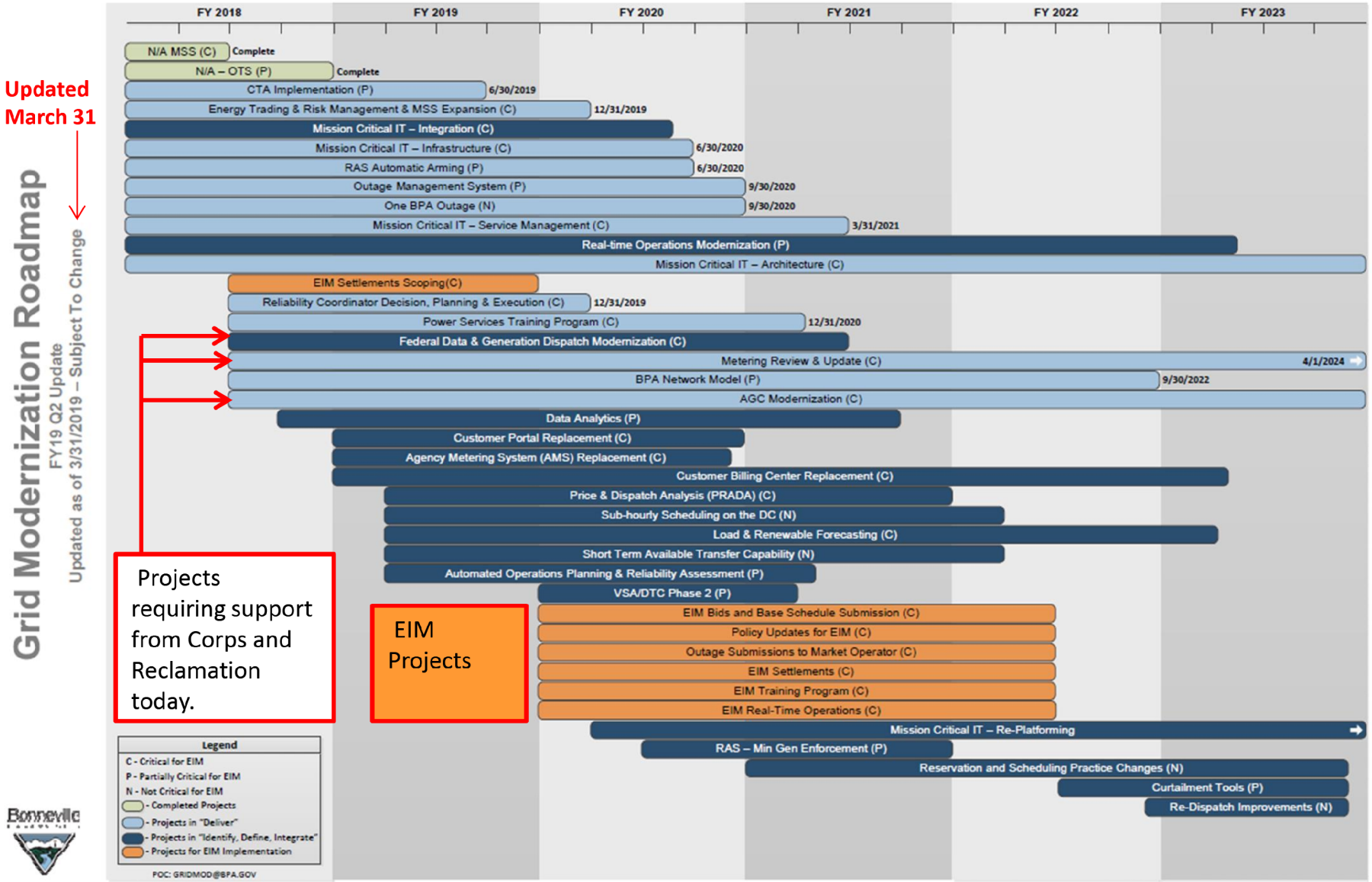
Centralized dispatch is not integral to EIM. It is not required to capture the benefits of EIM participation.

USACE EIM Questions from 4/1/19

7. **If BPA takes the next step forward with EIM this summer, what is the Corps/Reclamation support required for the 6 EIM projects that will start at that time? What are key milestone dates for the Corps to note?**

BPA has not yet determined to what extent USACE and USBR support will be required to support the 6 EIM projects on the current Grid Modernization Roadmap. However, BPA does anticipate that USACE and USBR will be involved with BPA leading the coordinated development on unit operations for EIM but this effort is expected to *not* be significant. This information will inform the operations for each of the Big-10 projects that would participate in the market. This work would need to be completed before the end of end of Q-3, before start of Milestone 4.

