After-the-Fact and System Schedulers Meetings

October 25-26, 2016 – Portland, OR

NORTHWEST PowerPool

AFTER THE FACT & SYSTEM SCHEDULERS MEETING – OCTOBER 25-26, 2016
Courtyard Marriott Portland City Center

550 SW Oak Street, Portland, Oregon 97204

Agenda

Oct. 25 - 1:00 p.m. to 5:00 p.m. Pacific Time

1. **Welcome and Arrangements** — ChaRee DiFabio, Northwest Power Pool
2. **WECC ISAS Update** — Bud Freeman, SCL – WECC ISAS Chair
3. **WECC ATF Update** — Sheryl Welch, BPA – WECC ATF Chair
4. **Preschedule Calendar –** How it works — Lou Miranda, Bonneville Power Administration

   Introductions & Break

5. **NWPP Renewables Integration** — Ryan Leonard, Avangrid
   - Current profiles
   - What is coming online
6. **Solar Power Presentation** — Kathryn Arbeit, First Solar, Inc
7. **Gas Scheduling – coordination between gas and electric** — Scott Johnson, NW Natural

   5:00 - 7:30 Evening Reception

Oct. 26 - 8:00 a.m. to 12:00 p.m. Pacific Time

7:30 – 7:45 Breakfast

1. **Welcome Back** — ChaRee DiFabio, NWPP
2. **Frequency Response Sharing Group – Status Update**
   Rian Sackett, Bonneville Power Administration – FRSG Chair
3. **EIM Round Table** — John Schaffroth, PacifiCorp; Bob Frost, Portland General Electric; Steve Schmidt, Puget Sound Energy and Olga Zvyagina, NV Energy
   - Those who've gone live (PAC & NVE)
     - growing pains
     - lessons learned
     - what has worked
     - hasn't worked
     - What impacts has the EIM had in tagging, settlement world (checking out - verification), transmission and merchant
   - Those coming online (PSE & IPC)
     - growing pains
     - lessons learned
     - what has worked
     - hasn't worked

   Break

4. **Changes in OATT and impacts on Transmission Contract Holders** — Steve Schmidt, Puget Sound Energy
5. **Peak Reliability – Status Update** — Jeremy West, Peak Reliability
   - Understanding the division between Peak and WECC
   - Reliability Messaging Tool (RMT)
   - Enhanced Curtailment Calculator

   Closing

Presenter Biographies –
After-the-Fact & System Schedulers Meetings
October 25-26, 2016 – Portland, OR

WECC ISAS Update

Bud Freeman joined Seattle City Light in 1999. Prior to SCL Bud worked at Puget Sound Energy in Bellevue and Pacific Gas and Electric in San Francisco. Bud earned a Bachelor of Science in Mechanical Engineering from the University of California, is a licensed Professional Engineer in Washington State and holds a NERC Balancing and Interchange Operator Certification. He is the current WECC ISAS Chair.

ATF Update

Sheryl Welch began her career with the Government in 1977. In 1987, she transferred from the Treasury Department to Bonneville Power Administration. She has held several positions from Secretary, Accounting Technician, Office Manager in Boise, ID, to Public Utilities Specialist (After-the-Fact Scheduler). She has been working in After-the-Fact since 2001. When she is not working, she enjoys sewing and helping her husband cater different events

Preschedule Calendar

Lou Miranda has been with BPA for over 20 years and has worked in both Power and Transmission Scheduling for over a decade. A graduate of Portland State University, Lou is a native of the Pacific Northwest.

NWPP Renewable Integration

Ryan Leonard works at Avangrid Renewables as Director of Market Structure and Policy. He oversees 20+ renewable energy facilities and one gas-fired generator facility in WECC, representing a combined installed capacity of ~3,100 megawatts. Ryan is also involved in state, local, and federal policy issues to help ensure proper representation of the renewable energy sector. Ryan joined Avangrid Renewables in February 2014.

Solar Power Presentation

Kathryn Arbeit is a Regional Director of Project Development leading First Solar's development activities in the Western US, including the 179 MW Playa Solar Project under construction in Nevada. Kathryn has eighteen years of experience working with electric utilities in the U.S. and Canada and fifteen years of experience focused on large-scale renewable energy project development, including the 550 MW Topaz Solar Farm in San Luis Obispo County, California, and the Biglow Canyon Wind Farm in Sherman County, Oregon. Prior to joining First Solar, Kathryn was a Director of Business Development at OptiSolar Inc, initiating the development of Topaz and building a strategic solar project portfolio in the Western US. Before that, she led the development of 682 MW of wind energy projects currently operating in Oregon and Texas at Orion Energy LLC.

Gas Scheduling – coordination between gas and electric

Scott Johnson works at NW Natural as Assistant Director of Gas Supply. He manages the gas acquisition and scheduling team which handles the physical gas purchases and financial derivatives for the company. Scott focuses on relationships with regulators and upstream pipelines. He also works with the company's third party optimization partner and manages a gas reserves joint venture with reserves located in Wyoming. Scott comes from an accounting background and started his career auditing energy companies with Moss Adams and has worked in financial reporting and gas and regulatory accounting at NW Natural. Scott lives out in the hills of Washougal with his wife and three boys where they love everything outdoors.

NWPP Frequency Response Sharing Group

Rian Sackett works for Bonneville Power Administration's, Operations Control team.

Operations Control (TOOC) provides control center technical oversight for Automatic Generation Control (AGC), Balancing Authority (BA) operations responsibilities, Remedial Action Schemes (RAS), disturbance monitoring and event reporting. Operations Control plans and develops control center operation procedures. We support power system automation efforts, as well as provide support to specialized research and development projects, capital and expense. We provide technical expertise for NERC and WECC Compliance standards, including the development of standards, documentation of compliance, and identification of potential standard violations

Rian is BPA's subject matter expert for NERC BAL-003, and chair for the NWPP Frequency Response Sharing Group.

EIM Round Table

John Schaffroth has been at PacifiCorp for 13 years. He started on the Balance & Interchange Desk where he worked for about five years, moved to the Transmission Preschedule group for two years, supervised the B&I desk for about three years until he was reassigned to the EIM Implementation team. He currently supervises the EIM Desk in PacifiCorp's Grid Operations. He has a Bachelor of Science in Psychology from the University of Oregon and a Bachelor of Science in Economics from Portland State University. He has a wife and two kids and currently resides in Vancouver, WA.

EIM Round Table

Bob Frost has worked at Portland General Electric for 27 years. For the past seven years, he has been managing PGE's Balancing Authority and real-time transmission scheduling. Previous to this he spent eleven years as on-shift as a Balancing Authority Operator and has been a NERC Certified System Operator since 1999. Before working in PGE's System Control Center, Bob was a plant operator for over eight years at the now decommissioned Trojan Nuclear Plant. In 1988, he earned a degree in Applied Physics from Linfield College. When not working, Bob enjoys running and participating in marathons. He lives in St. Helens, OR with his wife and one of two adult children.

EIM Round Table / Changes in OATT and impacts on Transmission Contract Holders

Steve Schmidt has been with Puget Sound Energy for 25 years. He started his career in 1990 at a Hydro-Electric Plant (Electron) where he worked his way to become a Journey level Mechanic, a Journey level Hydro-Electrician, a Hydro Plant Operator, and a Hydro-Technician/Foreman. He also has work experience in the Thermal Group with simple cycle combustion turbines and holds a CT Journey level card. He moved to the Load Office in June of 2014 where he Supervised Real-time Schedulers' desk and Generation Desk and he currently Supervises EIM functions and Transmission Services in PSE's Load Office. He enjoys outdoor activities such as hiking and fishing, along with restoring classic cars and antique tractors.

EIM Round Table

Olga Zvyagina moved from Russia to the United States 18 years ago. She studied law at the St Petersburg State University in Russia. Prior to joining NV Energy (Sierra Pacific Power Company) in 2008 where she manages compliance and training teams for Transmission business unit, including Critical Infrastructure Protection, Olga worked in manufacturing and local government.

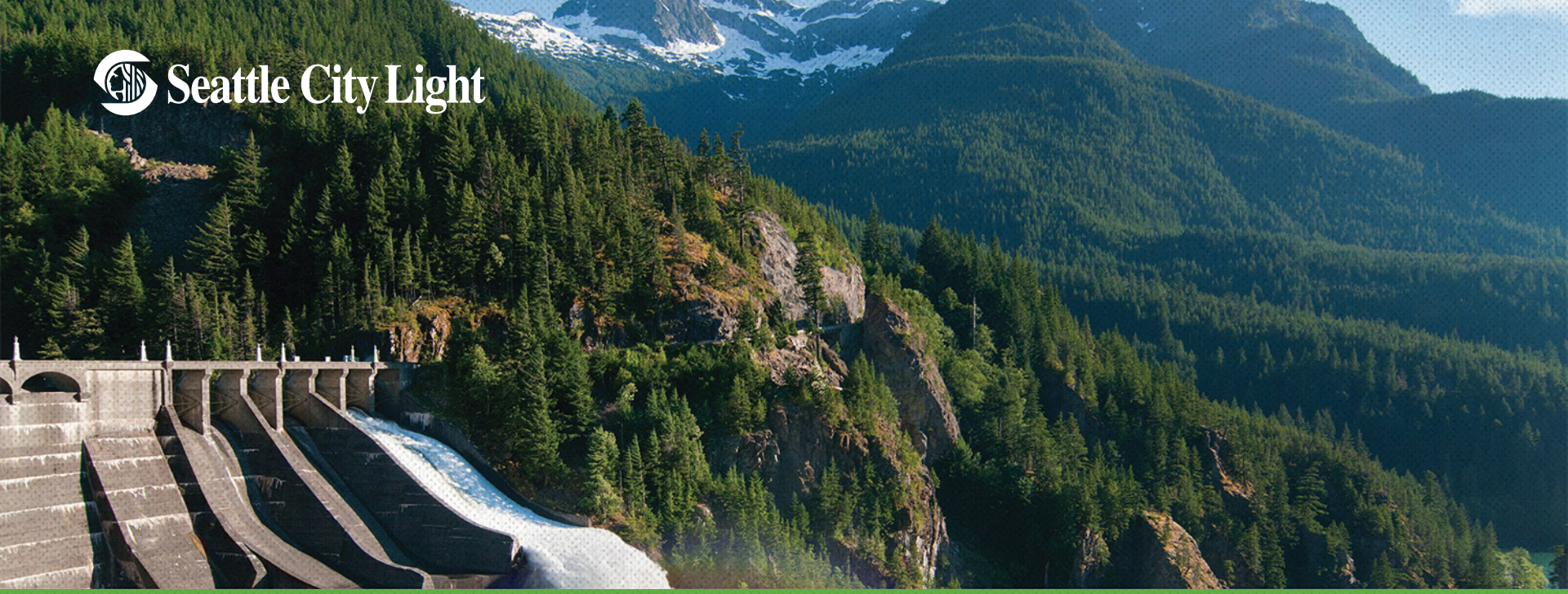
Peak Reliability – Understanding the division between Peak and WECC / Enhanced Curtailment Calculator

Jeremy West works at Peak Reliability in Loveland, CO. Jeremy joined Peak in May 2014 as a Senior Operations Engineer and serves as the primary Peak support for the Enhanced Curtailment Calculator (ECC) project. Prior to joining Peak, he worked for Entergy Services, Inc. for 10 years supporting scheduling and tariff issues related to monitoring of the Entergy transmission grid in Arkansas, Louisiana, Mississippi, and Texas.

NWPP Meeting MC

ChaRee DiFabio joined the joined the Northwest Power Pool in July 2000. She is currently the Reserve Sharing Group Committee Manager and oversees all related activities as well as the program. Also, she provides support to the NWPP Operating Committee (OC), NWPP Training, various subcommittees and work groups through coordination, meeting facilitation, and informational reporting on behalf of the membership to the internal companies and other organizations such as WECC and NERC.

Prior to working for the NWPP she worked for Idaho Power Company for 5 years at the Boise Bench Substation where she worked with the System Dispatch, After-the-Fact, and the System Scheduling groups.



INTERCHANGE SCHEDULING & ACCOUNTING SUBCOMMITTEE

Northwest Power Pool

Bud Freeman| October 25, 2016

Seattle City Light

WHO ARE WE AND WHAT DO WE DO?

WECC BOARD

- WECC is governed by a nine-member Independent Board of Directors and the Chief Executive Officer. The nine Directors are independent of any Registered Entity in the Western Interconnection either by employment or affiliation. The WECC Board is elected by the WECC membership and the Directors are compensated for their time.

WECC COMMITTEE STRUCTURE

- Many the WECC work products are developed in coordination with external subject matter experts and other interested parties. These stakeholders participate in our processes through committees focused on topics that impact reliability in the Western Interconnection. Many of these committees report to our Board of Directors.

TWO COMMITTEES OF PARTICULAR INTEREST

- Operating Committee
  - Chair Darren Buck, WAPA
  - Vice Chair Richard Hydzik, Avista Corporation

Purpose/Responsibilities

The purpose of the Operating Committee is to advise and make recommendations to the WECC Board of Directors (Board) on all matters within the jurisdiction of WECC pertaining to maintaining reliability through the operation and security of the interconnected Bulk Electric Systems (BES) in the Western Interconnection.

TWO COMMITTEE'S CONTINUED

- Market Interface Committee
  - Chair Andy Meyers, BPA
  - Vice Chair Brad Bouillon CAISO
  - Purpose/Responsibilities The purpose of the MIC is to advise and make recommendations to the WECC Board of Directors (Board) on the development of consistent Market Interface practices and compatible commercial practices within the Western Interconnection. Market Interface involves all interactions among market entities and entities responsible for reliable grid operation related to transmission service and physical delivery. Commercial Practices include the products and practices involved in trading electricity, including the interaction among market entities that does not affect or require assistance from entities responsible for reliable grid operation.

WHERE DOES ISAS FIT?

- ISAS is a subcommittee of the Operating Committee
- Chair Bud Freeman, Seattle City Light
- Vice Chair Raymond Vojdani, WAPA
- There are 60 plus members of the ISAS

WHAT DOES ISAS DO?

- The purpose of the ISAS is to develop scheduling, tagging, and accounting practices and procedures among participants in the Western Interconnection.
- The ISAS shall:
- a. Create and improve scheduling and tagging regional criteria and/or guidelines for WECC as assigned by the Operating Committee.
- b. Review NERC/North American Energy Standards Board (NAESB) standards and compare them to WECC scheduling regional criteria and/or guidelines to ensure that WECC is not duplicating or contradicting any NERC or NAESB scheduling standards.
- c. Provide a forum to aid in the education and implementation of national and regional standards, criteria, and guidelines.
- d. Assess scheduling regional criteria and/or guidelines relative to regulatory and industry changes.

HOW IS ISAS ORGANIZED?

- After the Fact Work Group-ATFWG
- Electronic Scheduling Work Group-ESWG
- Interchange Work Group-IWG

AFTER THE FACT WORK GROUP

- Researches and facilitates resolutions to identified After-the-Fact (ATF) energy accounting issues that arise among participants that use the Bulk Electric System in the Western Interconnection to maintain load-interchange-generation balance.

ELECTRONIC SCHEDULING WORK GROUP

- The purpose of the ESWG is to research and facilitate resolution to identified electronic scheduling issues in the WECC Region.

INTERCHANGE WORK GROUP

- The IWG was formed with the purpose of supporting the WECC ISAS in developing WECC Guidelines and supporting documents as needed. All documents developed, modified or retired through the IWG are reported to ISAS for consideration, prioritization, and direction.

WHAT'S CHANGING?

- Market Interface and Operating Committee Reorganization
- Likely that the ISAS may move to the MIC
- If approved by MIC (September 19) a recommendation submitted to the Board

WHAT DOES THAT MEAN

- In the short term probably nothing
- The standing committee's will need to present three year work plans after the reorganization
- Over the long term, the ISAS focus may shift toward market related issues

QUESTIONS?

- Thoughts
- Discussion

Review of After-the-Fact (ATF) Tagging Criteria

NWPP ATF-System Schedulers Meeting
October 25, 2016

SHERYL WELCH, ISAS ATFWG CHAIR

Review of ATF Tagging Criteria

- Background
  - ATF Transactions Has Been Getting a Lot of Publicity
  - OC has some concern regarding the use of ATF Tags.
  - There is confusion as when ATF transaction is needed or warranted
- Purpose
  - Review the ATF Tagging Guideline

REASON	2016	2015	2014	2013	2012
Incorrect Path or Sched Entity	17	66	56	82	72
Scheduling or Adjusting Error	11	21	20	16	36
System Error		0	3	12	27
Generation/Meter Adjustment	18	50	40	26	31
Incorrect Source / Sink	8	13	203	11	16
Curtailment Error		0	3	3	12
Incorrect PSE	1	0	0	8	5
RSG Tag Error	6	8	9	18	9
Integration Error		1	0	2	4
Tag Type Correction		0	49	0	0
Incorrect Tag	6	68	0	21	18
WIT not match OATI Tag		8	0	0	0
Oversold		1	0	0	0
Unknown		0	4	0	1
No Original Tag	10				
TOTAL	77	236	383	199	231
Originally Reported				88	87
Current MW	1606	5840	22662	1679	12896
Changed to MW	430	2301	9614	1365	7691
Total MW Change	1176	3539	13048	314	5205
Minus ATF Tags	830				
Actual MW Change	346				

Review of ATF Tagging Criteria

- Rule of Thumb as When ATF Tag Should be Used
  - For Reliability reasons to properly reflect interchange that flowed and was not properly documented during the real-time
    - What did the BA control to
    - What transmission path(s) were used
- When ATF Tag Should NOT be Used
  - To eliminate energy imbalance or generation imbalance within a BA
  - When creation of ATF tag creates Inadvertent Interchange for the BA
  - Market Purposes

Review of ATF Tagging Criteria

- How Does an e-tag Become a Schedule
  - A RFI (Request for Interchange) Is created by one of the PSEs
  - The WECC Interchange Authority distributes the e-tag to all affected parties
  - The RFI goes through appropriate approval by affected parties
    - PSEs, TSPs, BAs, and Sometimes SEs
  - Once the e-tag is approved, then a schedule Is created in WIT
  - The WIT schedules impacted all BAs (from Source BA to the Sink BA) in the Western Interconnect (WI).
    - WIT cannot see or correct a schedule that sinks outside the WI.
  - The BAs use the schedule to control their EMS and AGC based on the their Net Schedule Interchange (sum of all schedules)
  - Any subsequent changes to WIT Schedule has to be done by modifying an existing e-tag, creating a new e-tag, or zeroing out the Schedule in WIT.

Review of ATF Tagging Criteria

- Purpose of ATF Tag
  - There was no tag (schedule) for the interchange as agreed by the affected BAs
    - Reserve Sharing Tags
    - Emergency Situation
      - Energy Emergency, transmission loading issues
  - There was a tag but the tag had the following incorrect information
    - To allow BAS, TSPs, and PSEs to accurately reflect a schedule which was coordinated and controlled by a BA's EMS and AGC system during real-time system operations but was not properly tagged
    - Missing or Incorrect Balancing Authority, TSP, Scheduling Entity
    - Missing Adjacencies or incorrect POR or POD - Incorrect POR or POD could be changed in the e-schedule.
    - Emergency situation when WIT is down

Review of ATF Tagging Criteria

- General Principals for Creating an ATF tag
  - There was no tag created, but controlled to in the AGC and EMS system during Real Time.
    - Entities can create a new ATF tag up to 7 days later from the start time
    - Close BA coordination between affected entities is required
    - No Peak RC intervention or submittal of a form is needed
  - There was a tag but it contain incorrect information
    - If the original schedule needs to be zeroed out, then, lead BA is to complete the form and coordinate with affected entities for approval. When submitting form to disputereports@peakrc.com, copy all parties and ATF Chair.
    - If the original schedule needs to be modified (increase MW), then a new ATF tag can be created

Review of ATF Tagging Criteria

- **Logistics of creating an ATF Tag/Schedule**
  - Call and/or email all parties involved on the tag when an ATF tag is needed and gain agreement to proceed.
  - Coordinate changes needed within the timeframe for processing/submitting the ATF tag.
  - Route WIT Schedule Change Request Form to all parties for signatures.
  - Submit the WIT Schedule Change Request Form to the WIT Administrator (disbutereports@peakrc.com), copy all parties involved and the ATFWG Chair.
  - After WIT Administrator responds that the changes have been completed, all parties should verify that the changes were made properly in the WECC Interchange Tool (WIT).
  - Submit the ATF tag by 2:00 p.m. (MST) on the same day that the WIT Administrator makes the changes to WIT, inform all involved parties that the tag is out for approval and reference the new tag number.
  - The lead BA will follow up that ATF tag was approved.
  - Each entity will update its in-house scheduling software to reflect the changes (adjust or zero MW on the original tag schedule) and if necessary verify that the resultant Net Schedule Interchange matches with WIT for that particular hour.

DATE: **LEAD PARTY:**

WIT SCHEDULE CHANGE REQUEST FORM

Please send this completed and signed form to disputereports@peakrc.com and cc the ATFWG Chair.