Grid Modernization Roadmap: Strategic and prioritized investments



https://www.bpa.gov/goto/GridModernization

https://www.bpa.gov/goto/EIM

EIM Resources

- BPA's EIM 101 training from the August, 2018 EIM Stakeholder meeting:

YouTube Video: https://www.youtube.com/watch?v=ChYJRXElADk&feature=youtu.be

Slide deck: https://www.bpa.gov/Projects/Initiatives/EIM/Doc/20180913-September-13-2018-EIM-101-Workshop.pdf

- CAISO Western EIM general info website:

https://www.westerneim.com/

- CAISO EIM Computer Based Trainings:

https://www.westerneim.com/Pages/Resources.aspx

- BPA's EIM Initiative website

https://www.bpa.gov/Projects/Initiatives/EIM/Pages/Energy-Imbalance-Market.aspx

- BPA's Grid Modernization website:

External https://www.bpa.gov/Projects/Initiatives/Grid-Modernization/Pages/Grid-Modernization.aspx

Internal https://internal.bud.bpa.gov/Agency/Pages/Grid-Modernization.aspx

- Centre for Energy Advancement through Technological Innovation (CEATI) https://www.ceati.com/

CEATI EIM Working Group, contact Miles Bell Hydro Programs Coordinator: Miles.Bell@ceati.com

3 Agency EIM Meeting
Corps of Engineers questions for 5/6/19 meeting

1. **How does BPA plan on changing generation dispatch to COE Operating Projects for EIM participation?**

, The short answer is that BPA intends to change the generation dispatch to realize the value of the flexibility that sits currently unused. However, BPA does not intend on Day 1 to submit bids that will results in unit starts/stops that could increase maintenance costs. Instead, BPA intends to start with only bidding surplus spinning capability into the EIM, and, after BPA and the project operators gain experience, consider bidding additional non-spinning flexibility at a later time. Also, it is expected that there would be no changes to GDACS with EIM Participation. See slide 6 from the May 6, 2019 slide deck.

2. **What differences in generator operation at Big 10 plants does BPA envision as a result of EIM participation? I.e. how much can we actually vary from current operations due to the myriad of constraints that we operate under (ESA, BiOp, water management, etc.)? (Use of current level of extraneous spinning reserves only, which would be identified through Grid Mod initiatives?)**

It is difficult to answer this and the previous question regarding current operations absent a benchmark on how to describe current operations. In general, though, operations will be consistent with any constraints or obligations on the system, such as BiOp, water management. The amount of FCRPS flexibility that is bid into the market is under BPA's control.

3. **Does BPA envision differences how each of the 3 aggregated nodes (LCR, Snake, UCR) would participate in the EIM?**

BPA would be adjusting market bids and Generation Distribution Factors (GDFs) at each of the aggregations to reflect market conditions, spinning capacity available, and consideration of non-power obligations (e.g., BiOp, water management). In general, like today, the majority of the within hour flexibility resides at LCR and UCR projects, so we would expect those projects to be utilized by the market most of the time.

4. **Does the difference in price for generation at different Operating Projects affect which aggregated nodes (and which Projects within each of the nodes) will be called upon for 5 min dispatch?**

Yes, the Locational Marginal Price (LMP) for each aggregation is a product of each project's individual LMP and GDFs. (see question 3 above for context on GDFs) Congestion would influence the LMPs, but if there is no congestion on the transmission system then the LMPs would be similar. If the LMPs are different, the lower cost aggregation zones would be called upon first.

5. **How will EIM participation affect slow rolling units for fish (10 minutes before it hits the grid)?**

There would be no impact. Slow rolling fish units would be operated in the same manner they are today, to meet FCRPS BiOp fish passage and annual Fish Passage Plan obligations.

6. **What does BPA need from the COE in order to join the EIM other than completion of COE actions related to Grid Mod initiatives? E.g. a team to participate in Master File database creation during milestone 3 of the BPA-CAISO implementation process.**

The non-EIM Grid Mod initiatives that the USACE and USBR will be engaged in contain no "must-haves" for EIM participation. However, some of this work (installing high-side metering, collaborating on unit-loading plans, etc…) would enhance the value of EIM participation. In addition, BPA would lead and USACE and USBR would participate in the development of the Master File database Resource Data Template (RDT) files. Additionally there would be continued coordination on the Grid Modernization projects currently in flight (metering, AGC, FDGDM). It will be necessary to continue the current coordination / communication as per the Three Agency Coordination Plan to ensure target dates and deliverables are met.

7. **Please confirm that there are no direct costs to the COE to join EIM (BPA is solely responsible for the milestone payments to CAISO).**

Correct. There are no direct costs to USACE or USBR from BPA joining the EIM.

8. **How does BPA envision involvement in the EIM will change unit start/stops and/or ramp rates for participating resources?**

BPA plans to initially participate with surplus spinning capacity held at the Big-10 FCRPS projects with the intent to minimize unit start / stops. BPA has the ability to model ramp rate restrictions in the RDTs. But the market does values responsive resources with large ramp rates.

9. **How will EIM participation affect outage scheduling? Could participation in the 5 min market necessitate "last minute" renegotiation to change the start or stop times of scheduled / approved outages?**

BPA does not foresee any changes to outage scheduling procedures. However, through the Grid Modernization outage projects (e.g., OTS, OMS) the FCRPS would gain visibility into more effective, coordinated and better managed outages to meet the multitude of obligations on the system.

10. **Are there rough zone or turbine limits to consider for EIM participation?**

The RDTs will identify any rough zone and turbine limitations, but they may not apply due to BPA EIM participation of using the 3 aggregates.

11. **How will EIM participation affect running units with respect to the 1% limits turbine efficiency limits?**

BPA would not be dispatching units, thus the 1% limits on turbine efficiency would hold due to BPA's EIM participation of using the 3 aggregates.

12. **How many plant set points will be required for EIM participation at each Operating Project?**

BPA does not expect the number of set points to change from the current methodology and process.

13. **What new instrumentation at Operating Projects will be necessary for EIM participation? Are new instrumentation requirements being identified and addressed through Grid Mod initiatives?**

Metering instrumentation will be necessary, please see question 19 below. Although other instrumentation may be needed as part of FDGDM, however that team is still evaluating that.

14. **Will the COE need to develop a calibration program for new or existing instrumentation? If so, when will that be required?**

If BPA installs the high side metering then the maintenance program would be BPAs responsibility.

15. **Will EIM introduce any new penalties for not having enough spinning reserve or shutdown reserves?**

There are no penalties in the EIM due to lack of flexibility, but it does reduce the level of participation in the market and reduced revenues during times when BPA would not pass the Resource Sufficiency tests.

16. **Does this change our regulatory compliance with WECC in any way? E.g. compliance issues related to spinning reserves?**

No. WECC compliance would not be changed with EIM participation. BPA would not be bidding in contingency reserves.

17. **Please confirm Milestone dates for EIM implementation.**

The completion of Milestone 3 (currently scheduled for CY Q2 2021 completion) will mark the time when the Master File RDTs and unit loading plans will need to be completed to move to the next phase, Market Simulation (Milestone 4). The first market participation day is planned for March 1, 2022.

18. **What will the Corps' role be in shaping BPA's bid curve and/or utilizing that to recoup the costs of additional component degradation that might result from 5 min dispatch?**

Should BPA join the EIM, BPA will be responsible for the development of bidding strategies. BPA will work with USACE and USBR to evaluate after-the-fact whether or not these strategies are resulting in unnecessary additional wear-and-tear and may adjust our bidding strategy accordingly.

19. **Grid Mod, BPA's high side metering initiative: have decisions been made for Ice Harbor and Bonneville First Powerhouse on where meters will be installed? COE is still getting some requests for info from BPA Transmission and we are unclear if BPA is still considering installing high side meters on COE property or if the information requests have to do with cost/benefit analysis and justification for installation on BPA property.**

BPA is still considering high-side metering for both BON and IHR. We need additional information to identify and evaluate a path forward. BPA has identified technically preferable options for both BON and IHR high-side metering that does not include installation of equipment at USACE facilities.

The additional requests USACE has received encompass both high-side metering for Grid Modernization and data required for participation in the EIM should BPA make that decision. The Phase 1A requests below will assist with cost and preferred option identification and evaluation for recommendations to BPA Executives.

BON and IHR identification and evaluation of metering options – includes high-side metering by BPA and or low-side metering upgrades by USACE

- BPA requested and received an update to the low-side metering from USACE covering material and installation only
- BPA will be requesting IHR (Ice Harbor) Phase 1A scoping of requirements for low-side metering upgrade with
- BPA will be requesting BON (Bonneville) Phase 1A scoping of requirements for low-side metering upgrade
- BPA requests USACE to continue maintenance and replacement of existing assets as needed/scheduled

Also supports EIM data requirements for Settlement Quality Meter Data (SQMD)

- BPA has already requested for BON and IHR metering inventory data and confirmation of metering one-line on 3/22/2019
    - This request is a resource draw for USACE
        - BPA has requested data required for the SQMD (settlement quality meter data) that includes:
            - Meter: Model & Manufacturer
            - CT/PT ratio
            - CT/PT accuracy
        - BPA requires all the information in the purple cells, although with any adjustment factors or calculations done in GDACS
        - BPA's estimate is approximately 24 hours per meter for data collection and documentation
            - Includes travel time to and from sites as required
    - BPA did not provide a due date for the response – we would like to know when USACE will be able to respond to the request
    - BPA is currently planning to engage all federal NPRs for a data call to complete required SQMDs
        - No schedule has been identified for this data call
            - Likely targeting late FY19 to start consistent with the target schedule for the ROD by the Administrator

20. Master File database ownership: BPA-ISO Implementation Agreement alludes to Master File as owned by the ISO. If BPA and COE join the EIM, does the COE retain the right to update the Master File database for its generation assets when / as it deems necessary?

BPA would be the entity joining the EIM since it is a market, not USACE or USBR. BPA's role is to market and transmit the power generated by the FCRPS projects in accordance with Bonneville's statutory directives to meet power customer loads and provide an adequate, efficient, economical, and reliable power supply.

The Master File can be updated as necessary with 2-3 days for the change to take place. If immediate change to generator operation is needed an outage card may be submitted. BPA would be the facilitator of the change to the Master File.

21. During spill season, currently it is reported that at operating projects operating to hourly spill amounts set based as a percent of total outflow, BPA sets spill levels at most projects twice an

hour, and hourly at The Dalles. Required tolerance of these operations is plus or minus 1 percent. Several of the Federal dams maintain the +/- 1% while also providing system reserves. We have been assured that these operations will not change if BPA enters the EIM. We request a plain language explanation for the Technical Management Team (TMT) of how BPA will manage within hour variability to achieve hourly spill requirements. Is the current adaptive management approach (i.e., TMT) adequate for evaluating unintended consequences of EIM?