	Date M-D-Y	HE	Time Zone	Tag	Current MW Schedule	Requested MW Schedule	Reason	ATF Tag Created (Y/N)	Number of ATF Tags Needed
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Source BA:	
Responsible ATF Name:	
Signature:	
Date:	

Sink BA:	
Responsible ATF Name:	
Signature:	
Date:	

Intermediary BA:	
Responsible ATF Name:	
Signature:	
Date:	

Intermediary BA:	
Responsible ATF Name:	
Signature:	
Date:	

For ATF Chair Use Only	
Original Tag Count	ATF Tag Count
1	0

ATF Items

- Southwest BAs submitted a White Paper at the last ISAS meeting for discussion as to why they need to create ATF tags for other reasons then what is in the ATF Guidelines.
  - Hoping to post it this month for comments
  - Hold Webinar late November to address comments
  - Take to the ISAS Meeting in January 2017 for a vote
- Since I will be retiring in June, I am looking for someone to replace me as ATFWG Chair.
  - Any volunteers
  - If interested, send an email to Bud, Raymond, or myself.

Questions ?

WECC
PRESCHEDULE CALENDAR GUIDELINES

BY LOU MIRANDA
BONNEVILLE POWER ADMINISTRATION
TRANSMISSION SERVICES

NWPP AFTER-THE-FACT & SYSTEM SCHEDULERS MEETING
COURTYARD MARRIOTT PORTLAND CITY CENTER
(550 SW OAK STREET)
PORTLAND, OREGON
OCTOBER 25 – 26, 2016

WECC-Approved Prescheduling Calendar Guideline Document

- Purpose: Provides direction for the preparation of the annual Prescheduling Calendar.
- Includes instructions on how to schedule around holidays and the beginning of new months.
- Emphasizes the importance of more effective scheduling alignment between the gas industry and power industry.

Standard Scheduling Holidays for the WECC Region

- New Year's Day
- Martin Luther King
- Presidents Day
- Good Friday
- Memorial Day
- Independence Day
- Labor Day
- Veteran's Day
- Thanksgiving Day
- Friday After Thanksgiving
- Christmas Eve
- Christmas Day

WECC-Approved Prescheduling Calendar Guideline Document

Document contains 14 Guidelines that should be followed when creating the calendar

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline # 1)** No more than 2 days are required to be scheduled on a single day unless more is made practicable by the occurrence of a Standard Scheduling Holiday and/or a new month. At no point will more than 3 days be scheduled on a single day, as determined by the guidelines that follow.

  Establishes the approach to be followed when creating the preschedule calendar.

- **Guideline # 2)** A week without a holiday or new month is typically scheduled as 1/1/1/2/2 (Tue/Wed/Thu/Fri-Sat/Sun-Mon).

  Guideline 2 is the most commonly used guideline.

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #3)** When a holiday falls on a Monday, schedule 2/2/2 (Thu-Fri/Sat-Sun/Mon-Tue) on the Wednesday-Friday of the preceding week.

Martin Luther King's Birthday—Monday, January 16, 2017

Wednesday, January 11—Preschedule for Thursday-Friday, January 12-13 (2)

Thursday, January 12—Preschedule for Saturday-Sunday, January 14-15 (2)

Friday, January 13—Preschedule for Monday-Tuesday, January 16-17 (2)

President's Day—Monday, February 20, 2017

Wednesday, February 15—Preschedule for Thursday-Friday, February 16-17 (2)

Thursday, February 16—Preschedule for Saturday-Sunday, February 18-19 (2)

Friday, February 17—Preschedule for Monday-Tuesday, February 20-21 (2)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #3** Continued:

Memorial Day—Monday, May 29, 2017
Wednesday, May 24—Preschedule for Thursday-Friday, May 25-26 (2)
Thursday, May 25—Preschedule for Saturday-Sunday, May 27-28 (2)
Friday, May 26—Preschedule Monday-Tuesday, May 29-30 (2)

Christmas Day—Monday, December 25, 2017
Wednesday, December 20—Preschedule for Thursday-Friday, December 21-22 (2)
Thursday, December 21—Preschedule for Saturday-Sunday, December 23-24 (2)
Friday, December 22—Preschedule for Monday-Tuesday, December 25-26 (2)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #4**) When a holiday falls on a Tuesday, schedule two days on the preceding Monday.

  Independence Day —Tuesday, July 4, 2017

  Monday, July 3—Preschedule for Tuesday-Wednesday, July 4-5 (2)

- **Guideline #5**) When a holiday falls on a Wednesday, schedule two days on the preceding Tuesday.

  Not Applicable for 2017

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #6**) When a holiday falls on a Thursday, schedule 2/0/3 (Thu-Fri/off/Sat-Sun-Mon). Thanksgiving will be scheduled as 2/2/3 (Tue-Wed/Thu-Fri/Sat-Sun-Mon) unless a different schedule is needed due to a new month.

Thanksgiving—Thursday, November 23, 2017 & Day after Thanksgiving Friday, November 24, 2017

Monday, November 20—Preschedule for Tuesday-Wednesday, November 21-22 (2)
Tuesday, November 21—Preschedule for Thursday-Friday, November 23-24 (2)
Wednesday, November 22—Preschedule Saturday-Sunday-Monday, November 25-26-27 (3)

WECC-Approved Prescheduling Calendar Guideline Document

- **GUIDELINE #7)** When a holiday falls on a Friday, schedule 1/2/2/2 (Tue/Wed-Thu/Fri-Sat/Sun-Mon).

Good Friday—Friday, April 14, 2017

Tuesday, April 11—Preschedule for Wednesday-Thursday, April 12-13 (2)

Wednesday, April 12—Preschedule for Friday-Saturday, April 14-15 (2)

Thursday, April 13—Preschedule Sunday-Monday, April 16-17 (2)

Veterans Day—Friday, November 10, 2017

Tuesday, November 7—Preschedule for Wednesday-Thursday, November 8-9 (2)

Wednesday, November 8—Preschedule for Friday-Saturday, November 10-11 (2)

Thursday, November 9—Preschedule for Sunday-Monday, November 12-13 (2)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #8)** When a new month begins on a Saturday, schedule 2/1/2 (Thu-Fri/Sat/Sun-Mon) from Wednesday-Friday of the preceding week.

New Month—Saturday, April 1, 2017

Wednesday, March 29—Preschedule for Thursday-Friday, March 30-31 (2)

Thursday, March 30—Preschedule for Saturday, April 1 (1)

Friday, March 31—Preschedule for Sunday-Monday, April 2-3 (2)

New Month -- Saturday July 1, 2017

Wednesday, June 28—Preschedule for Thursday-Friday, June 29-30 (2)

Thursday, June 29—Preschedule for Saturday, July 1 (1)

Friday, June 30—Preschedule Sunday-Monday, July 2-3 (2)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #9)** When a new month begins on a Monday, schedule 2/2/1 (Thu-Fri/Sat-Sun/Mon) from Wednesday-Friday of the preceding week.

New Month—Monday, May 1, 2017

Wednesday, April 26—Preschedule for Thursday-Friday, April 27-28 (2)

Thursday, April 27—Preschedule for Saturday-Sunday, April 29-30 (2)

Friday, April 28—Preschedule for Monday, May 1 (1)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #10)** When a new month and a holiday fall on a Monday, schedule 2/2/2 (Thu-Fri/Sat-Sun/Mon-Tue) from Wednesday-Friday of the preceding week.

New Year's Day Monday, January 1 2018 and New Month

Wednesday, December 27—Preschedule Thursday-Friday, December 28-29 (2)

Thursday, December 28—Preschedule Saturday-Sunday, December 30-31 (2)

Friday, December 29—Preschedule for Monday-Tuesday, January 1-2 (2)

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #11)** When a new month falls on Sunday and the holiday is observed on Monday, schedule 2/3 (Fri-Sat/Sun-Mon-Tue) on Thursday-Friday of the preceding week.

  New Year's Day—observed on Monday, January 2, 2017.

  Thursday, December 29—Preschedule Friday-Saturday, December 30-31 (2)

  Friday, December 30—Preschedule Sunday-Tuesday, January 1-3 (3)

- **Guideline #12)** When a new month falls on Saturday and the holiday is observed on Friday, schedule 2/3 (Thu-Fri/Sat-Sun-Mon) on Wednesday-Thursday of the preceding week.

  Not Applicable for 2017

WECC-Approved Prescheduling Calendar Guideline Document

- **Guideline #13**) When a new month begins on a Friday and holiday falls on Monday, schedule 2/3 (Fri-Sat/Sun-Mon-Tue) on Thursday-Friday of the preceding week.

  New Month—Friday September 1st & Labor Day—Monday, September 4, 2017

  Friday, September 1—Preschedule for Sunday-Monday-Tuesday, September 3-4-5 (3)

- **Guideline #14)** When a holiday falls on Monday and new month begins on Tuesday, schedule 2/2/1 (Fri-Sat/Sun-Mon/Tue) on Wednesday-Friday of the preceding week.

  Not applicable for 2017

WECC-Approved Prescheduling Calendar Guideline Document

QUESTIONS ?

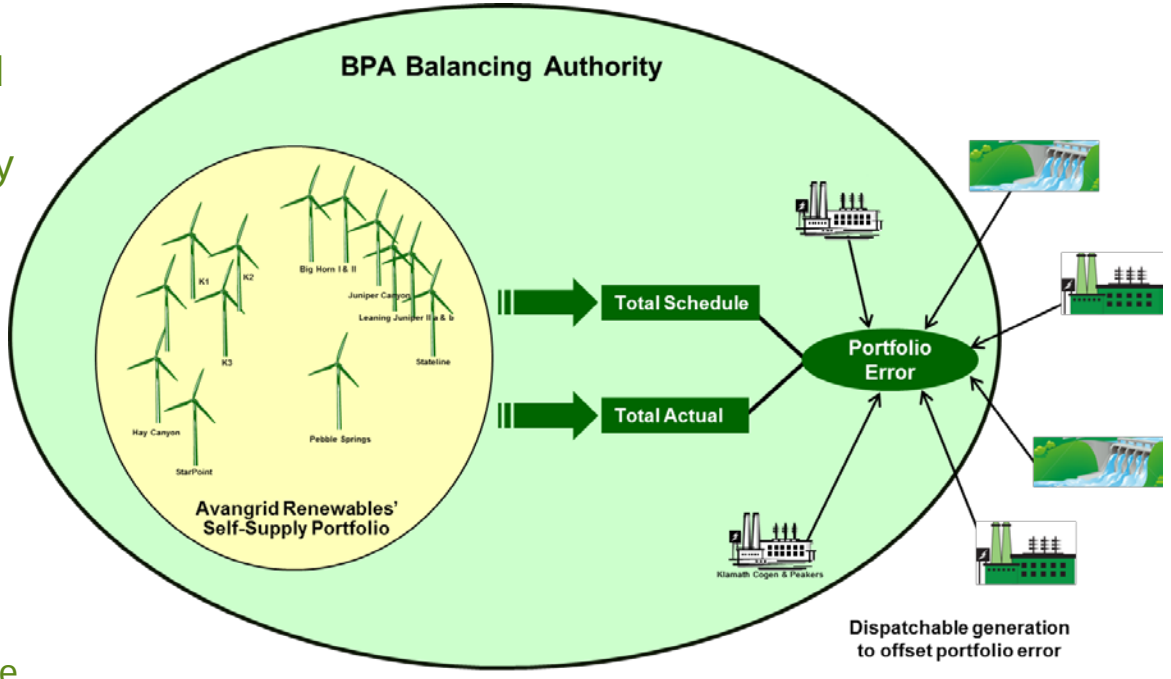
AVANGRID RENEWABLES

NWPP Renewable Integration

October 25, 2016

Customer Supplied Generator Imbalance (Self-Supply) Background

- In its 2009 rate proceeding, the Bonneville Power Administration (BPA) proposed a Wind Integration Charge.
- Avangrid Renewables negotiated with BPA to enable a “self-supply” option for customers and worked to implement the required infrastructure and protocols to take responsibility for balancing the error between our aggregated wind schedules and actual output.
- Utilizing our unique capabilities and a combination of owned and contracted dispatchable generation, we have successfully balanced our Northwest wind fleet on BPA’s system since 2010.
  - 24-hour Meteorological team
  - Technological sophistication
  - Top notch Trading personnel
  - Certified Dispatch personnel
  - Best-in-class Origination team
  - Services partnership with Gridforce Energy Management (control infrastructure)



Wind Integration Charge Comparison

BONNEVILLE POWER ADMINISTRATION

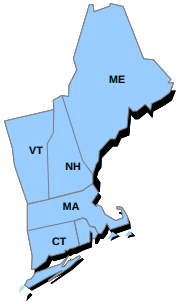
$6.75/MWh+ ($1.48/kw-month)

Does not include:
- Persistent Deviation Penalties
- Imbalance Penalties
- Curtailment Protocol Impact

California ISO (CAISO)

$0.60/MWh

ISO-NE



$0.75/MWh

ERCOT

$0.00/MWh
(Load pays all costs)

NYISO

$0.30/MWh

MISO

$0.21/MWh

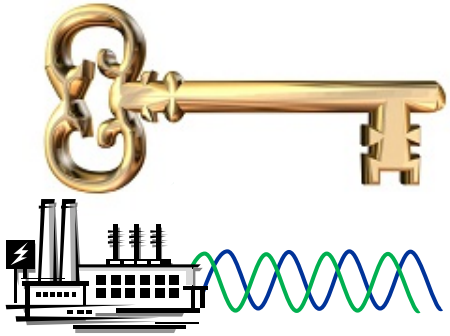
PJM

$0.25/MWh

Note: Market integration charges were calculated as all non-LMP (non-energy) costs charged to the wind assets divided by total MWh production at the wind facility.

Optimal Wind Integration Conditions

Modernized & robust electric grid



Large BAs with efficient access to flexible generation

Short-term electricity markets

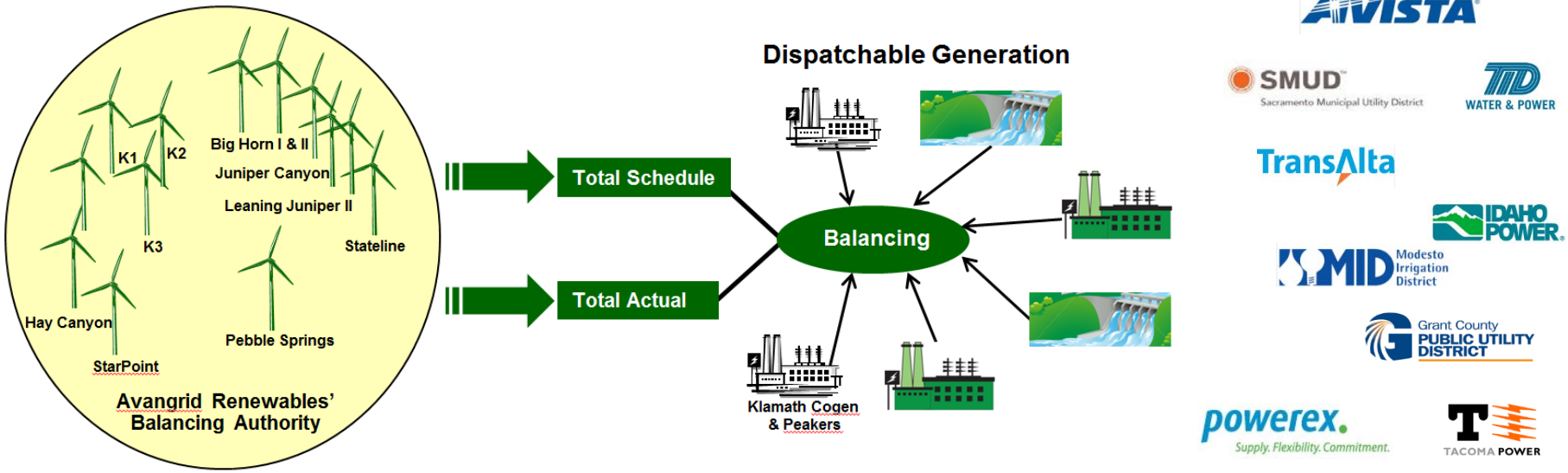
Price signals for generators to behave properly

Visibility of expected output of generation versus fundamentals

Strong incentives to offer ancillary services

What is the Balancing Authority project?

- Expand on Self Supply program and relationship with GridForce to become independent Balancing Authority Area (BAA)
- The new BAA will encompass Avangrid's Pacific Northwest assets (1390 MW of installed wind capacity) removing them from BPA BAA
- Utilization of existing Dynamic and On-Demand relationships to meet BA requirements



Drivers for becoming a Balancing Authority

Why are we becoming a BA?

- The Self Supply program has protected portfolio value and reduced wind curtailments on its 1,300 MW Northwest wind portfolio
- Self-Supply has provided considerable benefit to Avangrid since the start of the program
- In addition to financial benefit, Self Supply helped establish a strong reputation for the Avangrid as a as a sophisticated, solution-oriented player in the NW

BA Operations will enable the following Key Benefits:

- Increased cost savings
- Improved Operational Flexibility and access to a greater number of market structures that can only be utilized as a BA
- Long term integration cost certainty, enabling the company to provide improved service at a lower cost to customers
- A platform for growth through services to customers, 3rd parties and load serving entities

3% of online generation

Max of 42 MW based on 1389 MW of Installed Capacity

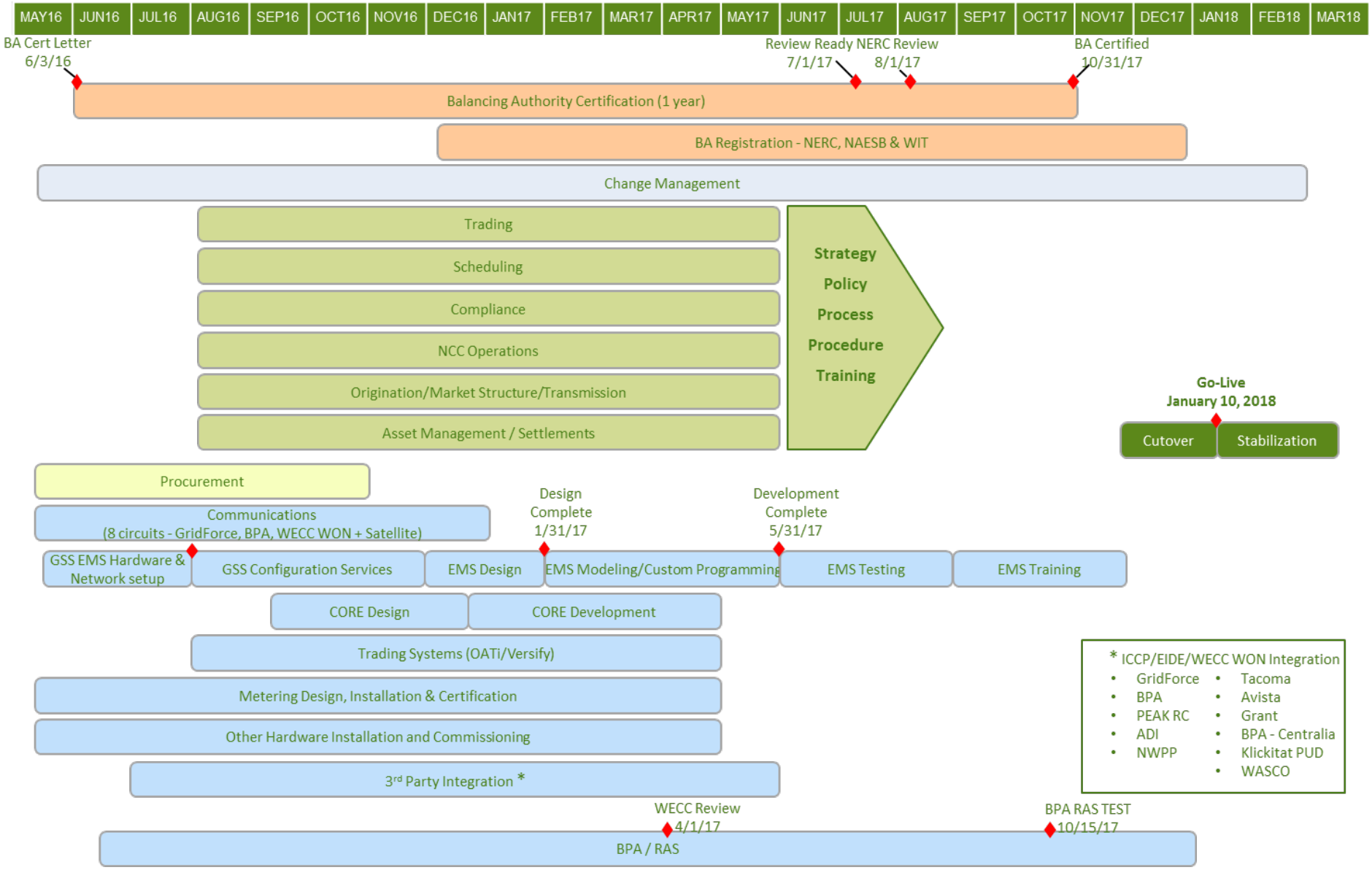
Spinning (Must be at least 50%)

- Dispatchable capacity on Klamath Falls co-gen and Hydro Slice
- Online peaking units with existing capacity
- Interchange transactions designated by the source BA as reserves
- Reserves held by other entities by agreement that is deliverable on firm transmission service

Non-Spin

- Offline Peakers
- Contract for on-demand INC for hours of need in DA or RT market
- Non-firm exports and/or other bilateral arrangements