Yes, the current adaptive management approach is adequate for evaluating unintended consequences of EIM participation. BPA's power marketing services and activities and power demand changes would be conducted consistent with the 2019 NOAA Fisheries CRS Biological Opinion and would be within existing operating constraints and normal operating limits of FCRPS projects.

USACE Questions for BPA for 04 June 3-Agency EIM Discussion meeting:

1. **Dave Brown's comments from Combined JOC: no additional unit starts/ stops; volatility should be negligible but time of day for actions will likely change; BPA will be providing 2 hr look ahead for dispatch targets (market changes, planned bids) - Projects will need to develop plans to inform BPA's bidding strategies. Q for BPA: What will these plans look like?**

BPA would like estimated unit loading/dispatch plans that include the expected number of units online and expected loading in order to meet the sustained plant output required for the 2 hour look-ahead for dispatch targets (MW requirement) and reserves. A project may have a portion of their generation resources identified as participating and a portion identified as non-participating. The exact content and format of the unit loading plan is not firmly established yet and BPA expects to work together with the USACE/USBR to define the content and format based on need for EIM participation including informing resource sufficiency tests and a successful bidding strategy. It is expected that the dispatch plan will need to be automated and be based on input from the plant operators in response to the look-ahead information that BPA will send to the plants.

2. **Dave Brown's comments from Combined JOC: Separating INC/DEC/Regulatory balancing reserves so they can be allocated to different projects and can be deployed independently; involves communication and coordination with Projects and RCC. Q for BPA: What operations / dispatch changes might result from Reserve Management modifications?**

With the separation of Increment and Decrement reserves used for balancing as well as the contingency reserves BPA can now hold and deploy the reserve types independently. What this means for the plant operator, is that based on time of year and river operation considerations, BPA will likely designate INC reserves be held and deployed at one project, DEC reserves held/deployed from a different project, and Contingency reserves held/deployed at yet another project. This will reduce the amount of up/down margin required at dynamic response projects since BPA will be able to spread it differently based on conditions. Additionally, Contingency reserves, which are infrequently deployed, can be held at projects that are base loaded since they will now be separate from balancing reserves. This added flexibility will result in finer control of river flows and minimize holding more reserves than are actually needed. Project operators will be able to see which type of reserve and the amount in MW that BPA is requesting be held at the project. It is expected that this will help inform the unit loading and plant operations. This change will be implemented in BPA AGC on June 18, 2019 and will be available for visualization at FCRPS GDACS projects sometime after that date.

An additional part of Reserve Management modifications will impact how reactive reserves are held. This will impact requirements for minimum generation and number of synchronized units to support voltage and grid stability. This change will not be occurring until FY21 time frame.

3. **From Agnes Lut's EIM overview at Combined JOC: BPA bids into EIM, dispatch order from CAISO; discretion of BPA hydro duty scheduler and project operators in how that dispatch order is spread among the projects in that aggregation. Q for BPA: What is the level of this discretion? Function of what is in the Master File, plant weightings pre-assigned within aggregated node, decision made at time of dispatch (by dispatcher and/or plant operator), or other?**

BPA would issue plant dispatch based on CAISO market awards to USACE / USBR for unit dispatch as we currently do. The discretion as to what and how much to dispatch is and will continue to be based on what flexibility is available at the projects after meeting the obligations on the FCRPS, such as Water Management Plan, Fish Passage Plan, Master File limitations, and any outage or de-rate limitations imposed on the system. It is anticipated that this flexibility will be limited to spinning capability when we start market participation.

4. Ice Harbor is not currently on AGC. How will this impact Ice's participation as part of the Lower Columbia aggregated node (high side metering issues aside)?

We have several options:

1. Exclude Ice Harbor from the aggregations – it would be a "non-participating" resource.
2. Set Ice Harbor's Generation Distribution Factor (GDF) to 0%

The most practical solution is probably #1. I don't see this as a big issue given the relative flexibility of Ice Harbor.

5. McNary is putting in 6 fixed blade units as part of their major rehab project, which can be anticipated to complicate EIM participation at that plant; having fixed blade units in the plant will decrease the flexibility for the other Kaplan units - as they reach the top of their range, will start a fixed blade and ramp the Kaplan unit(s) down; this will limit capacity and flexibility at that plant. (Also, alternatives involving use of fixed blade units at John Day as part of their future major rehab are being considered.) Has BPA considered this limitation in how they envision participating in EIM?

BPA has not explicitly quantified this limitation for our participation in the EIM. However, BPA understands that obligations and limitations of the system may change over time and we will remain flexible to manage those changes.

FOR INTERNAL USE ONLY

BPA talking points

BPA makes the business case for signing an implementation agreement as the next step to joining an energy imbalance market

June 2019

What this is

In July 2018, BPA began actively exploring becoming a member of the Western Energy Imbalance Market as part of its broader strategic plan to strengthen financial health and maintain a competitive edge in the utility landscape. BPA launched a stakeholder process at that time to determine how and under what conditions BPA could join the Western EIM operated by the California Independent System Operator.