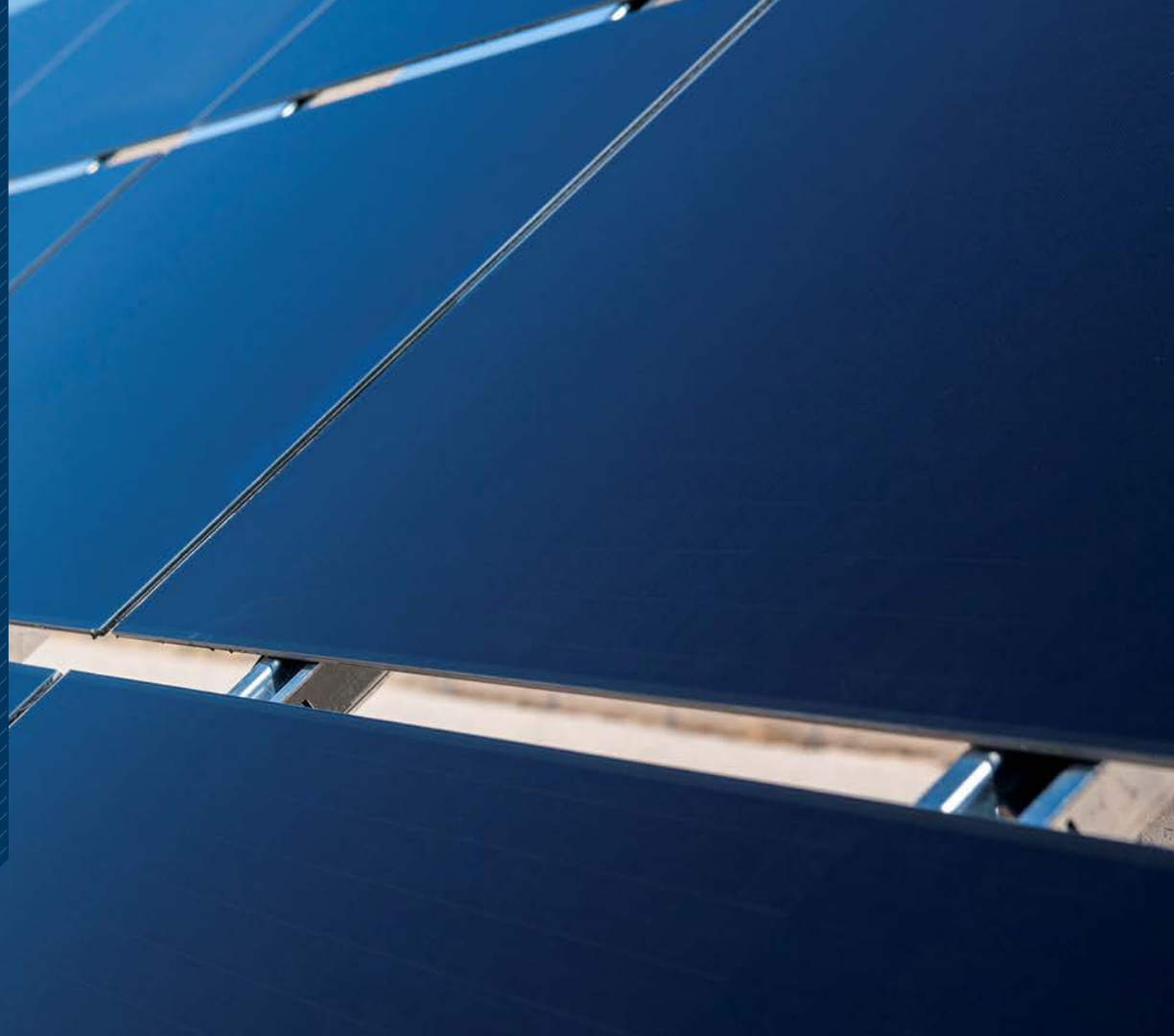
How do we get there - High Level Schedule



UTILITY-SCALE SOLAR OVERVIEW

October 2016

First Solar®



First Solar

- Brief History
- Manufacturing Capabilities
- Financial Strength

FIRST SOLAR AT A GLANCE

Over 13.5GW installed worldwide and over 4GW contracted pipeline

Cost competitive with conventional energy sources today

Partner of choice for leading utilities and global power buyers

Driving innovation across entire value chain and plant solution

Operate and Maintain over 5GW across North America

Strongest financial stability & bankability in the industry

Founded in 1999 and publicly traded on Nasdaq (FSLR)

GLOBAL OFFICES & MANUFACTURING

~6,060
Associates

~40,000
Global Supply Chain Jobs

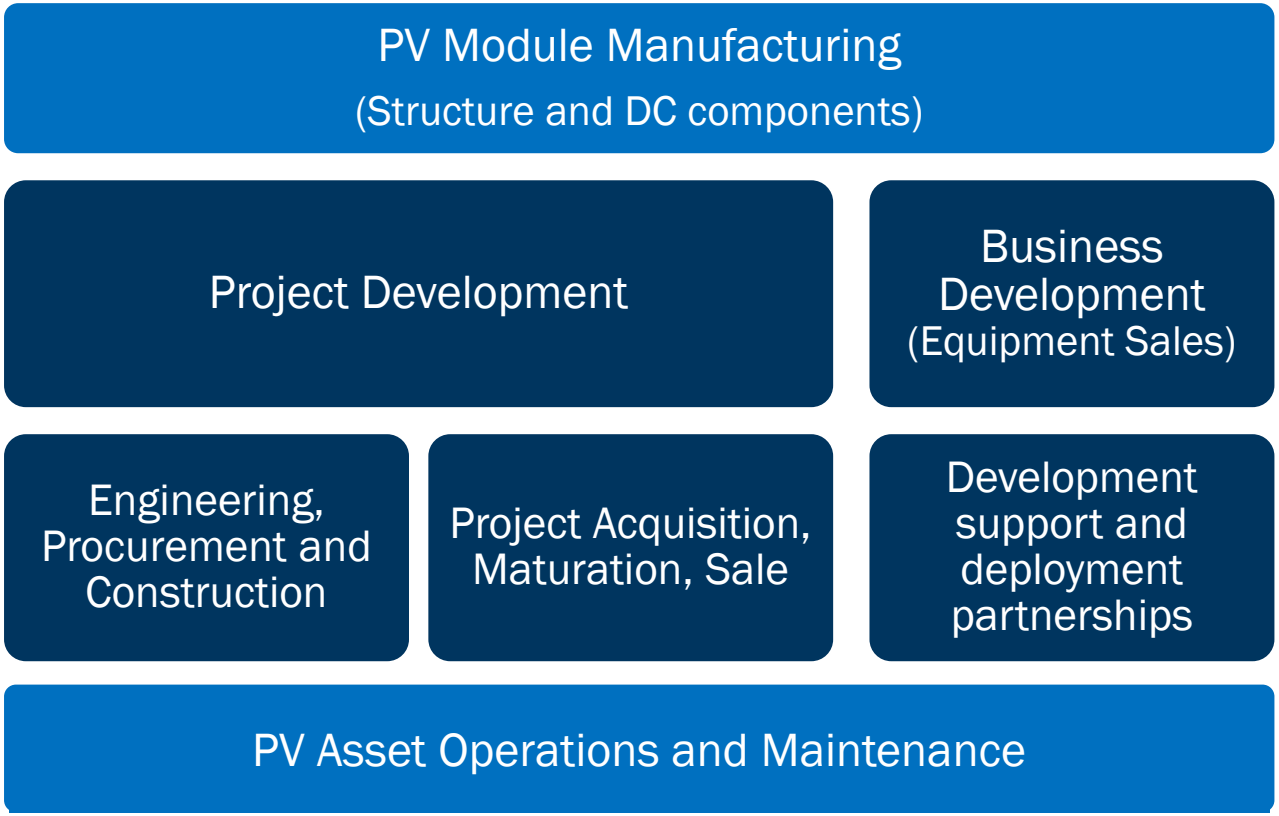
FIRST SOLAR AREAS OF OPERATION

Core Business: First Solar manufactures over 3GW/yr of thin film CdTe PV modules in Perrysburg, OH and Malaysia

Core Business: First Solar developed projects ensure enduring value to both PPA partners and asset owners. Equipment sales provides asset developers opportunities to create project and pipeline certainty

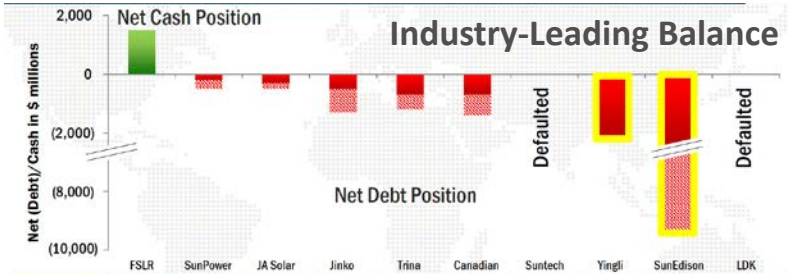
Enabling Business: First Solar EPC allows the company to drive innovation from concept to scale implementation. Supporting services enable delivery to key customers and their EPC partners

Core Business: First Solar global operational capabilities provide NERC support to over 5GW in N.A. and over 13GW globally



FIRST SOLAR PILLARS TO CREATING VALUE

Industry-Leading Balance Sheet

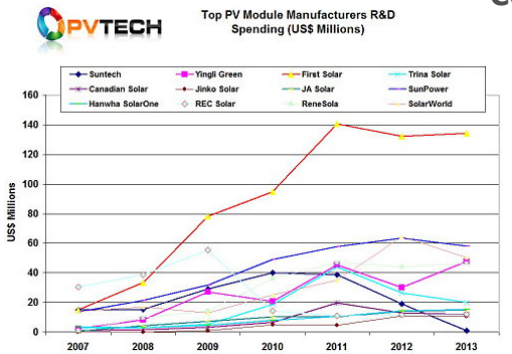


	FSLR	SunPower	JA Solar	Jinko	Trina	Canadian	Suntech	Yingli	SunEdison	LDK
Net Interest Income (Exp)	$16M	($42M)	($39M)	($60M)	($49M)	($37M)	Default	($155M)	($636M)	Default

2016 Competitor Capacity Announcements: Estimated Investment >$2 billion

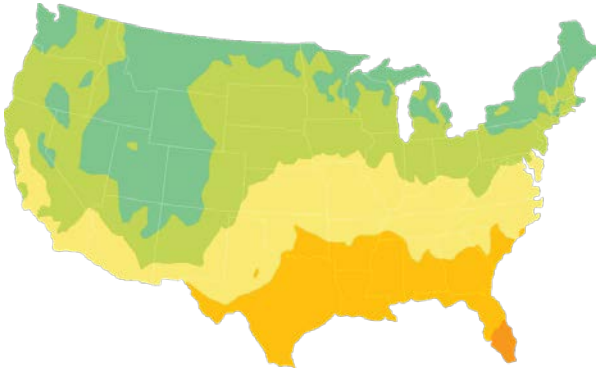
Source: Net cash/debt based on Photon Consulting estimates as of Dec 2015. Net interest expense for 2015 or last 12 months based on company filings. Competitor capacity based on public announcements. Estimated investment in capacity assumes $0.34/w for wafer, $0.23/w for cell and $0.09/w for module.

Consistent Investment R&D



$134M in 2013 → $130–140M 2014–2017

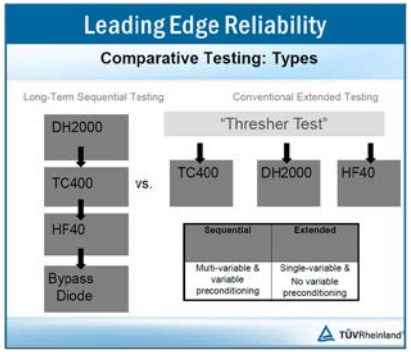
Proven Advancements – Real-World Energy Advantage

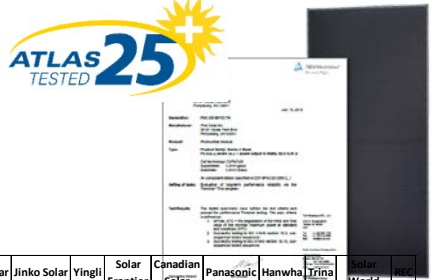


CdTe % advantage vs mc-si

- < = 2.0%
- < = 3.6%
- < = 5.2%
- < = 6.8%
- < = 8.4%
- < = 10.0%
- < = 11.6%
- < = 13.2%
- < = 14.8%
- < = 16.4%
- < = 18.0%
- > 18.0%

Commitment to Reliability





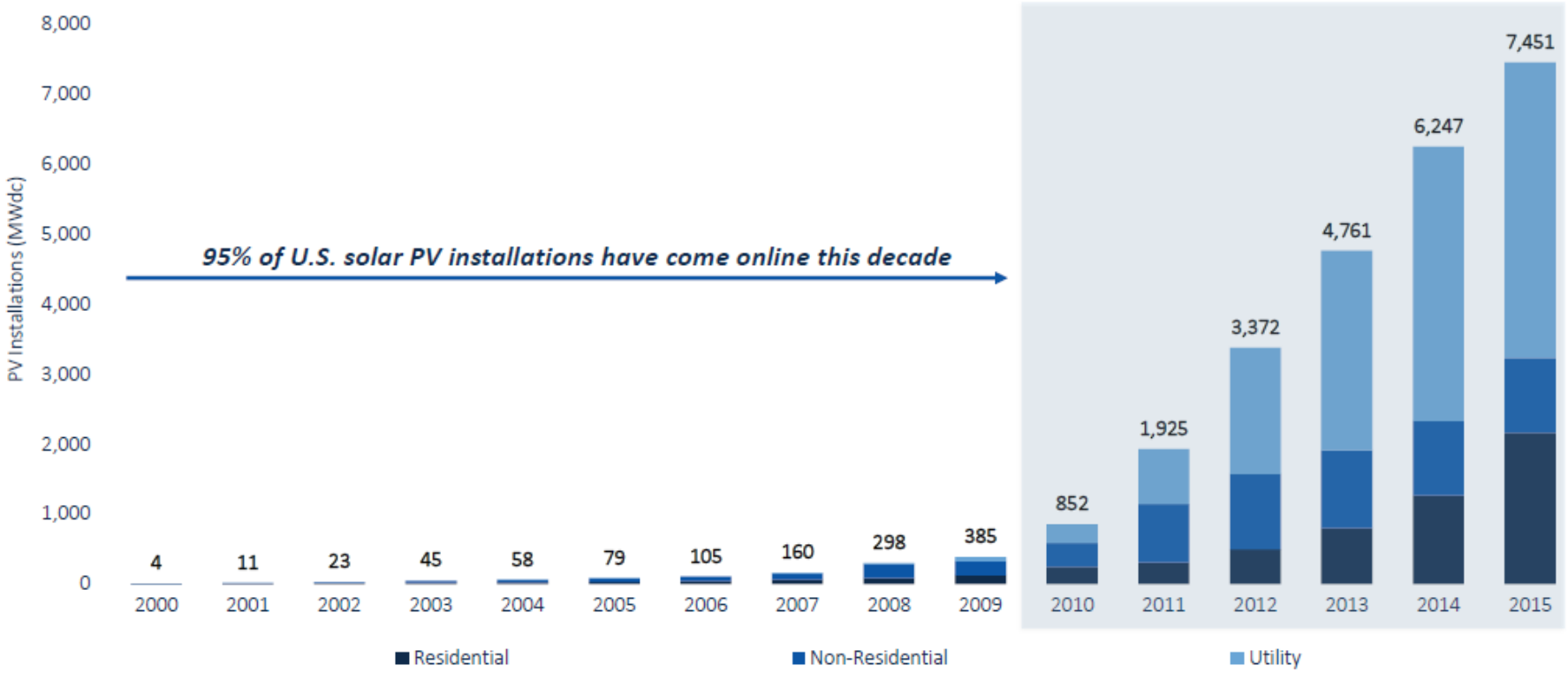
http://www1.eere.energy.gov/solar/pdfs/pvmrw12_amichman.pdf
http://www1.eere.energy.gov/solar/pdfs/pvmrw20

Long-term Reliability	FSLR S3 Black	SunPower	JA Solar	Jinko Solar	Yingli	Solar Frontier	Canadian Solar	Panasonic	Hanwha	Trina	Solar World	REC
Independent Thresher Test	X		X									
TUV Sequential Test Certification	X							X	X			
Atlas 25+	X	X										

First Solar®

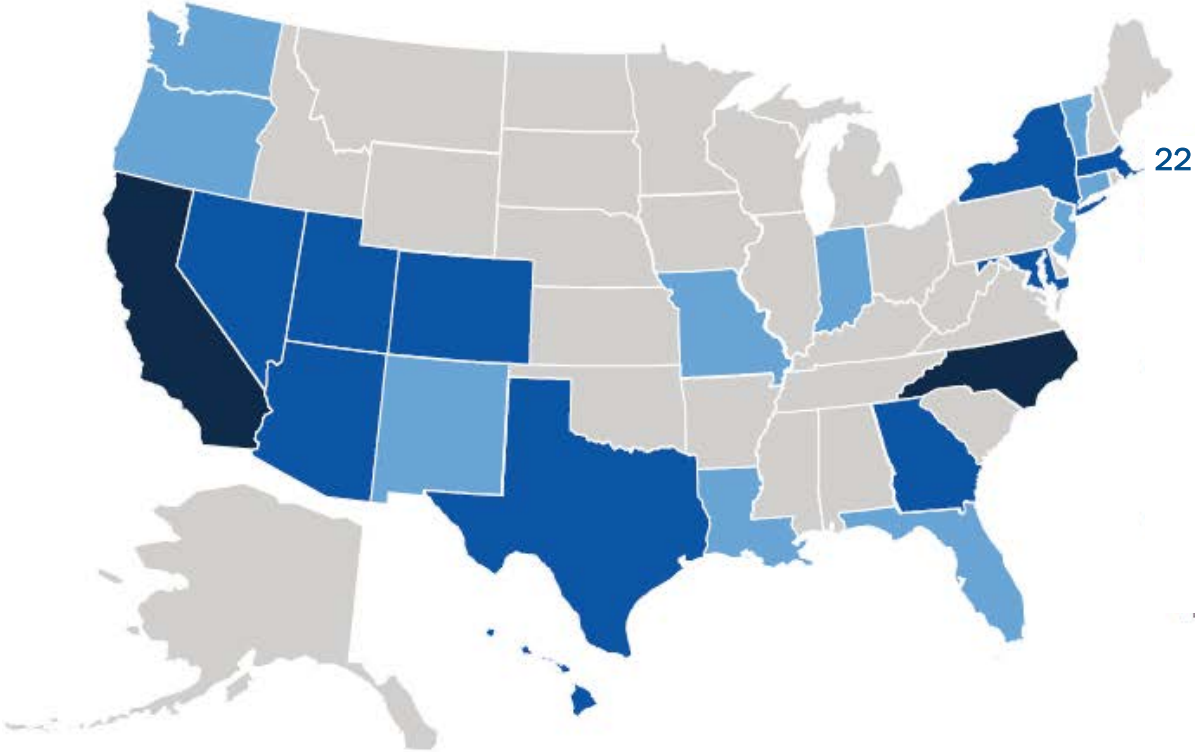
US SOLAR MARKET SNAPSHOT

ANNUAL INSTALLED CAPACITY CONTINUES TO GROW



GTM Research – The State and Future of US Solar

REGIONAL DIVERSITY IN DEPLOYMENTS IS RAPIDLY GROWING



22 states installed at least 20MW of PV in 2015

- 11 of those states added more than 100 MWdc
- 2 of those states added more than 1 GWdc

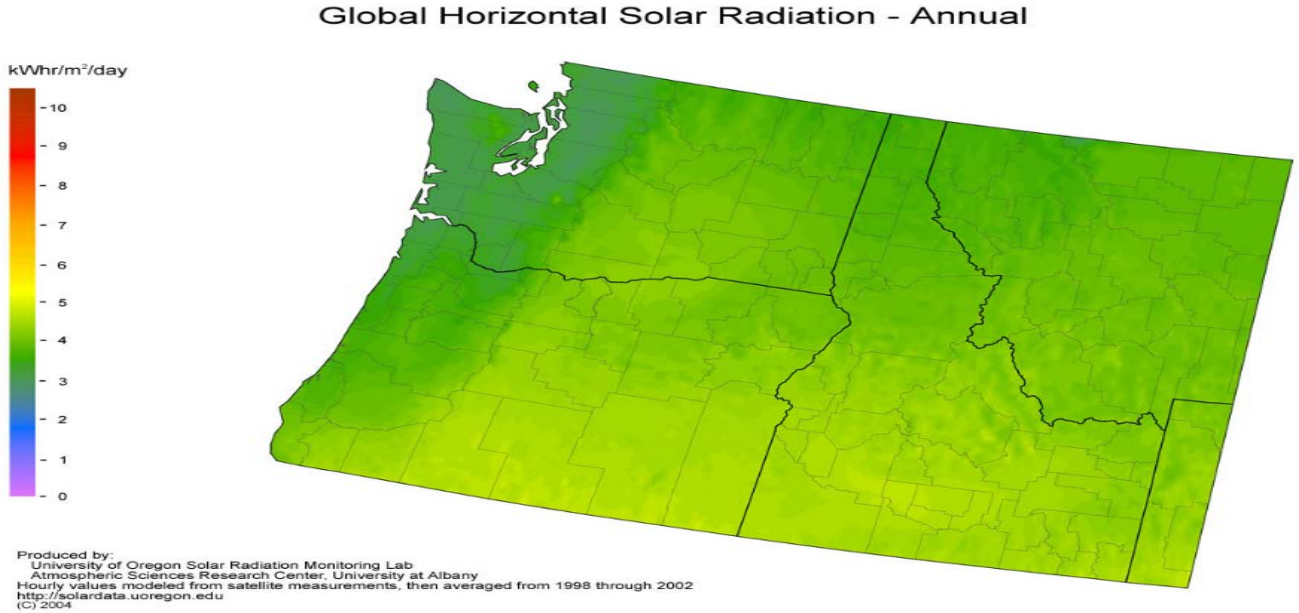
- For the past 10 quarters, the US solar market has added more than 1 GWdc of capacity

- There is now **over 27.5 GWdc of operating** solar PV capacity across the US

GTM Research – The State and Future of US Solar

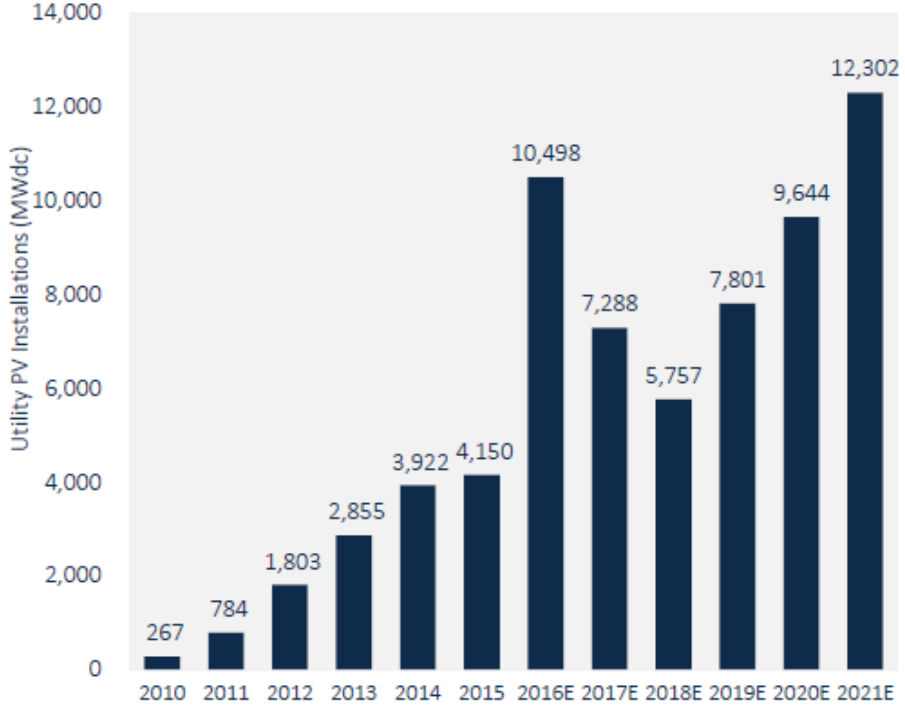
OPPORTUNITY IN NORTHWEST GROWING

- Utility-scale solar becoming increasingly competitive with wind in the Pacific Northwest
- Transmission constraints can present a challenge for renewable resources
- CAISO EIM and California RPS broadens regional opportunities for local renewable resources
- OR RPS (50% by 2040) and Clean Power Plan (potential trading opportunities) present long-term opportunities for new solar PV build. Utility scale market in WA is underdeveloped, but continued cost declines will open new market opportunities.

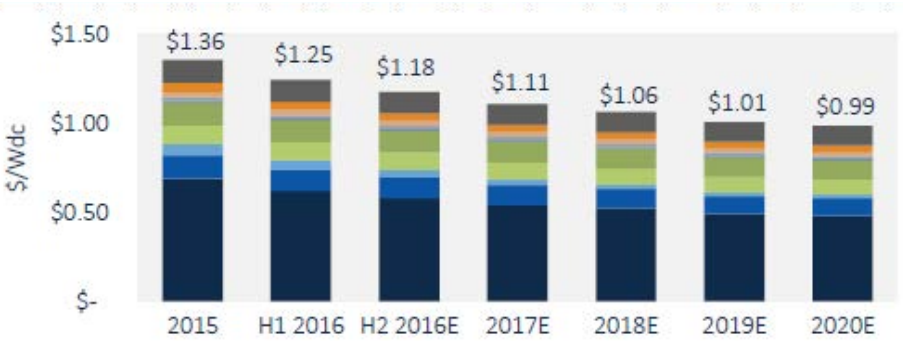


PROCUREMENT TO ACCELERATE AS RESOURCE DEMAND GROWS

Utility resource need-based procurement anticipated to rebound into 2020 and beyond



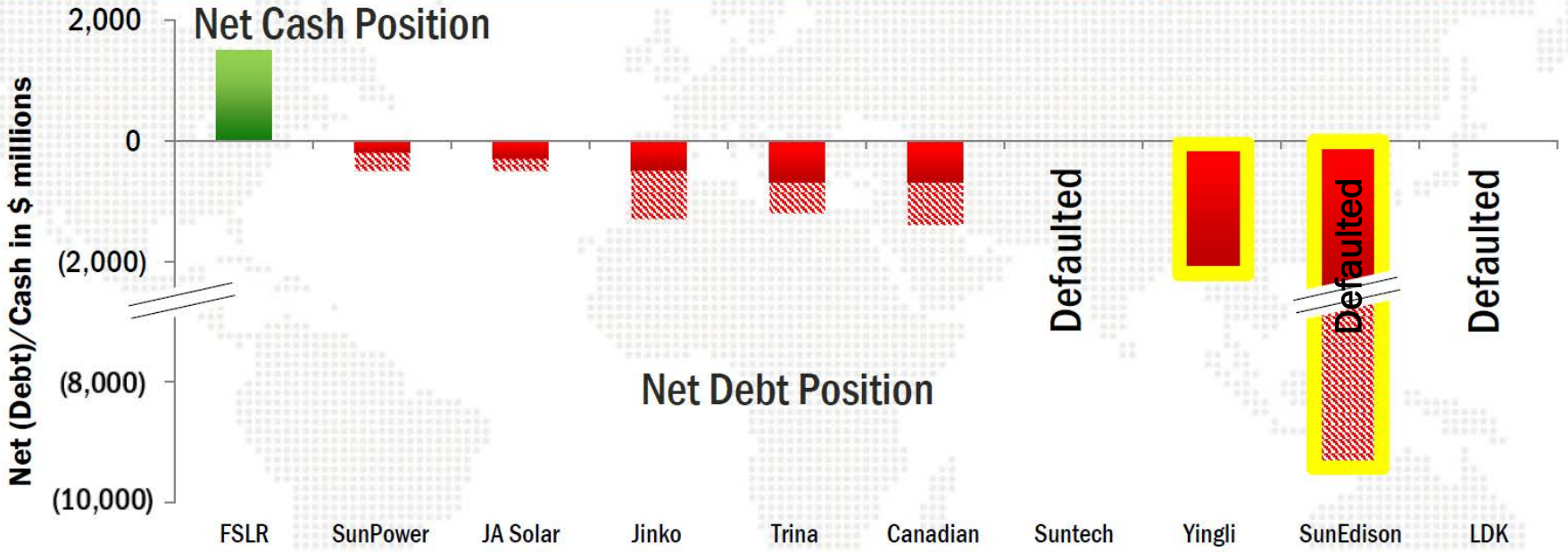
Fixed-Tilt Utility-Scale System Pricing



Fixed-tilt systems likely to remain valuable in the northern US

- Regional application on single-axis tracking increasingly viable in the north as system costs decline
- Single-axis tracker drive 6-10 cent premium over fix-tilt deployments

MARKET DYNAMICS HAVE DISTRESSED MANUFACTURE BALANCE SHEETS



	FSLR	SunPower	JA Solar	Jinko	Trina	Canadian	Suntech	Yingli	SunEdison	LDK
Net Interest Income (Exp)	$16M	($42M)	($39M)	($60M)	($49M)	($37M)	Default	($155M)	($636M)	Default

2016 Competitor Capacity Announcements: Estimated Investment >$2 billion

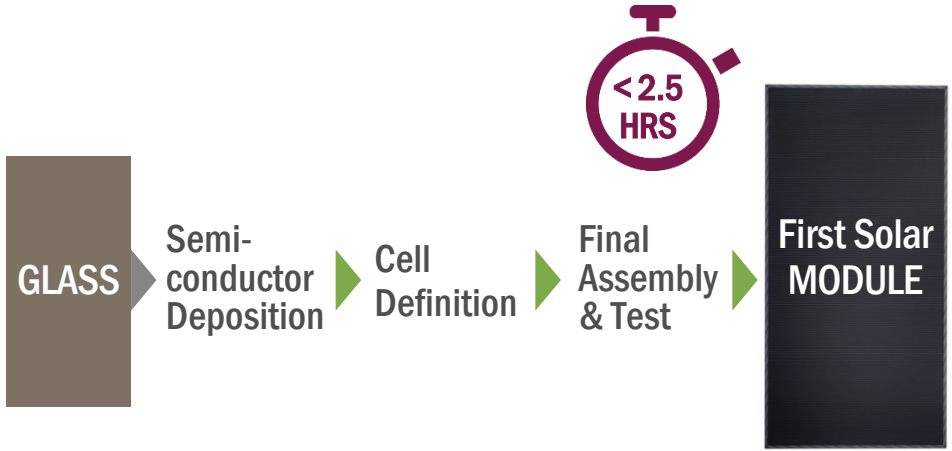
5 ***Source:*** Net cash/debt based on Photon Consulting estimates as of Dec 2015. Net interest expense for 2015 or last 12 months based on company filings. Competitor capacity based on public announcements. Estimated investment in capacity assumes $0.34/w for wafer, $0.23/w for cell and $0.09/w for module.

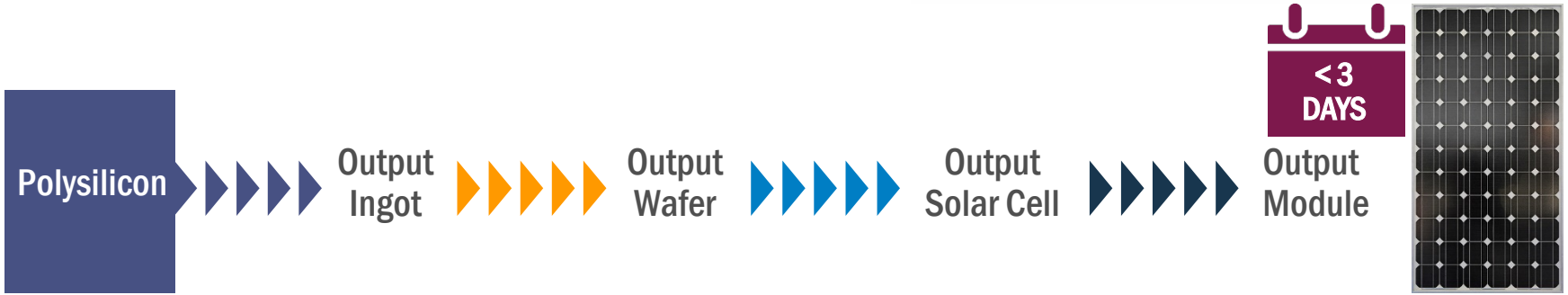
Manufacturing and Technology

- Manufacturing Process
- Efficiency Roadmap
- Reliability

TWO DISTINCT APPROACHES TO PV — IT'S ALL ABOUT MANUFACTURING

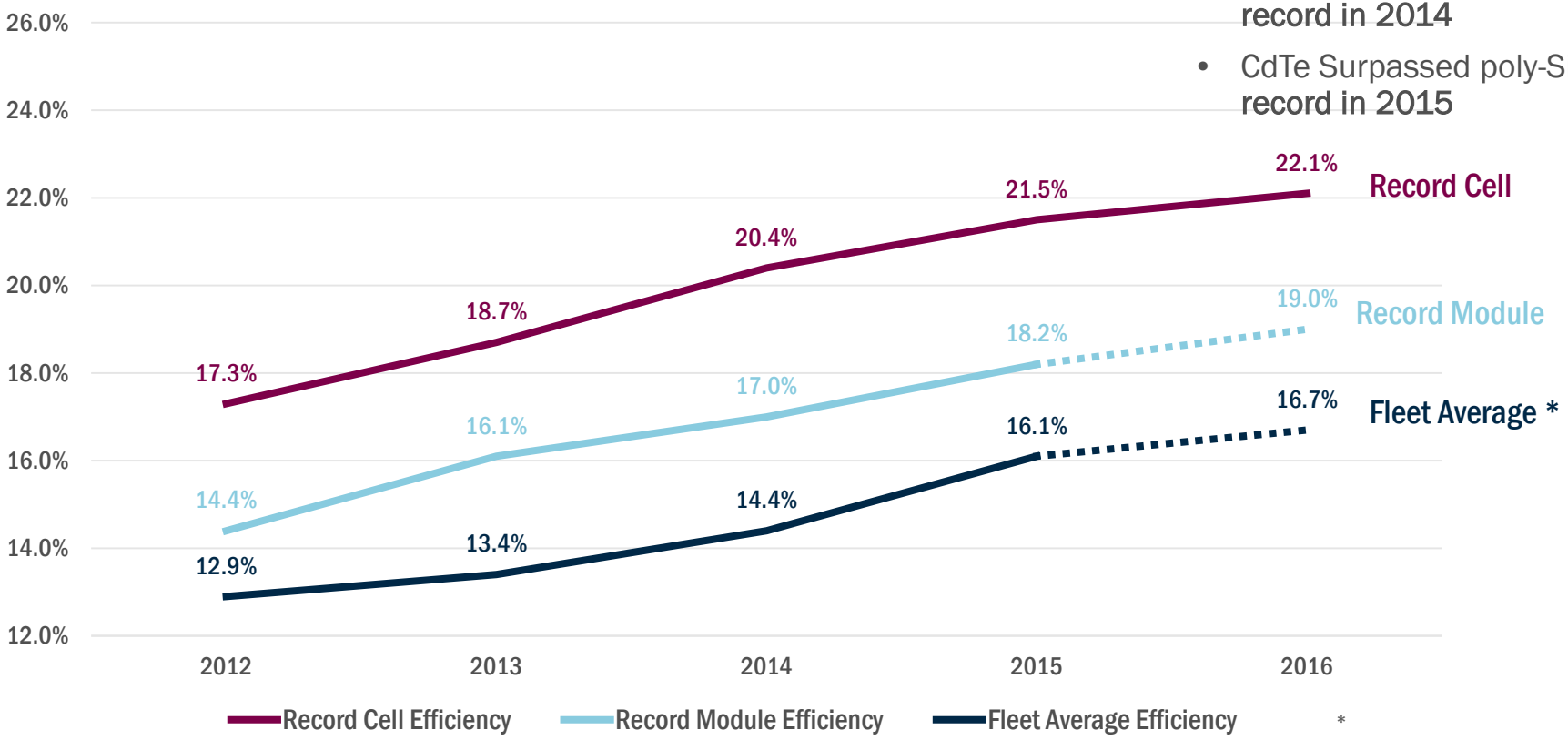
First Solar Fully Integrated, Automated & Continuous Thin Film Process





CONTINUOUS TRACK RECORD OF EFFICIENCY IMPROVEMENTS

- CdTe Surpassed poly-Si **cell** record in 2014
- CdTe Surpassed poly-Si **module** record in 2015



* Represents Q4 full fleet average.

FIRST SOLAR MODULES– WORLD LEADING RELIABILITY

- IEC 61646/IEC 61730 **1500V** Certification
- **External Thresher Certification → Pass!**
  - <5% Power Output drop
- **TUV Long Term Sequential Test → Pass!**
  - 1st thin film module to pass
  - **One of only 5 modules[1]** in the world to pass LST
- **Atlas 25+ → Pass!**
  - **One of only 4 modules[2]** in world to pass Atlas 25+
- PID-Free (+/- 1500V)
- IEC 60068 Desert Sand Resistant

TÜVRheinland®
Precisely Right.

Solar / Fuel Cell Technologies
Photovoltaic Modules

ATTN: Richard Morton
First Solar Inc.
28101 Cedar Park Blvd
Perrysburg, OH 43551

July 15, 2013

Declaration: FSC-20130712-TH

Manufacturer: First Solar Inc.
28101 Cedar Park Blvd
Perrysburg, OH 43551

Product: Photovoltaic Module

Type: **Product family: Series 3 Black**
FS-3xx.x, where xx.x = power output in Watts, 82.5 to 87.5

Cell technology: CdTe/CdS
Superstrate: 3.2mm glass
Substrate: 3.2mm Glass

All component details specified in CDF #FSC20120612_1

Setting of tasks: Evaluation of long-term performance reliability via the Thresher[1] Test program.

Test Results: The tested specimens have fulfilled the test criteria and passed the performance Thresher testing. The pass criteria is defined as:

1. ΔPmax, STC < 5% degradation of the initial and final value of the nominal maximum power at standard test conditions (STC)
2. Successful testing to IEC 61646 section 10.3, subsequent all tested sequences
3. Successful testing to IEC 61646 section 10.15, subsequent all tested sequences

TUV Rheinland PTL, LLC
2210 S. Roosevelt St.
Tempe, AZ 85282
USA
Tel: +1 480 966 1700
Fax: +1 778 314 8484
Mail: info@tuvpt.com

North American Headquarters
1 Federal Street
Boston, MA 02110
Tel: 617-422-4888
Toll Free: TUV-RHEINLAND
Web: www.tuv.com

Member of TÜV Rheinland Group

Samantha Driskill
Operations Engineer

Bill Shisler
Regional Business Field Manager

1st Thin-Film PV Module to pass Thresher & TUV Long Term Sequential Test
— TUV Rheinland

1-Panasonic HIT, Kyocera, Hanwha, Inventec, 2- Sunpower, LG, Suntech

FIRST SOLAR – TESTED AND PROVEN WITH UTILITIES IN MIND

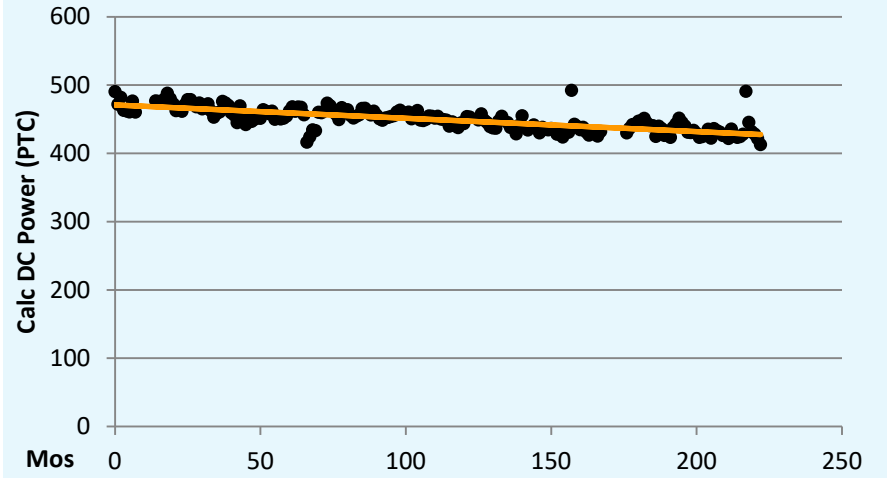
		FSLR S4	SunPower	JA Solar	Jinko Solar	Yingli	Solar Frontier	Canadian Solar	Panasonic	Hanwha	Trina	Solar World	REC
Long-term Reliability	**Independent Thresher Test**	X		**X**									
	TUV Sequential Test Certification	X							**X**	**X**			
	Atlas 25+	X	**X**										
Integrity in Under Specific Environmental Conditions	IEC Temp Cycle -40 to +85C 200 Cycles	X	X	X	X	X	X	X	X	X	X	X	X
	Temp Cycle -40 to +85C 600 Cycles	X	X	X					X	X			
	IEC Damp Heat 85C/85%RH 1000 hrs	X	X	X	X	X	X	X	X	X	X	X	X
	Damp Heat 85C/85%RH 2000 hrs	X	X	X					X	X			
	IEC Humidity Freeze 10 cycles	X	X	X	X	X	X	X	X	X	X	X	X
	Humidity Freeze 40 cycles	X		X					X	X			
	IEC 60068 Desert Sand Resistance	X			X	X							
Chemical Environments	PID Free (negative grounded)	X	X	X	X	X		X			X	X	X
	IEC61701 Salt Mist Corrosion	X	X	X	X	X	X	X					
	Ammonia Resistance	X	X		X		X	X					
	Chemical Exposure, FSLR-ALT, etc.	X											