BPA is issuing a Letter to the Region in June 2019 that will capture the business case for signing an implementation agreement with CAISO. The implementation agreement obligates BPA to spend funds specific to EIM participation. The letter also summarizes principles, proposes decisions on some specific issues and discusses the legal authority that are foundational to making this decision. BPA will open a 30-day public comment period on the letter. A Record of Decision will follow in September 2019.

The implementation agreement is the first of many decisions needed prior to BPA potentially joining the EIM. If the agreement is signed, then BPA will begin to spend money on EIM-specific projects identified in the Grid Modernization Roadmap as well as begin developing a detailed project plan with the CAISO to ensure the necessary systems, processes and training are in place prior to a proposed "go-live" date of March 1, 2022.

For more information, contact: Agnes Lut, 503-230-5651

Key messages

- The work by BPA to establish the processes and technology necessary for participation in the Western Energy Imbalance Market will give regional customers easier access to emerging markets. It could also reduce long-term transmission costs by potentially decreasing or delaying the need for system expansion.
- Selling surplus energy and capacity in the western markets is essential to keeping Bonneville's rates low.
- BPA must adapt its business model as energy markets evolve in order to remain competitive and continue to be a driver of economic prosperity for the Northwest.
- An independent, third-party cost-benefit analysis of BPA's potential participation in the Western EIM forecasts significant qualitative and quantitative benefit to BPA.
- While this is a significant step toward becoming a member of the Western EIM, several decision points and off-ramps exist if BPA determines participation in the EIM is detrimental to the agency, its customers or the Northwest.

Background

As BPA focuses on long-term financial health and continues its role as an economic engine in the Northwest, the utility landscape is evolving with new realities emerging. Variable energy resources are increasing across the West, creating opportunities to capture valuable flexibility and capacity services that clean hydropower can provide. Additionally, market developments are driving significant changes in transmission use for both customers and system operators. New visibility and congestion management tools are needed to help plan and operate the grid optimally.

These new tools and capabilities will help to more fully realize the value of the sub-hourly dispatch, flexibility and carbon-free hydro attributes of the Federal Columbia River Power System across an expanding energy imbalance market footprint. Much of the market drivers and technology behind the EIM are foundational to fast-evolving market opportunities like day ahead market enhancements.

In BPA's exploration of how and under what conditions it might join the Western EIM, BPA has identified the following 8 issues that need to be resolved or addressed:

- relationship of EIM to other emerging markets;
- balancing authority resource sufficiency;
- EIM settlements;
- market power;
- treatment of transmission;
- generation participation model for the FCRPS;
- governance; and
- carbon obligations in the EIM.

Since BPA began exploring the EIM, several of our bi-lateral trading partners have joined or begun the process of joining the market.

A third-party cost-benefit analysis of EIM participation by BPA suggests that dispatch benefits from the EIM participation would quickly pay for itself and result in ongoing net benefits range of $29-34 million[1]. Additionally, analysis has determined that EIM participation is a cost-effective tool for intra-hour congestion management that may defer the need for costly transmission builds.

EIM participation will result in efficient dispatch of generation to meet load across the entire EIM footprint, while providing BPA with increased visibility and discipline in the dispatch and marketing of federal power and transmission assets. This increased visibility of conditions across the grid will enhance reliability. As a member of the EIM, BPA would be able to effectively participate in the development of future markets that may appropriately compensate flexible resources for the services they provide.

[1] The $29-33.5M annual net benefit is based on stakeholder feedback which led us to consider alternate prices in the NW (PACW, PSEI, & PGE) in an attempt to more accurately simulate BPA's participation, where the previous $43M annual net benefit analysis used DGAP_BPAT prices.

The Western EIM is a voluntary market where each entity can choose whether or not to bid in resources. BPA can also voluntarily exit the market if market rules change and result in a negative impact to BPA.

Through its monthly EIM stakeholder meetings, BPA has received feedback on the public process moving forward. To that end, BPA is adding an additional opportunity beyond the implementation agreement for public comment with a close out letter in October 2021. This letter would represent the final and binding decision to join the EIM, with a proposed "go-live" date of March 1, 2022.

Questions and answers

GENERAL EIM

1. **What is the EIM? Where can I learn more?**

   An energy imbalance market is a voluntary market that provides a sub-hourly economic dispatch of participating resources for balancing supply and demand every 5 minutes. This market is security-constrained, meaning transmission and reliability constraints would be honored. The Western Energy Imbalance Market (EIM) is operated by the California Independent System Operator (CAISO). It is important to note that the Western EIM is not a regional transmission operator. BPA would preserve its autonomy and retain authority over transmission planning, day-ahead marketing, and transmission system and balancing authority operations if it were to join the EIM. For more information please see: BPA's Grid Mod internal website and CAISO's www.westerneim.com

2. **Does the EIM value both energy and capacity?**

   No, the EIM is an energy only market. The EIM compensates resources for the real-time energy and ramping capability they provide, which BPA views as just one piece of a well-designed electricity market. A well-designed electricity market is built on a strong foundation of resource adequacy, has features that optimize intra-hour energy balancing, and explicitly compensates capacity resources for providing capabilities that are essential for system reliability. Additional mechanisms are required to compensate Bonneville for the flexible capability, carbon-free federal power it chooses to provide. For example, the federal system can ramp up or down quickly to make up for unscheduled changes in solar and wind generation, but there is a cost assocated with holding capacity aside to provide this real-time balance of power supply.