The cornerstone of procurement is independently tested quality

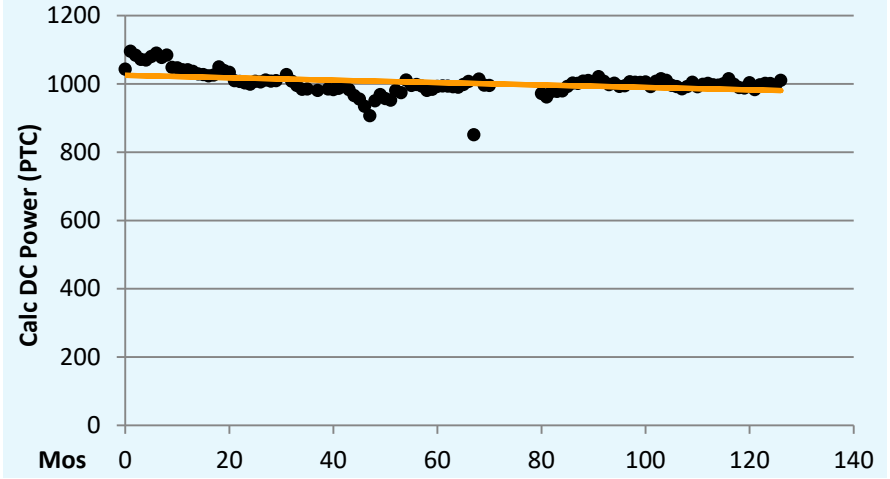
*Based on public available records

EXTENDED THIRD PARTY FIELD TESTING – LONG TERM DEGRADATION AT NREL

20+ year NREL degradation study: -0.45%/yr[1]



14+ year degradation study: -0.29%/yr[2]



- Long-term linear degradation rate
- Degradation rates comparable to other established PV Technologies (c-Si, poly-Si)
- No indication of wear out mechanism or cliff event that would limit life

[1] NREL January 2015 Study – FS Document PD-5-615 (±0.07 Type A Statistical Uncertainty) Author: Dirk Jordan, NREL
[2] NREL January 2015 Study – FS Document PD-5-636 (±0.19 Type A Statistical Uncertainty) Author: Dirk Jordan, NREL
Photo Credit: Dennis Schroeder, NREL PIX 21822

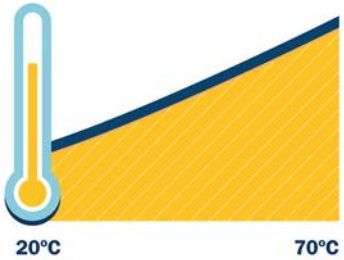
First Solar's Field Performance

Thermal, Shading and Spectral Responses

ENERGY DENSITY ADVANTAGE

A

SUPERIOR TEMPERATURE **COEFFICIENT**



UP TO 2%
MORE SPECIFIC ANNUAL ENERGY YIELD (SY) THAN C-Si

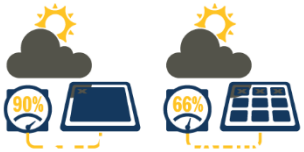
B

BETTER SPECTRAL **RESPONSE**

UP TO 6%
MORE SPECIFIC ANNUAL ENERGY YIELD (SY) THAN C-Si **IN HUMID CONDITIONS**

C

BETTER SHADING **RESPONSE**



1% **MORE** SY THAN C-Si

D

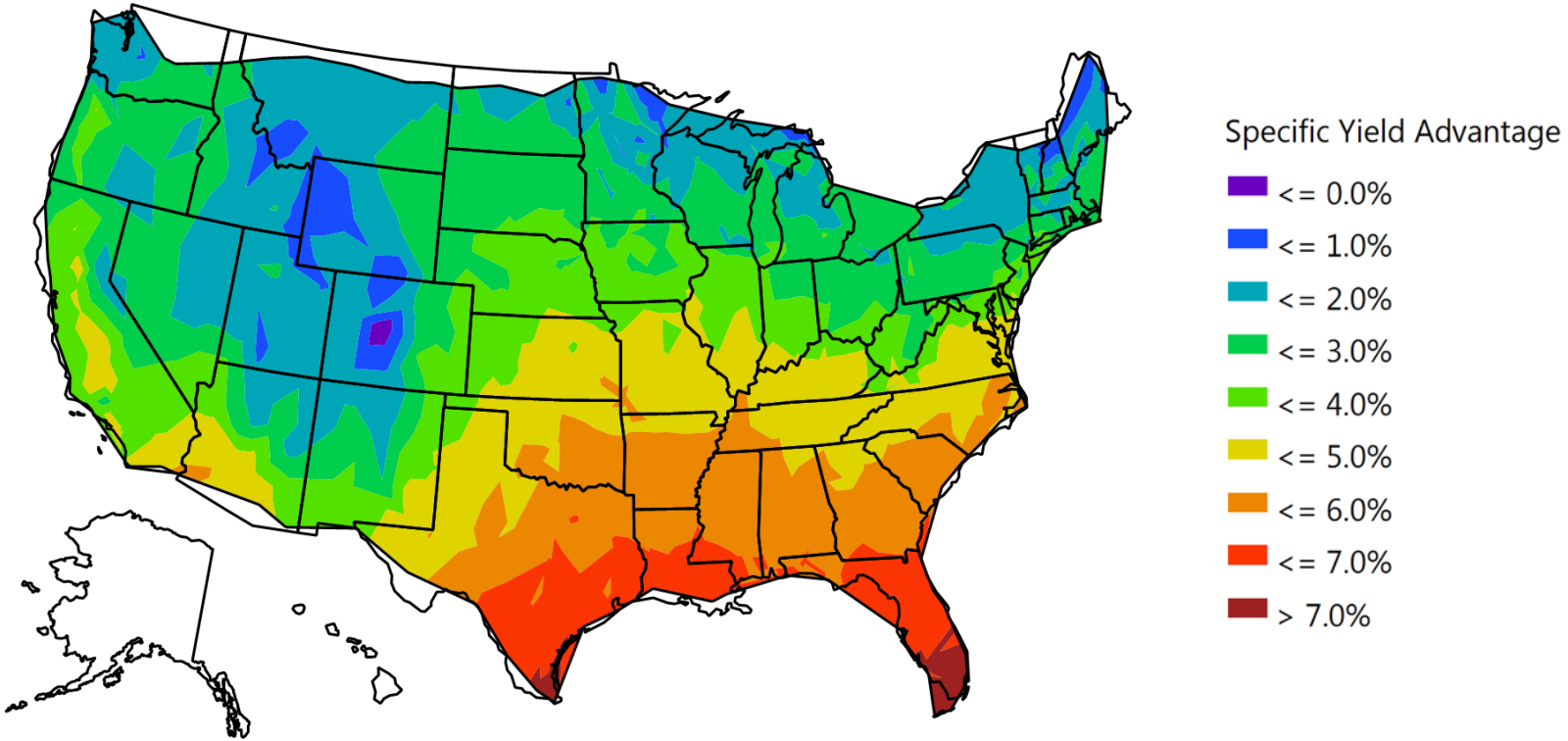
EFFICIENCY DIFFERENCE BETWEEN FIRST SOLAR AND mc-Si

A+B+C+D = UP TO 11%

BETTER ENERGY DENSITY

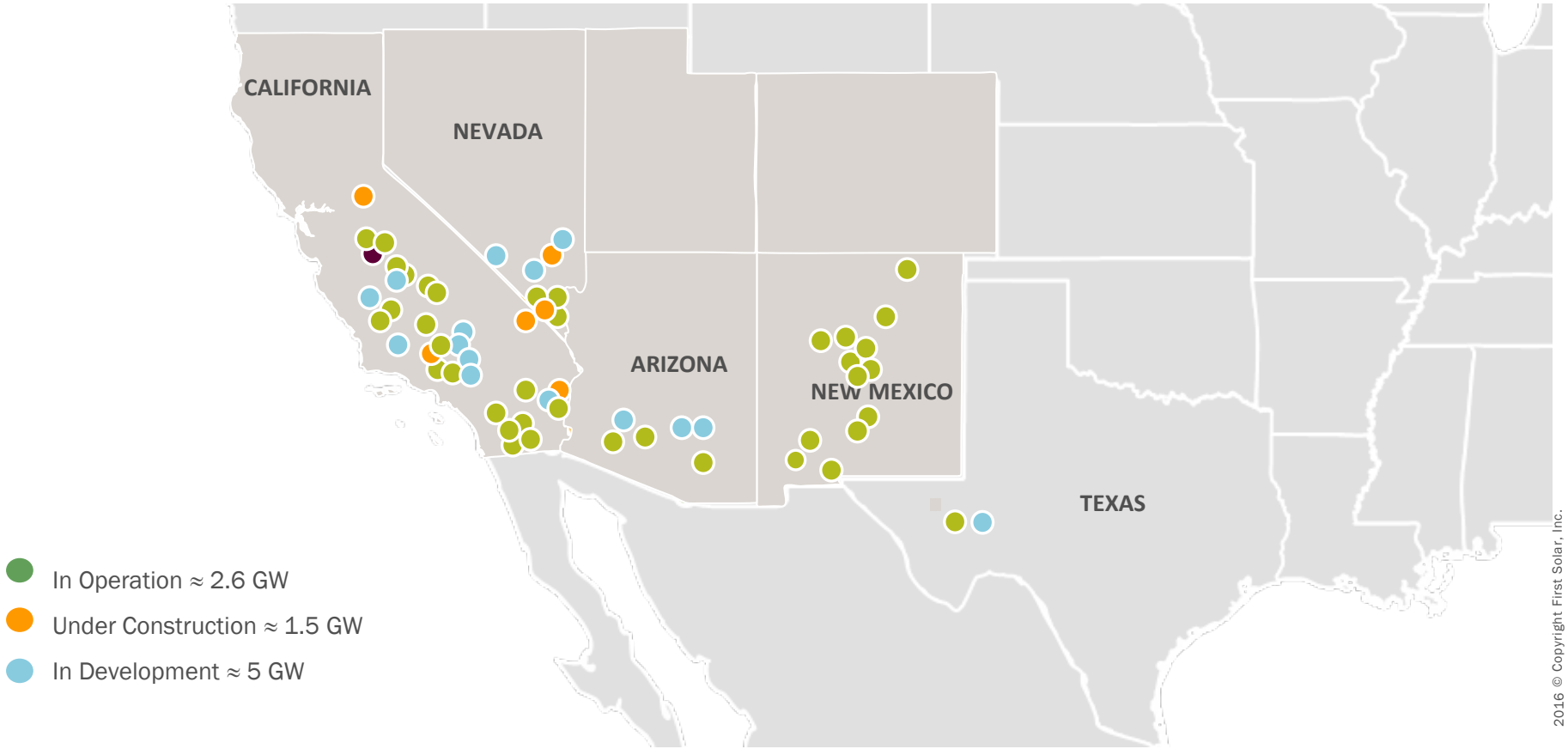
Represents lead line efficiency for both First Solar and multi-crystalline silicon. Multi-crystalline silicon based on 2016 forecast from ITRPV roadmap dated July 2015

FIRST SOLAR ENERGY YIELD ADVANTAGE



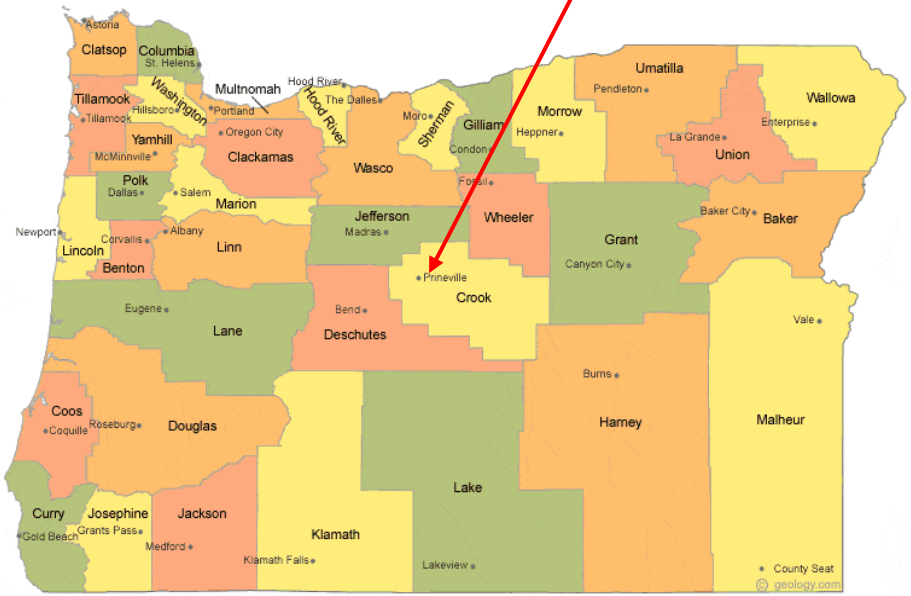
Solar Project Development and Finance

OVER 6 GW OF FIRST SOLAR TECHNOLOGY IN WESTERN U.S.



FIRST SOLAR OREGON PROJECT

- Project: Rimrock Solar
- Seller: First Solar Development, LLC
- Project Location: Crook County, OR
- Point of interconnection/delivery: Powell Butte – Houston Lake (115kV)
- DEF interconnection application filed 5/18/2016
- Contract Capacity: 55.0MW
- Estimated Net Capacity Factor: ~25%
- COD: 12/2019



EXAMPLE US PROJECT FINANCINGS

	AVSR 1	Agua Caliente	Desert Sunlight	Topaz
				
Size (MWac)	230	290	550	550
~US$ Raised (Public Estimates)	$1.2 bn	$1.5 bn	$2.5 bn	$2.4 bn
Owner(s)	Exelon.	nrg MIDAMERICAN ENERGY HOLDINGS COMPANY	NEXTera ENERGY GE Energy Financial Services	MIDAMERICAN ENERGY HOLDINGS COMPANY
Bond Market			✓	✓
Federal Financing Bank	✓	✓		
Bank Market			✓	
Credit Guarantee: DoE	✓	✓	✓	
Uncovered Markets			✓	✓

Solar Plant Operations and Grid Services

Grid Services
PV + Storage

FIRST SOLAR ENERGY SERVICES — THE WORLD'S LARGEST PV O&M PROVIDER*

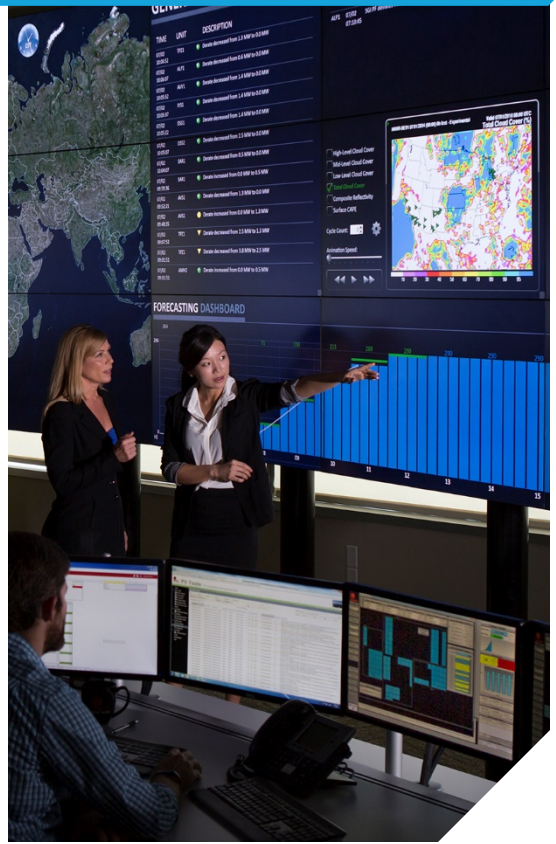
Bankability
- ✓ Backed by the PV industry's strongest balance sheet
- ✓ Bloomberg Energy Finance ranked First Solar the most bankable PV company**

Unique Experience
- ✓ 10,000MW+ DC managed with our supervision platform
- ✓ 4,300MW+ DC operated by our O&M staff

Advanced Technology
- ✓ World's leading monitoring platform for utility PV
- ✓ State-of-the-art Operations Centers
- ✓ Innovative performance engineering

Global Scale
- ✓ 300+ staff worldwide
- ✓ Running plants in over 30 countries
- ✓ Ops centers in the USA, Germany, Australia, Japan***

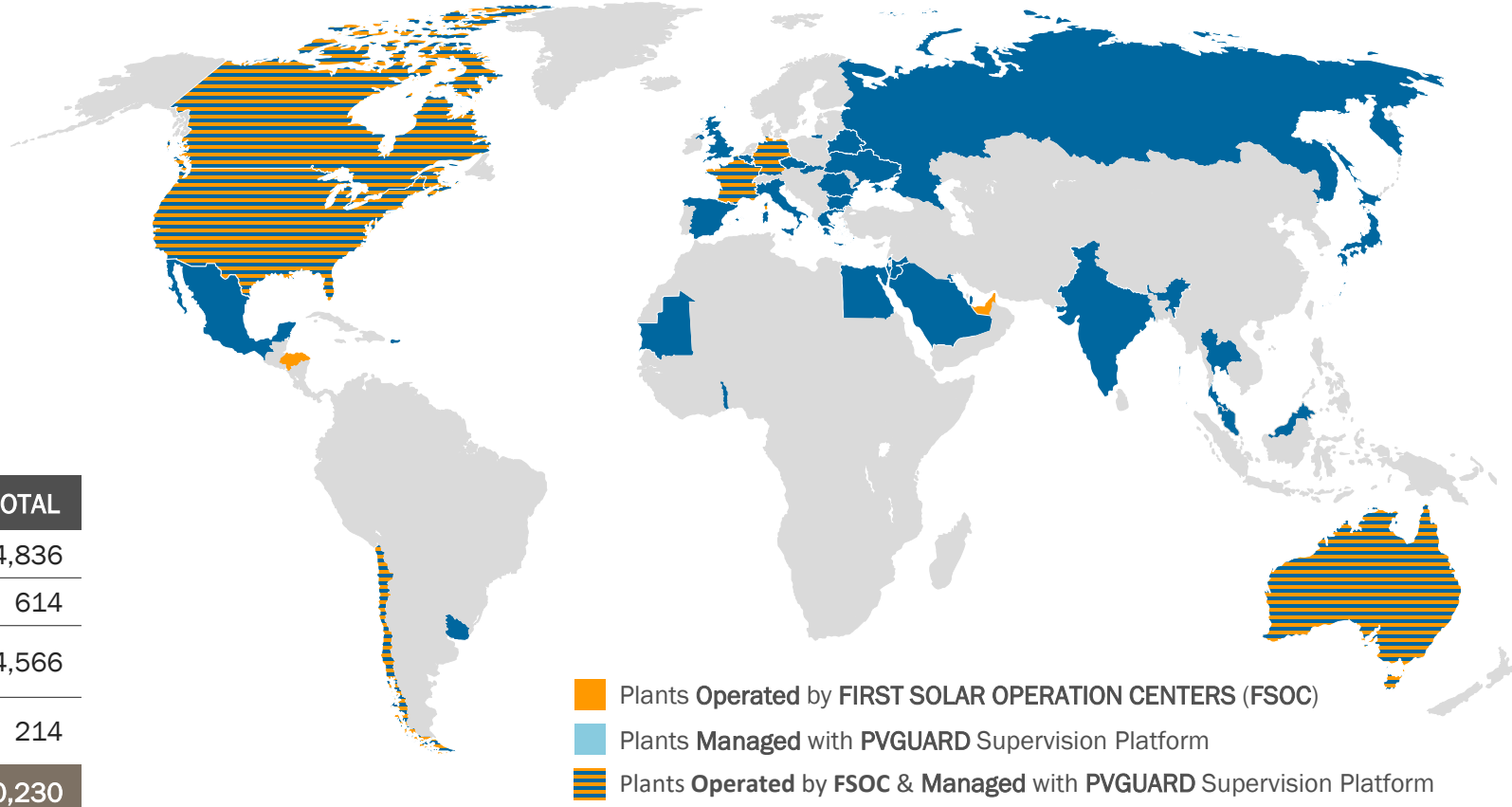
Proven Performance
- ✓ 99.5% energy availability (2012–2014)
- ✓ 101% performance vs. expectations (2014)



*Named by GTM Research in "*Megawatt-Scale PV O&M and Asset Management 2015-2020*" Operations Center planned in 2016

** Bloomberg Energy Finance *"PV module bankability 2014: where's the trust?"* ***Japan

10,000MW DC SUPERVISED BY FIRST SOLAR ENERGY SERVICES STAFF AND/OR TECHNOLOGY



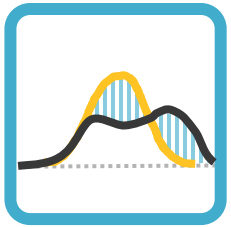
MW DC	TOTAL
EMEA	4,836
Asia Pacific	614
North America	4,566
Latin America	214
WORLDWIDE	10,230

ADVANCED SOLAR PLANTS PROVIDE A **SUITE** OF GRID SERVICES

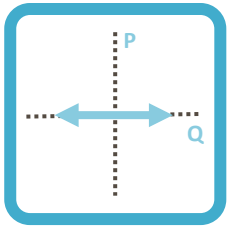
ISO/RTO Services

Frequency Regulation

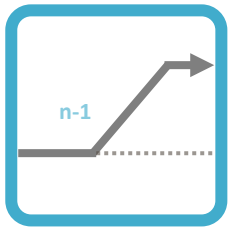
Load Following



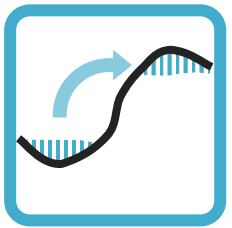
Voltage Support



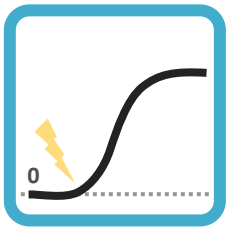
Spinning Reserves



Energy Arbitrage

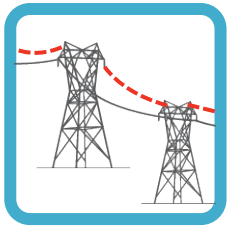


Black Start

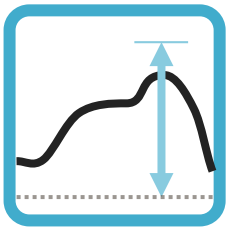


Utility Services

Upgrade Deferral

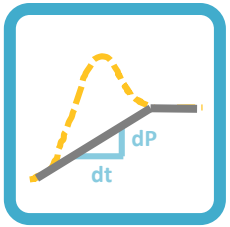


Resource Adequacy



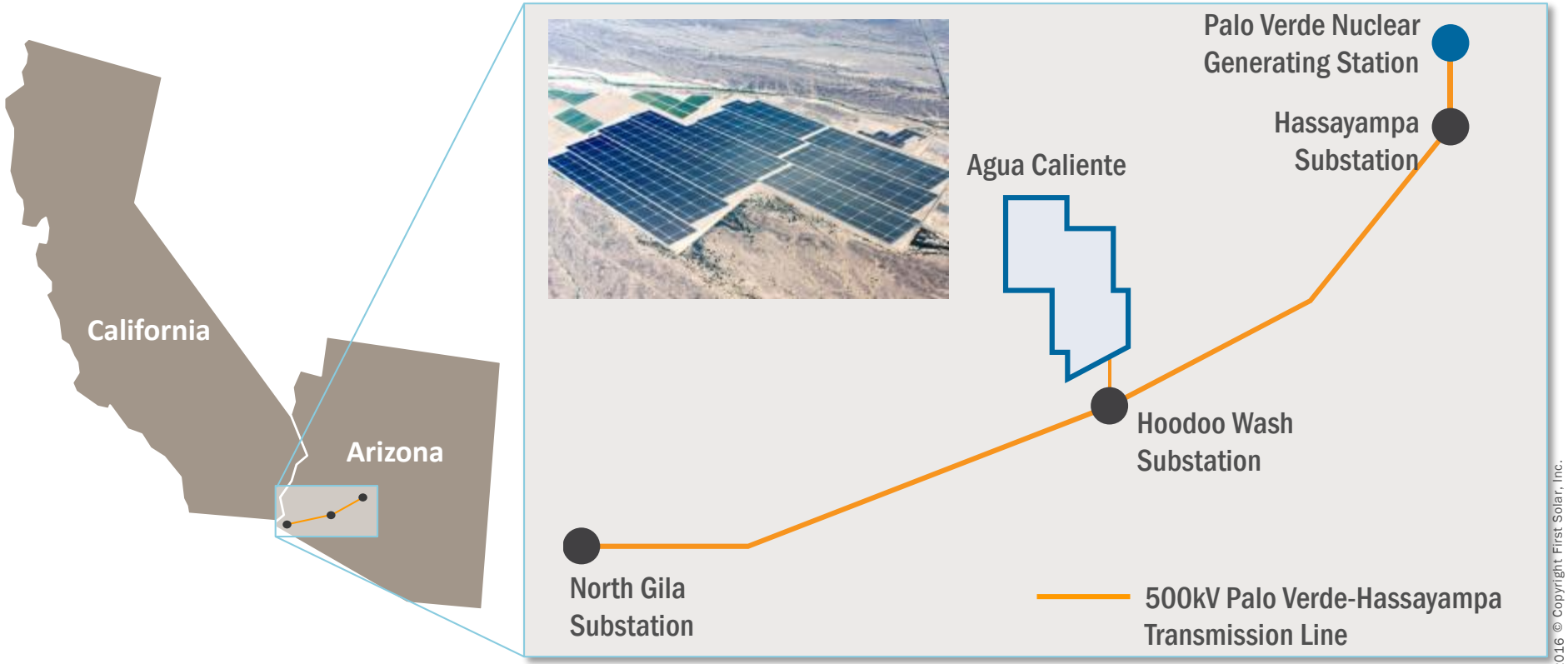
Plant Output shaping

Ramp Control

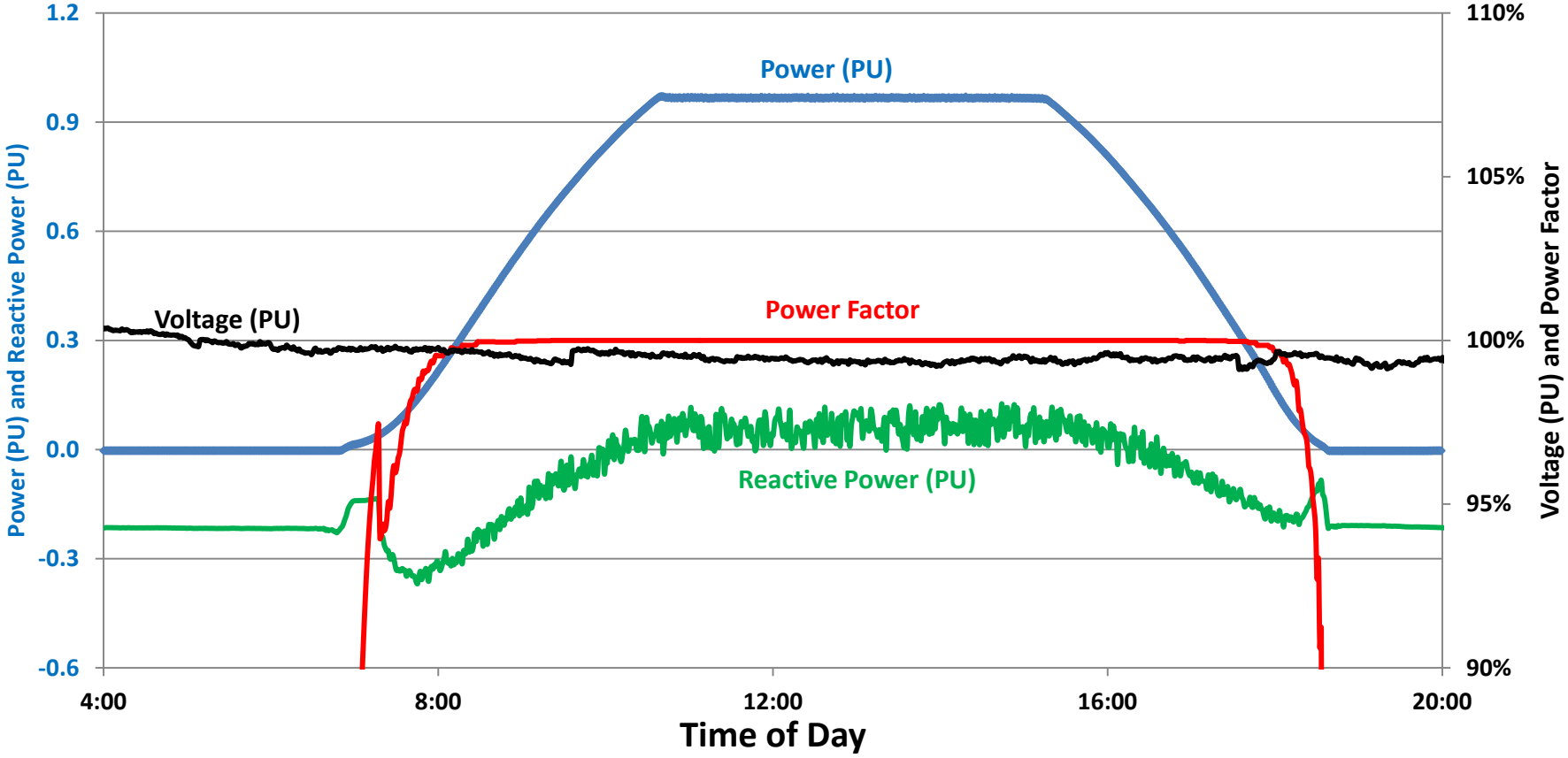


Firming

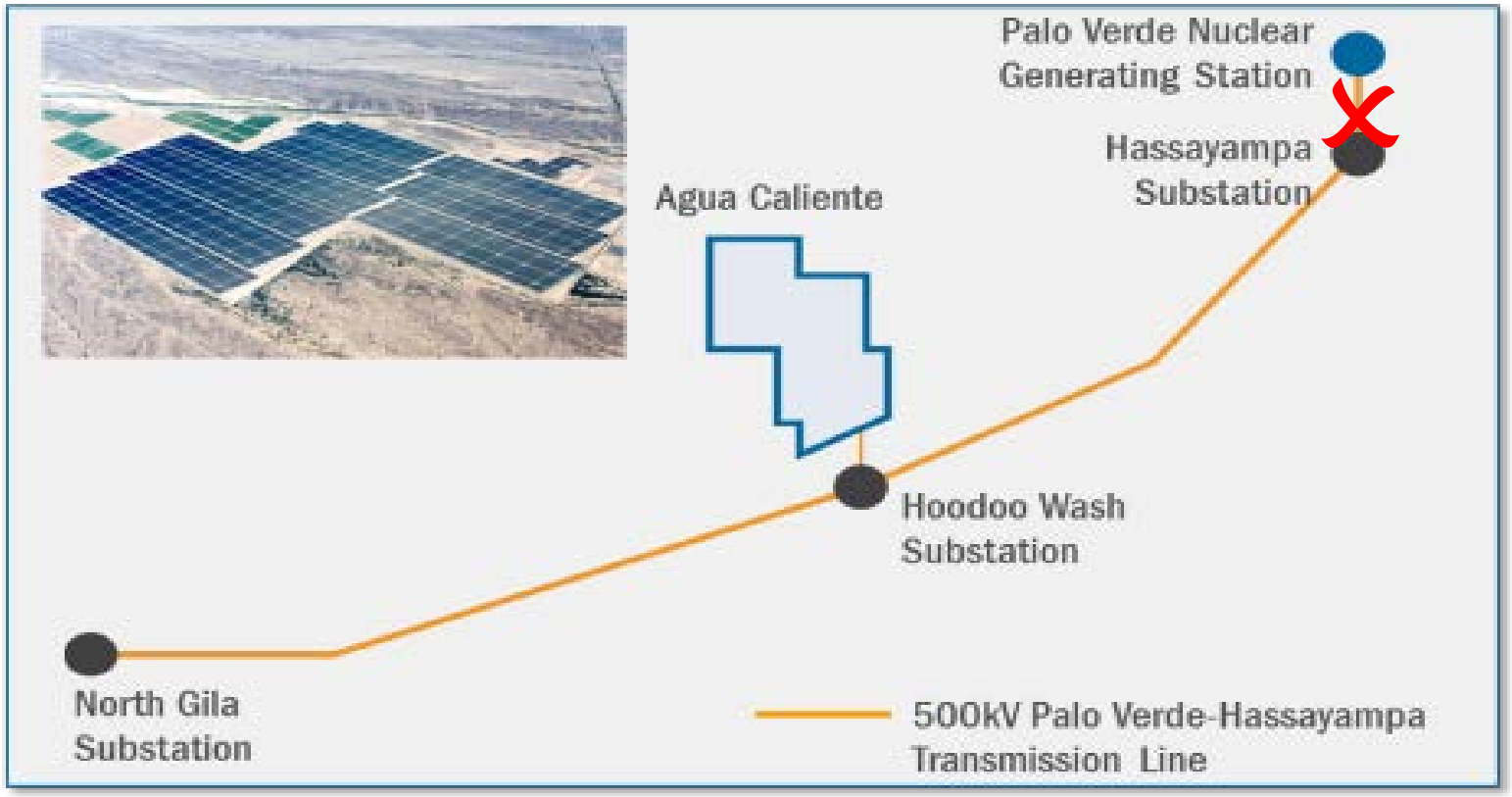
AGUA CALIENTE 290MW (AC)



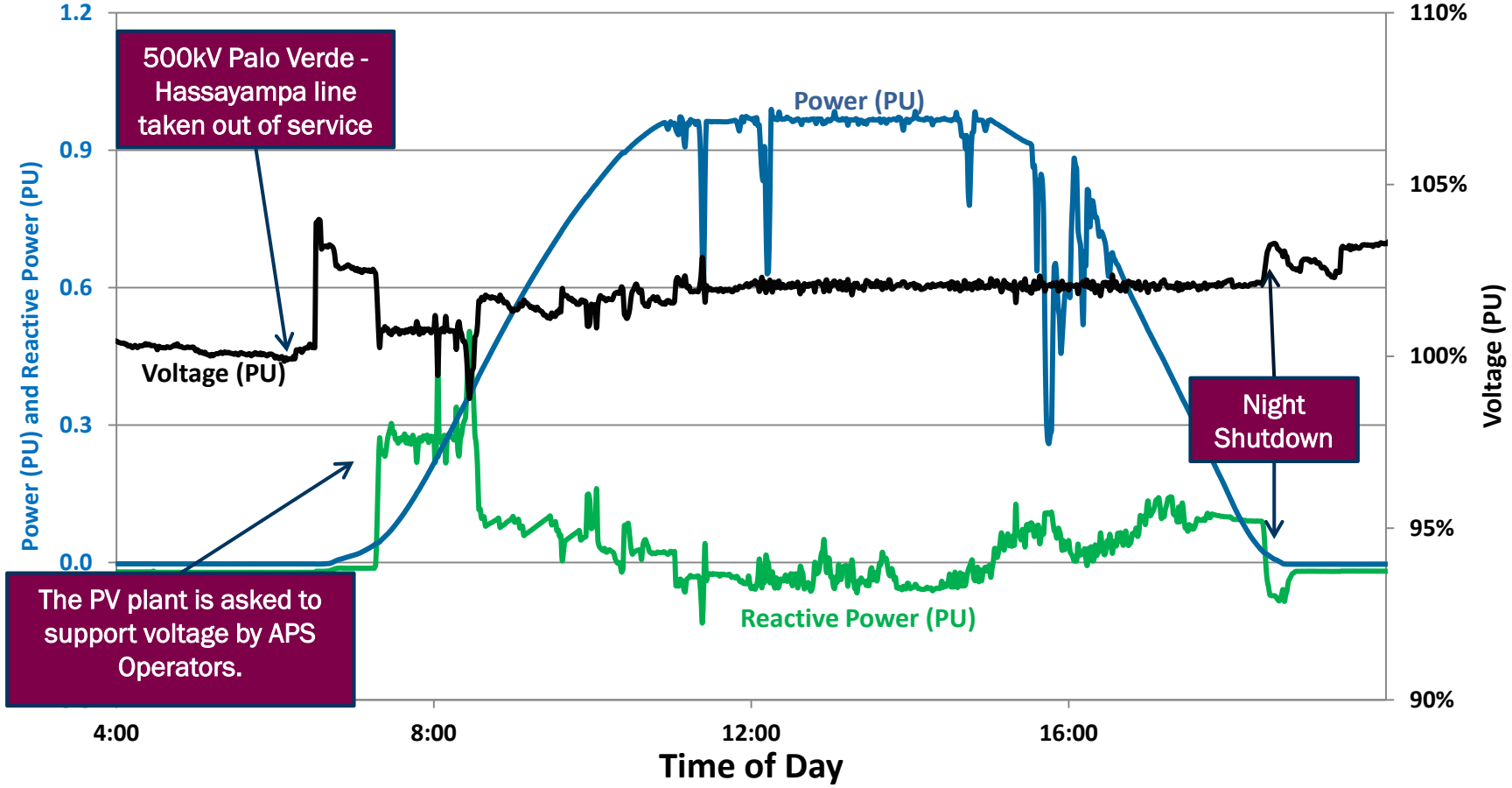
AGUA CALIENTE - TYPICAL PLANT OPERATING DAY (MARCH 19, 2014)



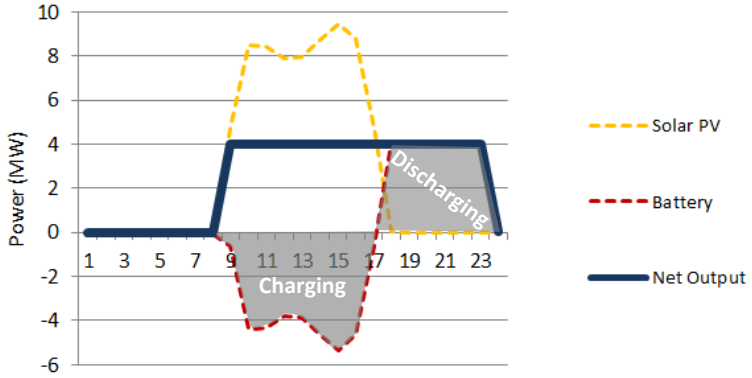
AGUA CALIENTE VOLTAGE SUPPORT – EVENT ON MARCH 21, 2014



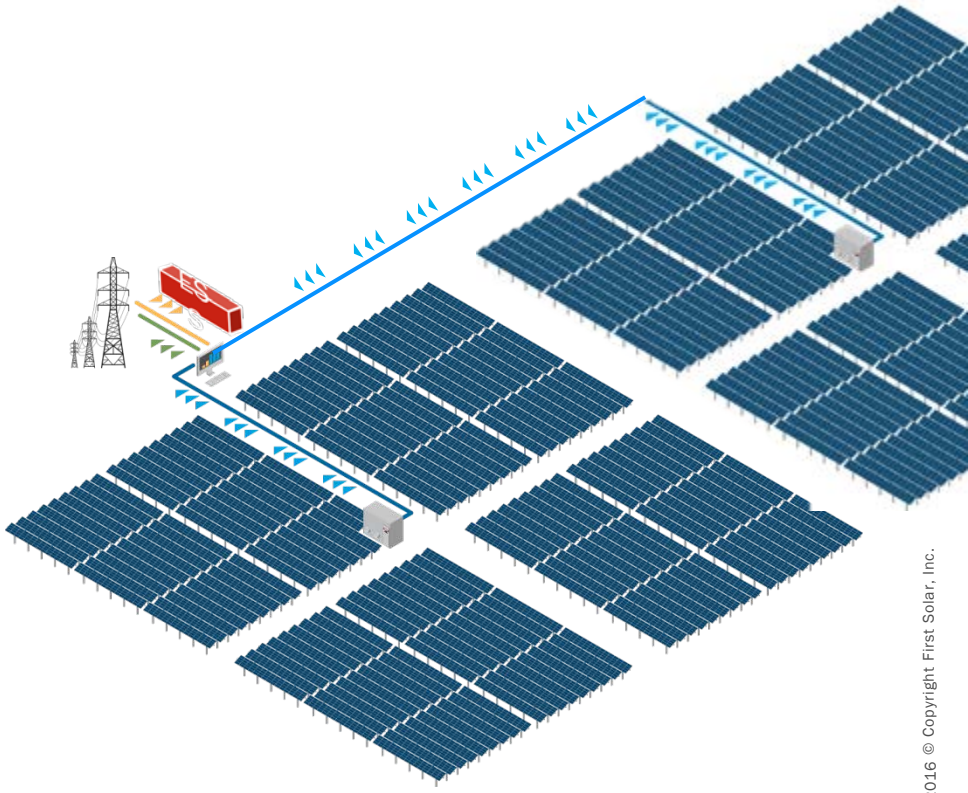
AGUA CALIENTE VOLTAGE SUPPORT – EVENT ON MARCH 21, 2014



PV + STORAGE = DISPATCHABLE PV = "PVS" CONCEPT



- Increase the PV array size
- Store excess energy in Energy Storage
- ESS provides flexibility to generate any desired profile (flat shown)
- Amount of battery capacity is set by desired dispatch profile and regional solar irradiance