   BPA will continue to work with CAISO and stakeholders to enhance regional resource adequacy by ensuring that flexible resources are appropriately compensated for the services that they provide.

3. **Are there market functions being considered that will provide capacity compensation ?**

   Yes, and Bonneville has taken an active role in the CAISO's ongoing effort to develop a day-ahead flexible ramping product. Specially, the Flexible Ramping Product as part of the Day-Ahead Market Enhancements (DAME) which would be used to manage uncertainty that occurs between the CAISO's day-ahead and fifteen-minute markets. Further, the Implementation Agreement articulates an expectation that the CAISO will consider implementing a bid range transfer system that would allow for bilateral arrangements that value the hydro system's flexibility.

PROCESS

4. What are the principles guiding BPA's decision-making process relative to the question of joining the Western EIM?

BPA will be guided by four key principles throughout its process to making a final determination with a close out letter in October 2021 on whether to join the Western EIM:

- Consistency with statutory, regulatory and contractual obligations
- Maintain reliability of system
- Voluntary participation
- Sound business rational

5. What is the scope of the summer decision on the implementation agreement? What does it represent as a commitment to join the EIM?

If BPA signs the EIM implementation agreement, it would obligate BPA to begin spending on EIM implementation projects with the CAISO and signal BPA's intent to join the EIM as long as BPA's EIM principles continue to be met. However, it does not bind BPA to join the EIM. The CAISO system integration costs are roughly $1.9 million across 6 equal payments for CAISO to develop the systems and processes necessary for BPA to participate in the market. BPA would also begin on the EIM projects on the Grid Mod Roadmap.

6. Will there be another public process before decides to BPA goes live in 2022?

A second 30-day public comment process will be held in late 2021 in the form of a Close Out Letter that will allow for customers and stakeholders to comment on whether the entirety of the EIM-related decisions meet BPA's EIM principles. In addition, there will be additional public process associated with additional policy decisions discussed in the letter, and there will be specific rate and term and conditions associated with EIM participation tha twill be part of the BP-22 na d TC-22 processes.

7. What, if any, role is there for FERC for the agreement?

CAISO will submit the implementation agreement to FERC for review and approval – this is a standard CAISO process. BPA may submit comments in support of CAISO's filing.

8. What is an EIM implementation agreement? What issues will be resolved in the signing of an implementation agreement?

This agreement outlines the terms of our partnership to prepare for BPA's participation in the Western Energy Imbalance Market. The agreement also outlines scheduled milestones and associated payments to the CAISO for costs of related system changes, software licenses and other configuration activities.

Also, in Recital 14 of BPA's draft EIM Implementation Agreement, BPA has identified 8 EIM Implementation Principles and Participation Principles. These are:

1. A statement that BPA's statutory, regulatory, and contractual requirements will not be violated with BPA's participation;
2. A statement verifying the voluntary nature of market participation;

3. Affirmation that Reliablity and Operation of the Federal Power and Transmission systems will be maintained;
4. Federal generation participation will be accomplished through the use of 3 aggregations;
5. A request to CAISO for automation support;
6. An acknowledgement of BPA's greenhouse gas attributes as an Asset Controlling Supplier;
7. A request prior to implementation for CAISO to consider base schedule submission timeframe changes; and,
8. A request prior to implementation for CAISO to consider several EIM enhancements.

9. What is BPA's decision process between now and EIM go-live? Where will specific issues be resolved?

Stakeholder engagement will continue until EIM go-live. Specific issues will continue to be addressed by the EIM core team and AE's as we currently do today. After BPA signs the implementation agreement, BPA will initiate a policy implementation decisions phase in which we will address issues and alternatives and seek customer and stakeholder feedback in pre-rate case workshops and pre-terms and conditions case workshops in preparation for the necessary BP-22 Rate Case and TC-22 Tariff Case.

10. What are the additional decision points or off-ramps that exist for BPA after it signs the implementation agreement with the Western EIM? Are there any potential 'deal-breakers' that may impact eventual participation?

At this point BPA has not identified any "deal breakers" that would prevent BPA from joining the EIM. However, BPA will continue to monitor the CAISO's public initiative process and advocate accordingly to protect the value of the federal hydro system and transmission system. Additionally, BPA expects that the CAISO will complete the Day-Ahead Market Enhancements (DAME) policy initiative and implement the Flexible Ramping Product before BPA goes live in the EIM.

11. How will BPA deliver the value of joining an EIM to customers?

If BPA signs the EIM implementation agreement this summer, BPA's participation would give power and transmission customers the opportunity to participate in the market with their own generation. Owners of independent power plants located in the BPA's balancing authority area would also be eligible to participate in the market. The EIM through price signals and market dispatches could incent effective resources to be dispatched (incremental or decremental) to manage the congestion in the most cost effective manner possible while simultaneously ensuring each EIM participating balancing authority area remains balanced. Since any effective and economic EIM Participating Resources can potentially fulfill the market dispatches, the EIM has the potential of reducing the burden on BPA transmission customers and reduce the likelihood of curtailments or scheduling restrictions.