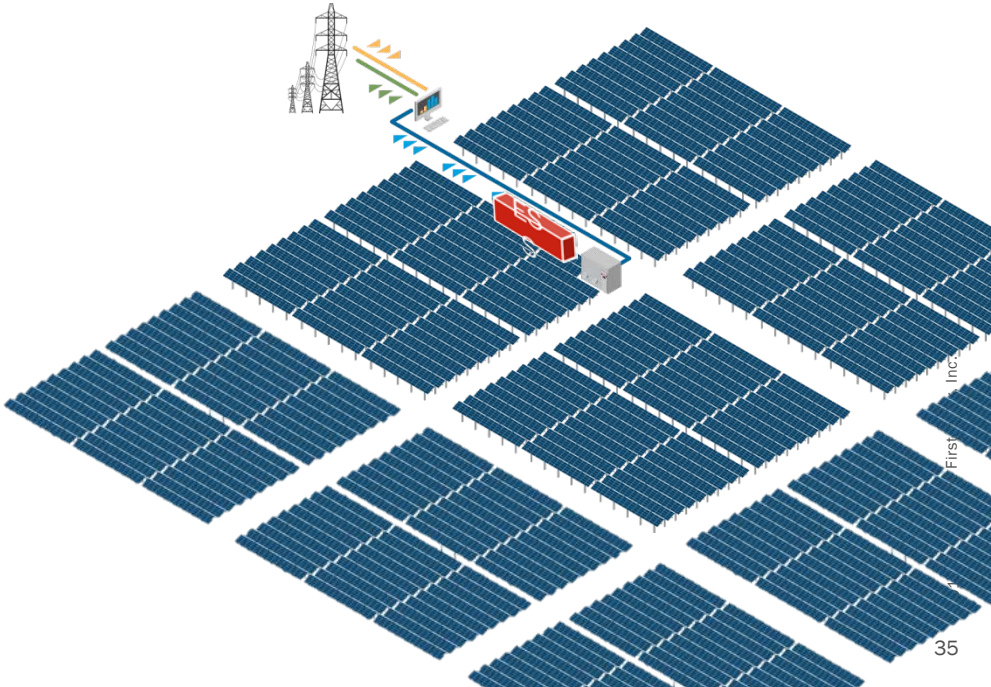


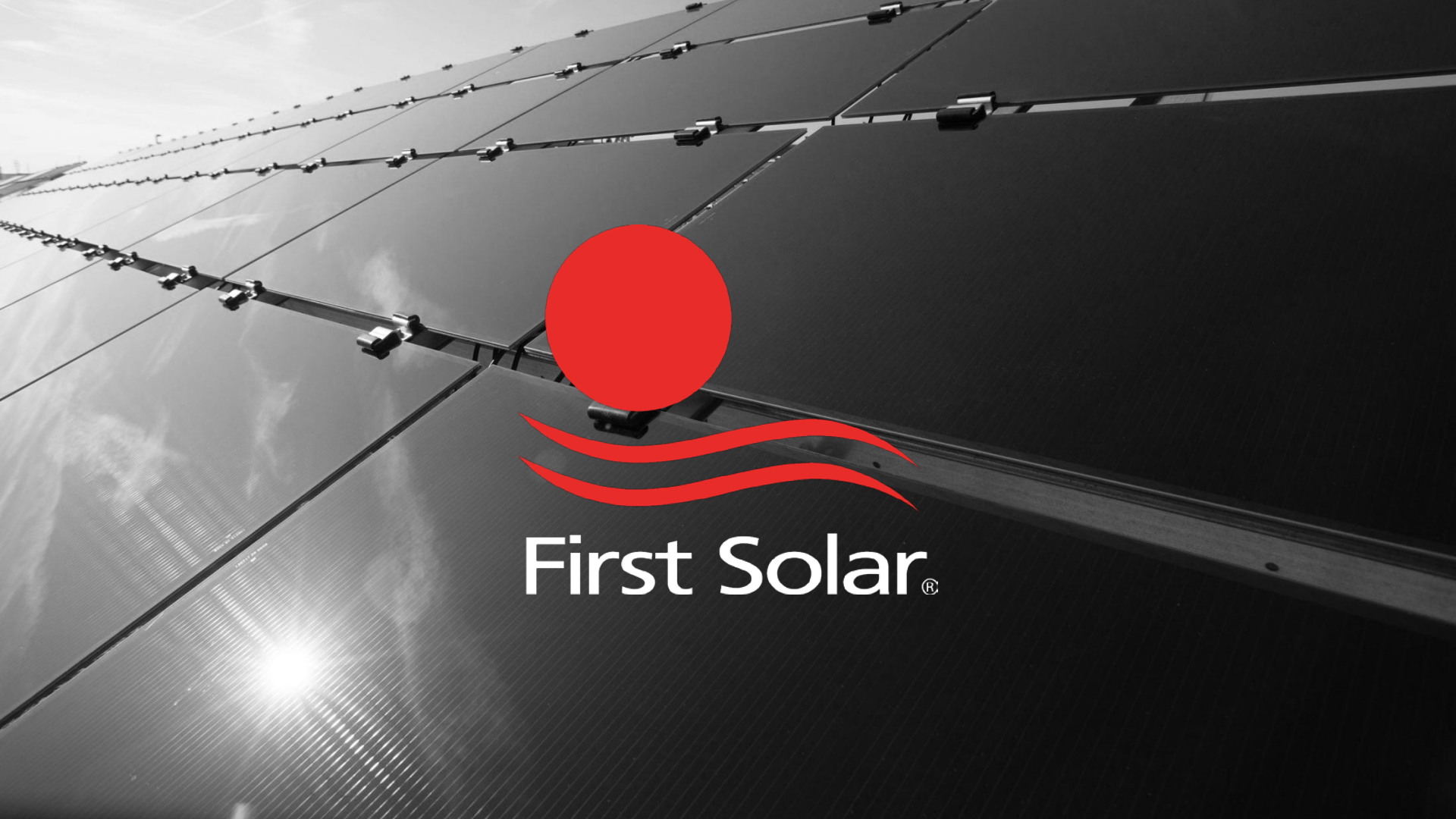
WHY STORAGE AND SOLAR?

Sustained cost advantage over separate installations

- Shared fixed costs (site, inverter, interconnect)
- Shared soft costs (Development, EPC)
- ITC applies to storage (in US)
- Shared O&M costs (same truck rolls)

~30% lower combined installed cost




First Solar®

NW Natural

Natural Gas Scheduling

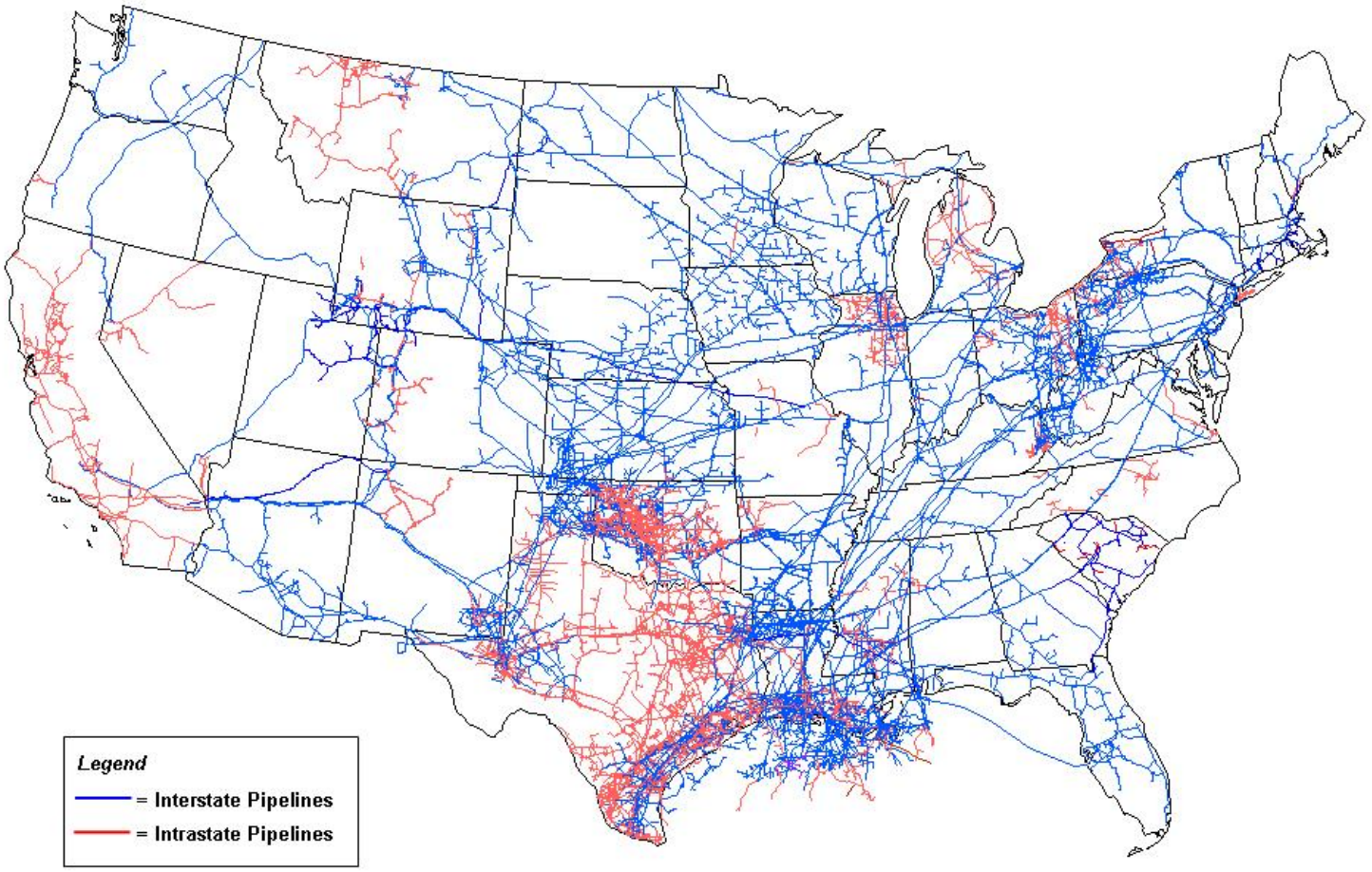
Presentation to the NW Power Pool
After the Fact & System Schedulers

Scott Johnson
Gas Supply

October 25, 2016

NW Natural

US Natural Gas Pipeline Network

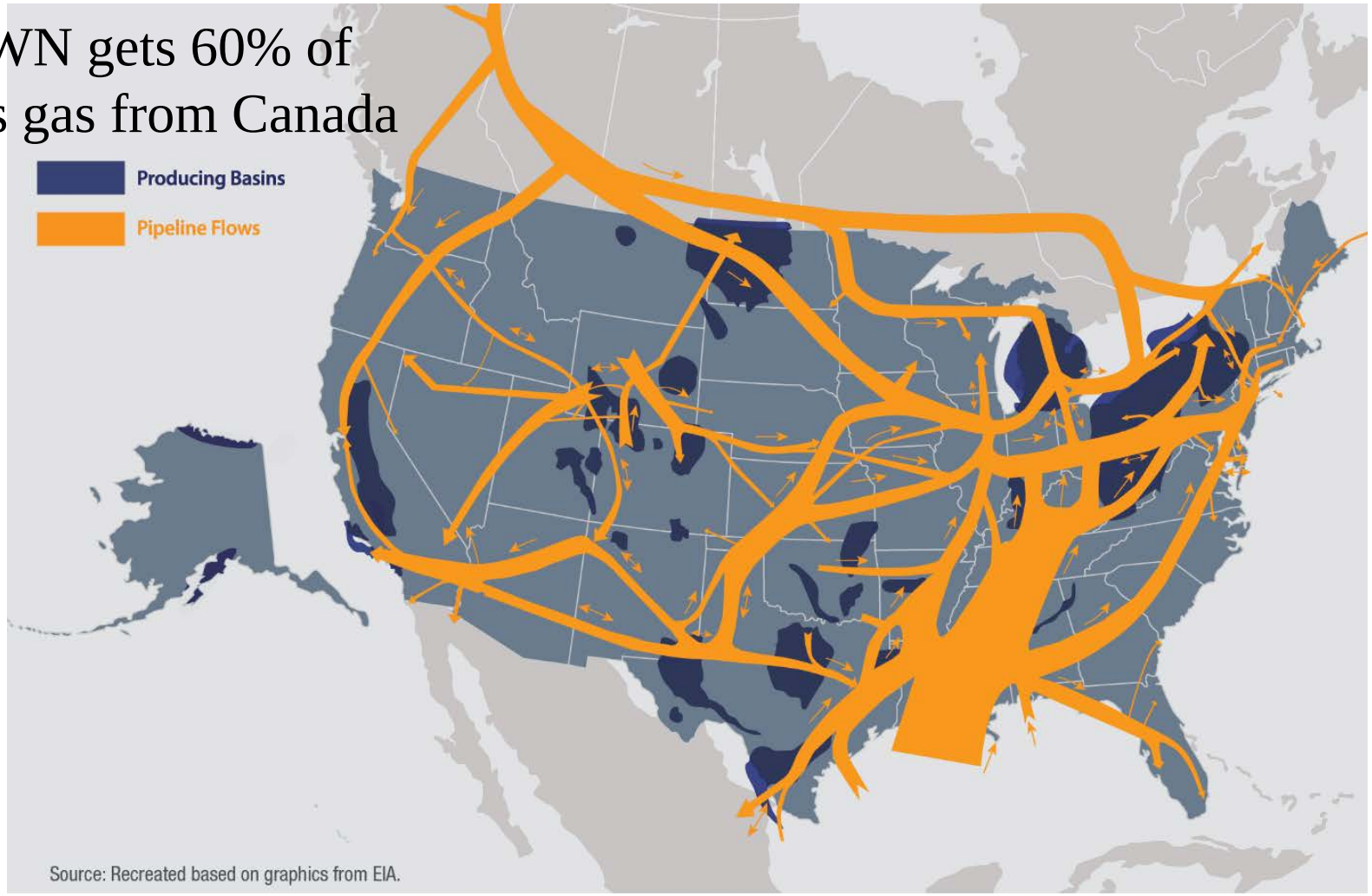


Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

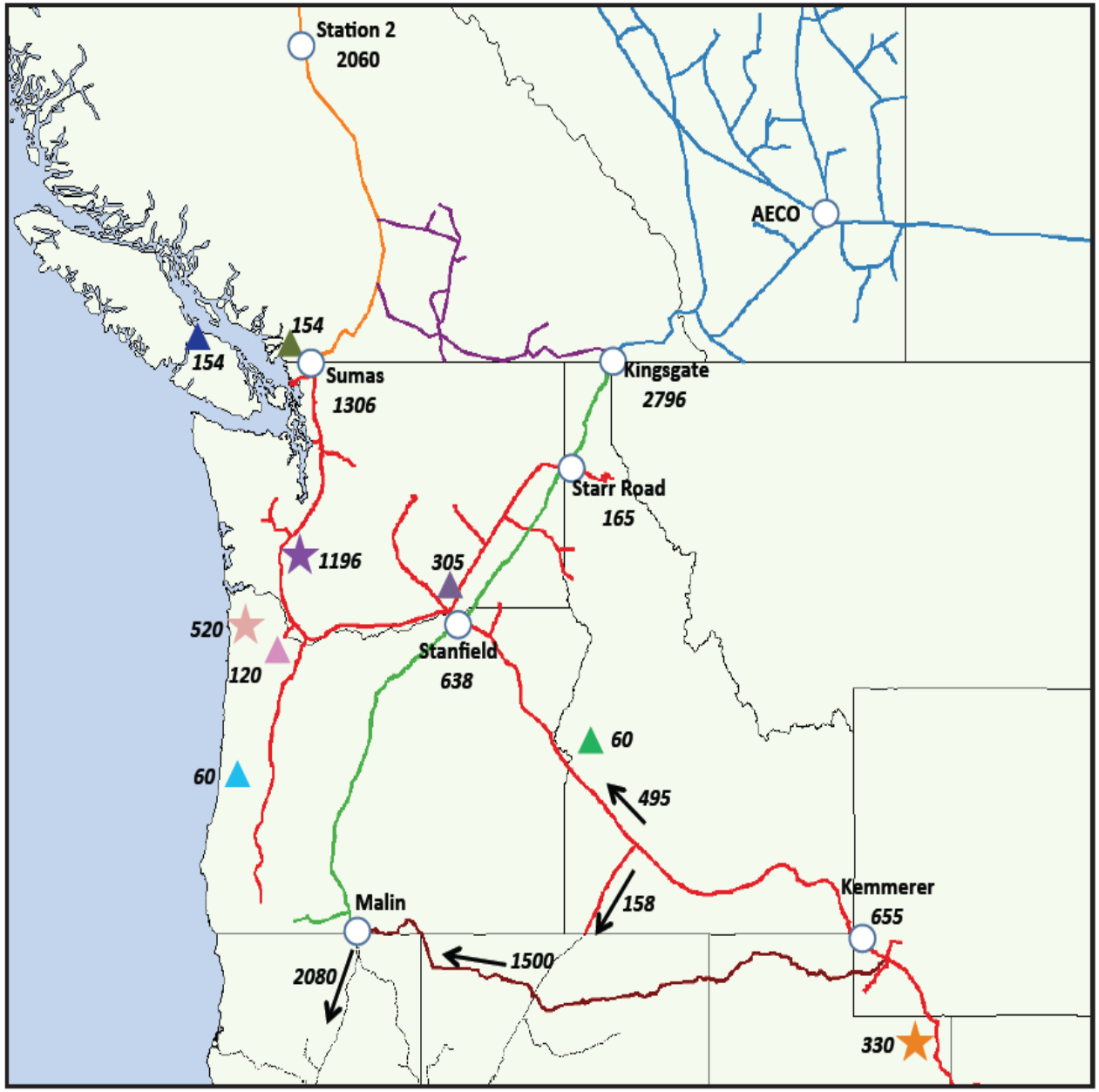
NW Natural

Gas Markets are Interconnected

NWN gets 60% of it's gas from Canada



Key Infrastructure in the Pacific Northwest



Pipelines

- Spectra BC Pipeline
- Williams NWP
- TransCanada GTN
- FortisBC SCP
- El Paso Ruby
- TransCanada (TCPL)

Underground Storage

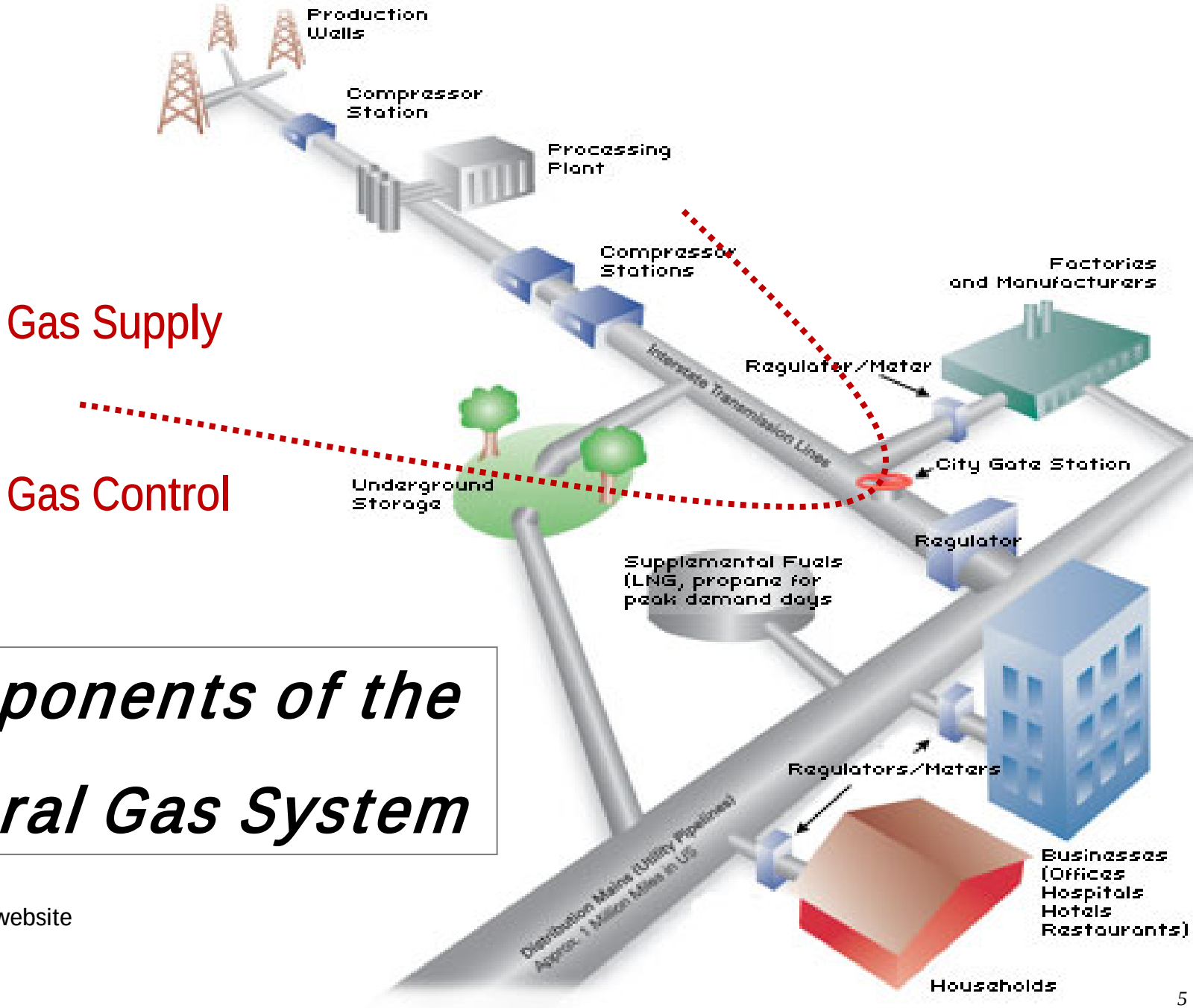
- Jackson Prairie
- Mist
- Clay Basin

LNG Storage

- Nampa
- Newport
- Plymouth
- Portland
- Tilbury
- Mt. Hayes

Source: Northwest Gas Association - Numbers indicate delivery or takeaway capacities in MDth.