GRID MOD

12. What does it mean for any new BPA expenditures for the grid modernization initiative? Will customers have an opportunity to have detail and provide input on those initiatives and their costs?

The IPR and QBR for Grid Modernization included expense funding for the EIM projects on the Grid Modernization Roadmap if BPA signs the implementation agreement this summer. Customers can get additional information on Grid Modernization expeditures and project updates from the QBR or Bonneville's external Grid Modernization website.

COST BENEFIT ANALYSIS

13. Are these costs going into the current rate case?

The expense costs associated with EIM are part of the IPR for Grid Modernization which includes starting up several projects related to joining the EIM. Costs associated with joining the EIM and Grid Modernization beyond the current rate period will be part of the 2022 Rate Case.

14. Does BPA believe there is enough value from joining the EIM given the results of the preliminary costs and benefits analysis?

Yes, both the quantitative benefits to BPA of $29-34M annual net benefit and the qualitative benefits that will allow for greater visibility and congestion management of the grid, provide significant value to BPA and form the foundation of the business value that EIM can bring to BPA.

15. Has BPA done an analysis of the costs and benefits of the EIM to date based on actual operations?

Yes, BPA utilized the operational years 2016, 2017 and 2018 to determine the cost benefit analysis of $29-34M annual net benefit. The analysis projected bidding in only the available spin capacity at the Big-10 projects[2].

16. Are there additional benefits of joining the EIM such as opening doors for BPA to participate other emerging market discussions?

Yes, there are potential opportunities for emerging market participation if BPA decides to join the EIM. The CAISO initiative process is looking at possible enhancements and expansion of its markets such as the Expansion of the Day-Ahead Market to EIM (EDAM). EDAM is expected to expand the enhanced day-ahead market to some or all EIM entity balancing authority areas. EDAM is currently in the pre-CAISO policy initiative conceptual phase with an anticipated kick-off of the CAISO policy initiative expected for late summer. BPA is currently not involved in any discussions regarding EDAM with the CAISO or other EIM entities.

[2] Big 10 projects include: Grand Coulee, Chief Joseph, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville dams.

17. What are the major assumptions in the current cost and benefits analysis?

The current cost benefit analysis is conservative and assumed the following based on the operational years 2016-2018:

	E3 Study
Time frame	• 2016-2018
Flexibility	• Varies over all hours • Historical spinning capability remaining after BA Regulation Requirement is met.
Prices	• Alternative NW price nodes (PSEI, PACW, PGE)
Dispatch Granularity	• Four stage o Daily diurnal o Hourly o 15-min o 5-min
Benefits Sources	• Within-day shaping of energy • Volatility of 5-min prices • Price differentials across daily diurnal, hourly, 15-min, and 5-min markets
Success Rate	• 75% - 90%
Volatility Assumption	• Volatility of 15-min prices and 5-min prices reduced by 50% from their hourly averages
Transmission Availability/Cost	• Verified EIM sales were within transmission portfolio expectations
Transmission Benefits	• Qualitative and Illustrative

18. Will BPA or its customers receive any benefit or reduced costs in terms of the preparation needed for participation in the EIM by virtue of the decision to take reliability coordinator (RC) services from CAISO?

The CAISO fee of about $1.9M to join the EIM is based on a specified formula identified in CAISO's tariff which is calculated using each balancing authority areas load and there is no savings related to CAISO providing RC services. However, there is some integration work that will be accomplished as part of the RC integration that will not have to be done for EIM participation.

POWER & RESOURCE ADEQUACY

19. How does joining the EIM impact the real-time market?

Joining the EIM may have little impact on the real-time market. BPA currently participates in CAISO's day-ahead and hour ahead markets as well as bilateral trading with counterparties throughout the region. Joining the EIM will provide BPA with another opportunity to market its clean flexible hydro resources.

20. What is the collaboration plan and coordination structure planned for federal partners to stay organized as BPA enters the EIM?

Coordination and communication during the EIM implementation phase will be critical if BPA signs the EIM implementation agreement with the CAISO this summer. BPA will lead this effort, and the "Three Agency Coordination Plan" will continue to be used to facilitate this work. BPA will continue to have weekly Monday check-ins with USBR and USACE, and continue with the monthly technical 3-Agency EIM meetings.

One of the additional EIM-related work streams is improving the coordination between BPA and the hydro projects on how generator units should be loaded for 1-3 future hours. This information will inform the operations for each of the Big-10 projects that would participate in the market.

21. Will FCRPS Biological Opinion spill be impacted by EIM participation?

No. BPA's power marketing services and activities and power demand changes would be conducted consistent with the 2019 NOAA Fisheries CRS Biological Opinion and would be within existing operating constraints and normal operating limits of FCRPS projects.

22. How does BPA plan on changing generation dispatch to USACE and USBR Operating Projects for EIM participation?

The short answer is that BPA intends to change the generation dispatch to realize the value of the flexibility that is available. BPA will likely start with only bidding surplus spinning capability into the EIM, and, after BPA and the project operators gain experience, consider bidding additional non-spinning flexibility at a later time. Also, it is expected that there would be no changes to GDACS with EIM Participation.

23. What is the Pacific Northwest electricity industry doing to ensure resource adequacy is preserved given this focus on electricity markets?

BPA will continue to engage with Pacific Northwest utilities through the NW Power Pool on regional resource adequacy initiatives.

TRANSMISSION

24. Does the Interchange Rights Holder methodology assume transmission is free?

No. Transmission rights are paid for through the purchase of BPA point to point transmission.This methodology specifies that purchased point to point transmission may be donated by BPA power services and other transmission rights holders for use in EIM dispatches rather than for another purpose.

CARBON

25. How will BPA meet California Air Resources Boards (CARBs) EIM carbon compliance requirements?

BPA's policy proposal on carbon in the EIM is to opt out of selling directly into California via the EIM unless Congress provides statutory expenditure authorization for BPA to directly purchase allowances under California and other state carbon programs. BPA does not believe this precludes its participation in the EIM.

- Energy generated in or imported into California is subject to California's greenhouse gas (GHG) regulations.
- If BPA were to participate in the EIM, any carbon attributed to imports into California would incur a compliance obligation
- BPA currently cannot purchase carbon allowances
  - Carbon allowances are considered a state tax by the U.S. DOE, BPA, and other federal agencies.
  - Federal agencies have sovereign immunity from state taxes and cannot pay them without specific Congressional authorization.
  - Absent Congressional authorization to purchase allowances, BPA would not be able to directly deliver EIM energy into California.
  - Analysis suggests that this would decrease the annual net benefit by $4.4M.

26. What if OR and WA adopt carbon legislation similar to CARBs?

If it is determined that purchasing allowances in OR or WA is a state tax (and not a fee), BPA would be precluded from directly delivering EIM energy into these states as well. This would increase the devaluation of the EIM participation. BPA is closely watching both of these efforts.

GOVERNANCE

27. What is BPA's assessment of CAISO EIM Governance?

BPA has determined that the current EIM governance structure does not contain any "showstoppers" to joining the EIM. However, BPA would like to see some improvements to the current governance structure, including:

a. Expand the EIM Governing Body's primary authority;

b. Improve the durability of the current EIM governance structure;

c. Allow for ability to adapt to expanded market functions; and

d. A broader role for public power in the EIM governance structure.

BPA is supporting these improvements in a current stakeholder process that the CAISO has initiated.

28. In its consideration of EIM participation, is BPA considering the current CAISO EIM Governance model or is BPA assuming some changes as fundamental to its decision of whether to join?

BPA is considering participating in the EIM as it is currently governed by the independent EIM Governing Body and the Board of Governors of the California ISO. However, BPA supports the recent initiation of a review of EIM governance.

BPA believes the review of EIM governance is well timed given the EIM's expansion in both geography and in membership, particularly with the addition of public power members and, potentially, at least one federal power marketing administration. With future market evolution discussions taking shape, Bonneville believes it is important that the ISO demonstrate that regional market expansion is transparently and fairly administered.

BPA views the improved durability and independence of the EIM governance structure as fundamental to the stability and expansion of the market. Strengthening the durability of the EIM Governing Body will help to allay regional concerns that the EIM will be directed primarily by California-centric interests.

29. What steps could CAISO take that might allay BPA's concerns regarding governance?

BPA favors the expansion of the EIM Governing Body's primary authority to encompass any market rule change that is driven primarily by factors specific to the EIM balancing authorities. BPA believes that the EIM Governing Body's primary authority should extend to all generally applicable real-time market rules regardless of the driver for the change, except for those changes that have no material effect on the EIM or EIM Balancing Authority Areas.

BPA recommends expanding the role of the EIM Governing Body, with advisory input from stakeholders, to develop and recommend items for the ISO's annual Policy Initiatives Roadmap that would fall within its primary authority.

30. What is the CAISO's process for looking at changes to Governance going forward?

The current EIM charter calls for initiating a review of EIM governance by 2020. The CAISO and EIM Governing Body began that review in December 2018. They are currently considering public comments on the proposed review process.

The CAISO proposes to develop a stakeholder committee whose role would be facilitating the ongoing EIM governance review. This "EIM Governance Review Committee" would develop through an iterative public stakeholder process a set of proposed revisions to the current EIM governance structure in light of experience to date and changes to the EIM since its inception. The Committee would accomplish this by developing a series of issue papers and straw proposals for public stakeholder comment, culminating in a draft final proposal for consideration by the EIM Governing Body and the CAISO Board of Governors. The CAISO expects the review to take 8 to 12 months once the GRC is formed.

RATES (CUSTOMER IMPACTS OF EIM)

31. What would BPA's joining the EIM mean for me as a Load Following customer? Block? IPP? Slice/Block?

If BPA signs the EIM Implementation agreement this summer, these questions will be explored through internal teams and external customer and stakeholder engagement in pre-rate case workshops and pre-terms and conditions case workshops. The decisions on how to