Components of the Natural Gas System



Source: NWGA website

Gas Scheduling Timeline

Time	Day ahead	Day of
5:00 AM	Gas Acquisition	
5:30 AM		
6:00 AM		
6:30 AM		
7:00 AM		
7:30 AM		
8:00 AM		Intra Day 1
8:30 AM		
9:00 AM		
9:30 AM		
10:00 AM		
10:30 AM		
11:00 AM	Timely	
11:30 AM		
12:00 PM		
12:30 PM		Intra Day 3
1:00 PM		
1:30 PM		
2:00 PM		
2:30 PM		
3:00 PM		
3:30 PM		
4:00 PM	Evening	
4:30 PM		
5:00 PM		Intra Day 3

	Next Day Nominations		Same Day (Intraday) Nominations		
	Timely	Evening	ID 1	ID 2	ID 3
Nomination deadline	11:00 AM	4:00 PM	8:00 AM	12:30 PM	5:00 PM
Confirmations	2:30 PM	6:30 PM	10:30 AM	3:00 PM	7:30 PM
Start of gas flow	7:00 AM	7:00 AM	Noon	4:00 PM	8:00 PM

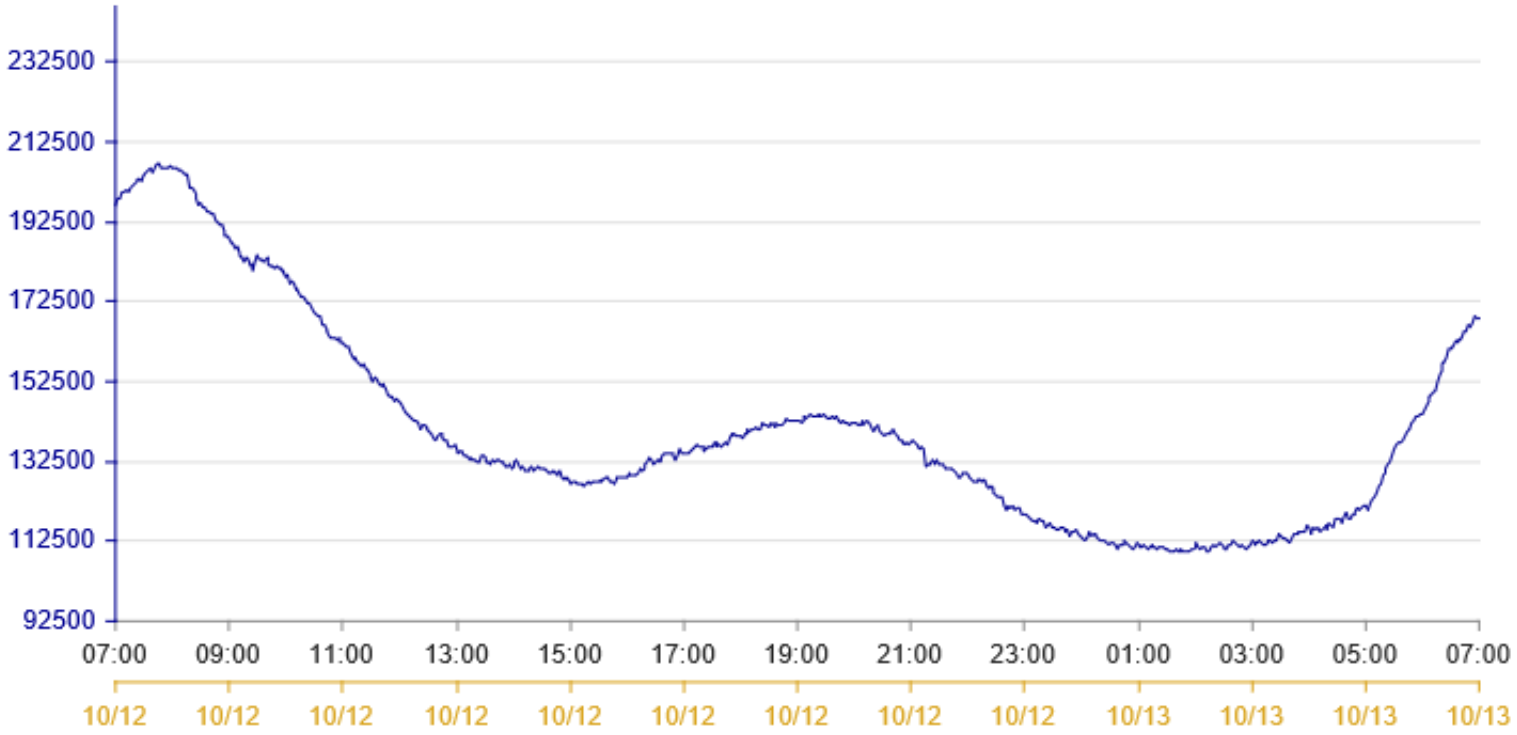
NW Natural

Pipeline Imbalances

- Packing and Drafting
  - Like a small battery
- Monitored in real-time
- Cumulative imbalance managed over time
- Can the pipeline support you?
  - Relying solely on line pack or do they have storage?
- Possibility for entitlements

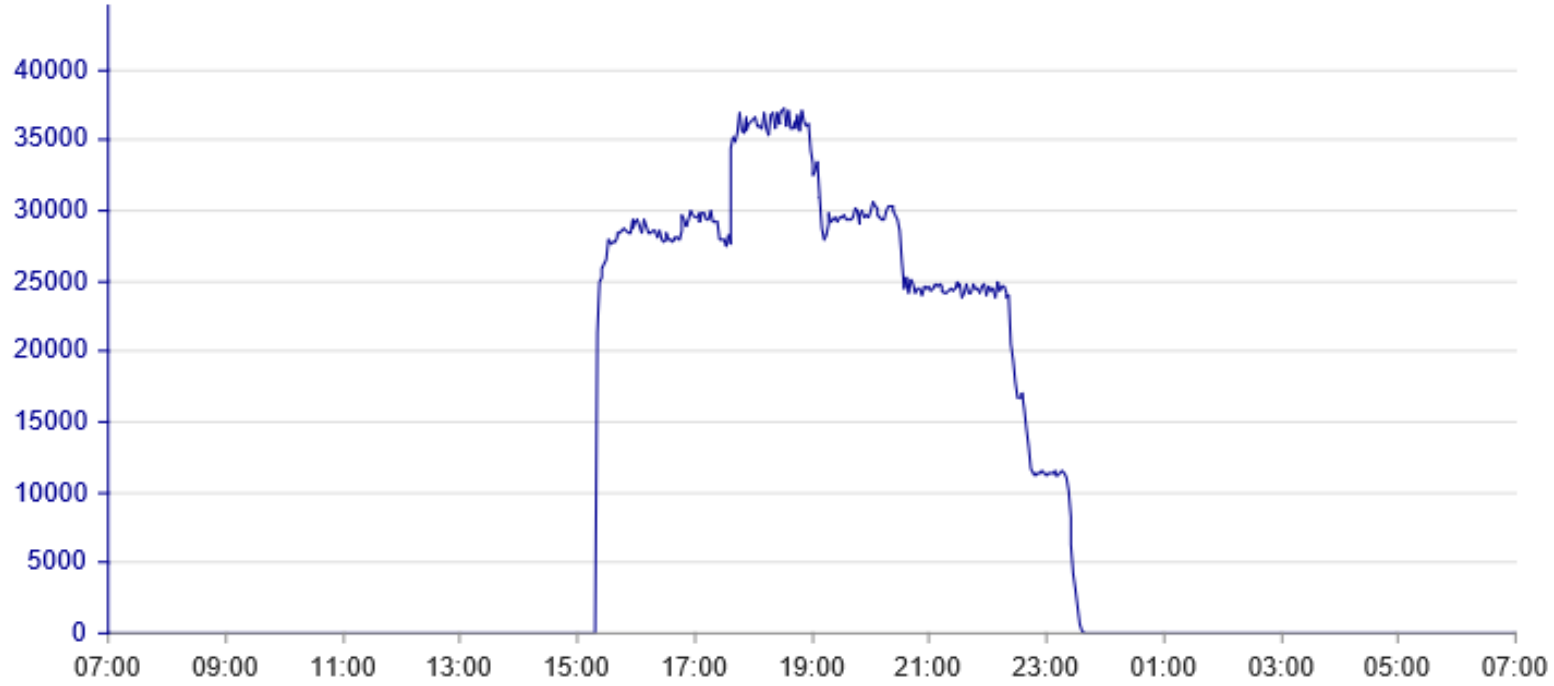
Typical Load Profile for NW Natural

The pipeline will pack the pipe in anticipation of morning burn



Load Profile for Peaking Gas Plant

Difficult for a pipeline to plan around and support a wind following peaking generation unit



Natural Gas Storage

- Gas storage is the ‘battery’ that the electric industry needs to support intermittent renewable generation

- No notice gas storage service is rare and expensive but very valuable

Mechanics of Frequency Response Sharing Groups

Rian Sackett

Chair, FRSG

October 2016

NORTHWEST PowerPool

Definitions

- **Frequency Response Sharing Group** (FRSG): A group whose members consist of two or more Balancing Authorities
- **Frequency Responsive Reserve**: An amount of reserve automatically responsive to locally sensed frequency deviation.
- **Agreement:** A contract or arrangement, either written or verbal and sometimes enforceable by law. For our purposes – an Agreement is a document indicating the formation of a FRSG (Refer to the NERC Operating Reserve Management Guideline)

Agreement

FRSGs should have a formal agreement among its members in place prior to registration. The FRSG agreement among the participant responsible entities for the FRSG should address the following:

- Identification of designated representative
- Minimum frequency-responsive (F-R) reserve requirement for the group
- Reporting, record keeping, and accountability for regulatory compliance
- Each member's portion of the total F-R reserve requirement
- Methodology used to calculate the member's F-R reserve responsibility
- How information is shared among members in Real-time
- Tools for operators to have situational awareness of F-R Reserve of the FRSG

FRSG Agent

- Designated Representative (Agent) - an entity that will provide the necessary information and compliance reports for the group.
  - Identifies the make up of the FRSG (listing of the participating BAs) to the compliance authority of the FRSG (i.e., Registration)
  - Must have access to all the data needed for the FRSG performance analysis.

The Term

- FRSGs should be pre-arranged and member participation should coincide with the BAL-003 operating year (December 1 through the following year November 30).
- Any member BA's minimum period of participation should be one (1) BAL-003 operational year.
- Partial BAL-003 operating year participation should not be allowed.
- Per event participation with other BAs is a bi-lateral transaction and is not considered an FRSG. Like bi-lateral transactions, FRSGs can only be established prior the analysis period.
- No BA may be a member of more than one FRSG at any given time.

Performance

Performance measurement FRSG - two methods

1. Determining the sum, for each compliance measured event of the FRSG BAs (sum of the FRSG BAs FRS Form 1 and FRS Form 2) and then designating the median Frequency Response Measure for the FRSG as the median of the sums, or
2. Measurement of the FRSG for each compliance measured event and then designating the median Frequency Response Measure for the FRSG as the median of the measurement.

FRSG

- FRSG – 18 Balancing Authorities.
- Agreement – *Agreement to Form and Appoint Designated Representative for Frequency Response Sharing Group,*
- *Effective as of August 1, 2016*
- Designated representative – Northwest Power Pool Corporation.
- Term – August 1, 2016 thru April 1, 2018
- Operating Year – December 2016 thru November 2017.
- Chair – Rian Sackett (BPA)
- Vice-chair – Neil Trotman (PAC)

NORTHWEST PowerPool

PAC-NVE-PSE-PGE
EIM Update
NWPP Schedulers Meeting
October 26, 2016

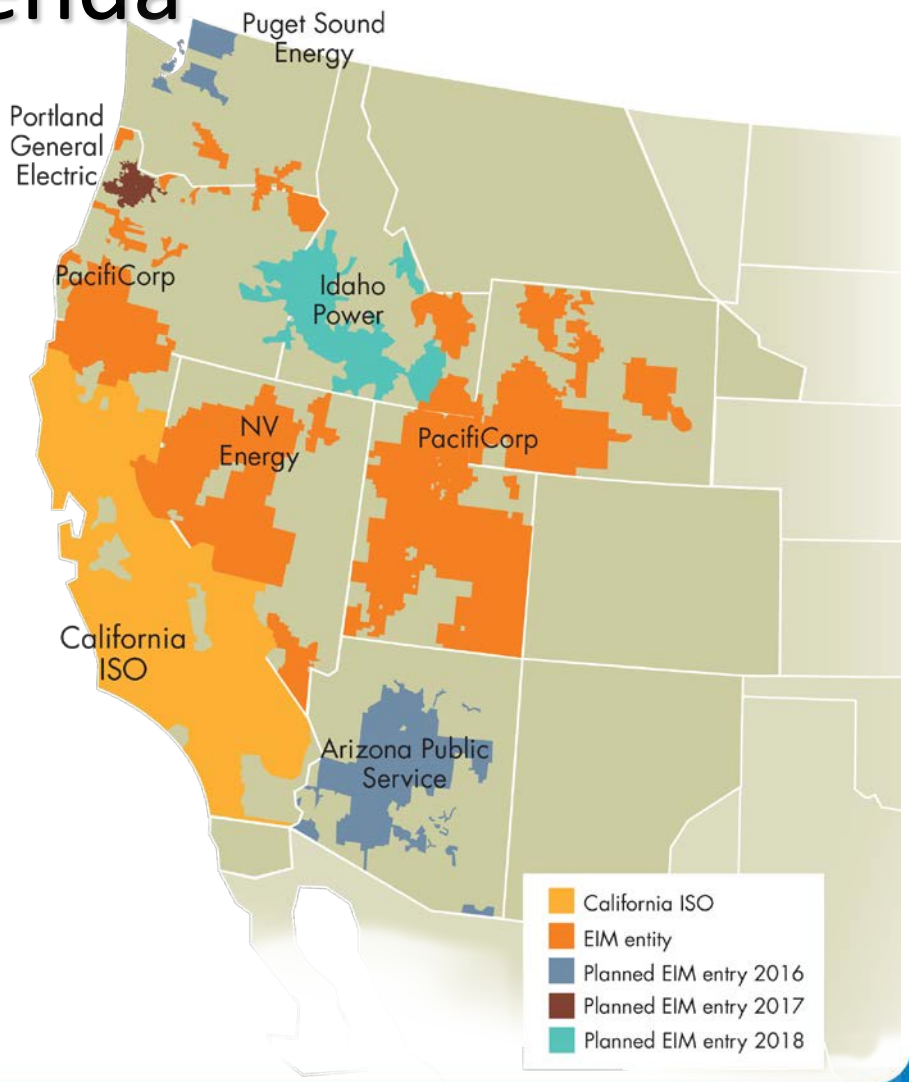



PACIFICORP

Let's turn the answers on.

Agenda

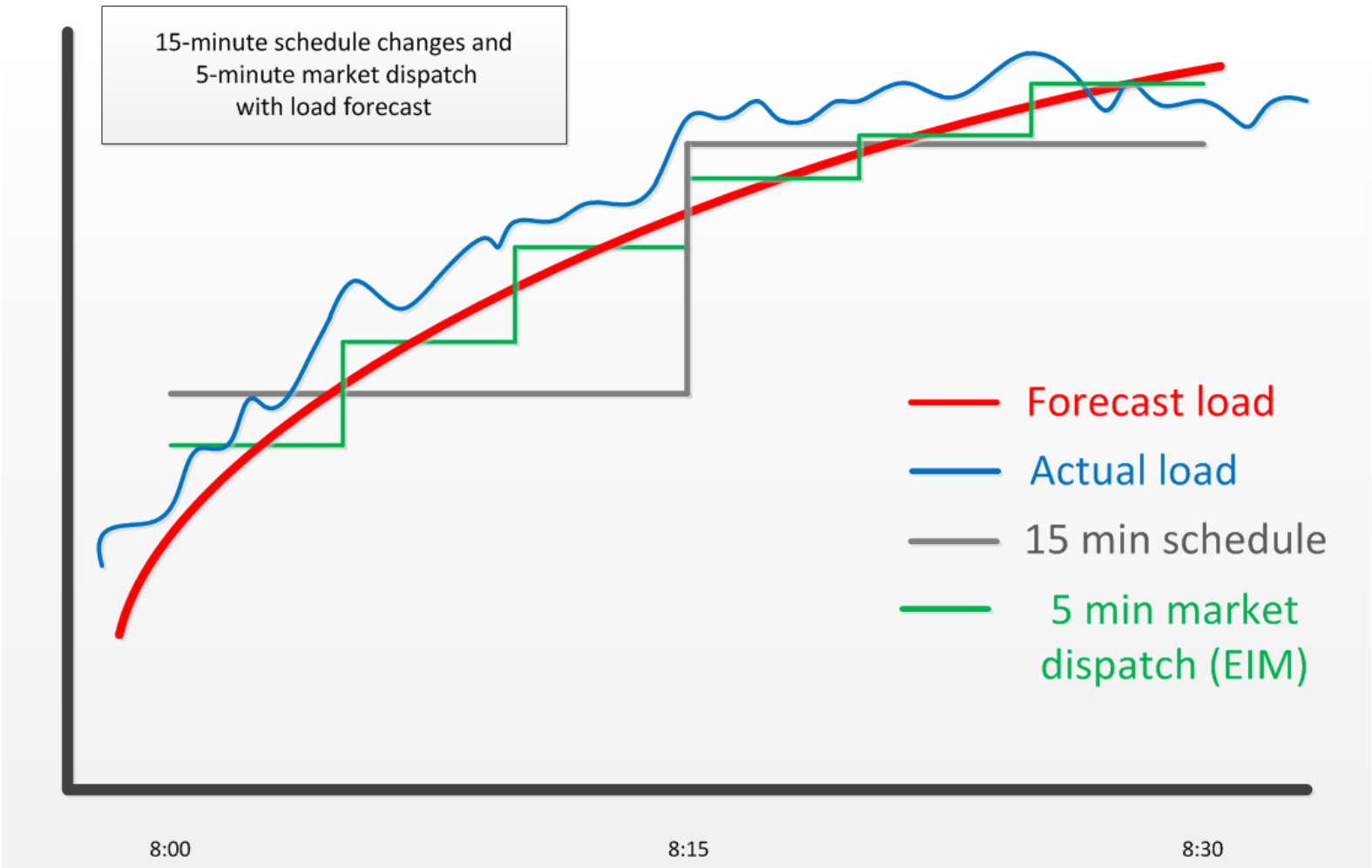
- EIM 101
- PacifiCorp
  - Enhancements
    - Flex Ramp Product
- NV Energy
  - Enhancements and impacts
- Puget Sound Energy
  - Operations and impacts
- Portland General Electric
  - Project and design



Operational Concept Overview

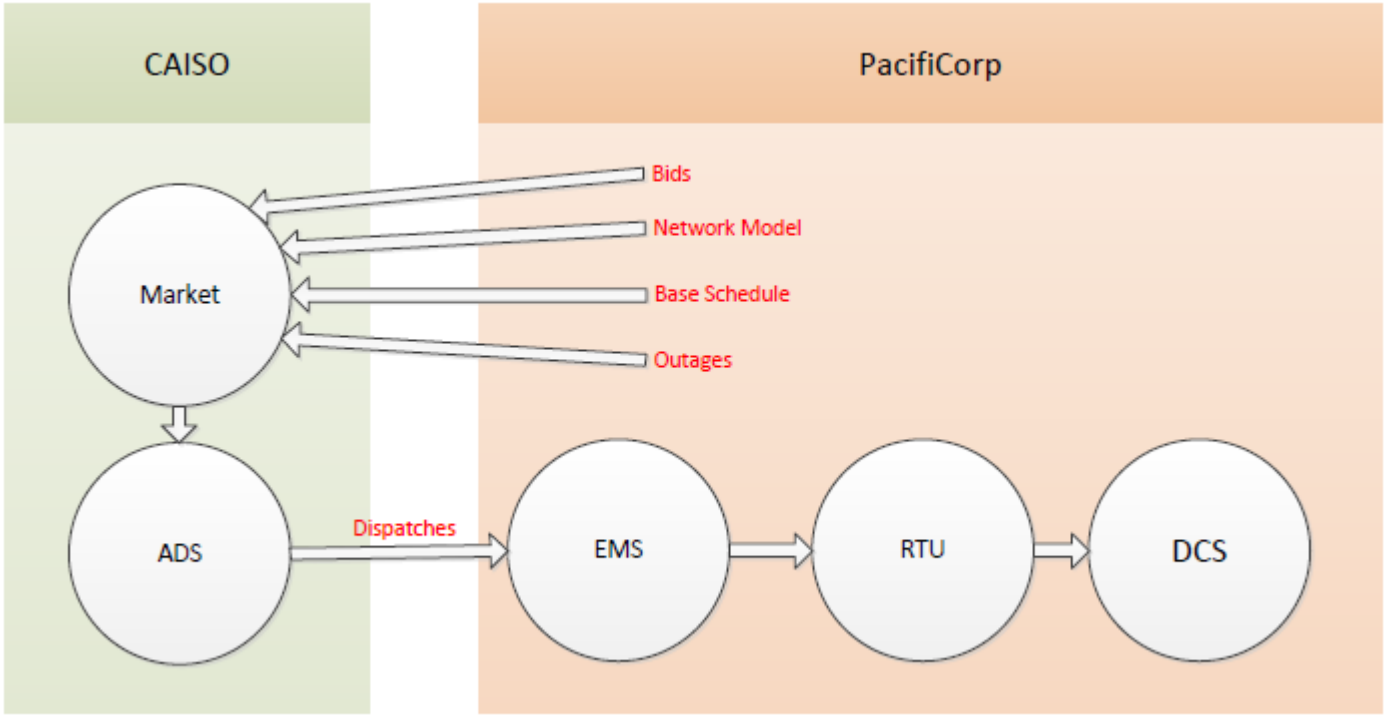
- Expansion of CAISO's advanced real-time market
- Security Constrained Economic Dispatch
  - Congestion management
- Network model visibility and accuracy
- Market Operator, EIM Entity, Participating Resources, Manual Dispatch, Instructed/Uninstructed Imbalance charges, …..
- Detailed outage reporting and situational awareness

Five Minute Redispatch



Dispatch Operating Targets

- Automated Dispatch System to PacifiCorp's EMS, to RTU, and to DCS at the plant



EIM Entity Responsibilities

Under EIM operation:

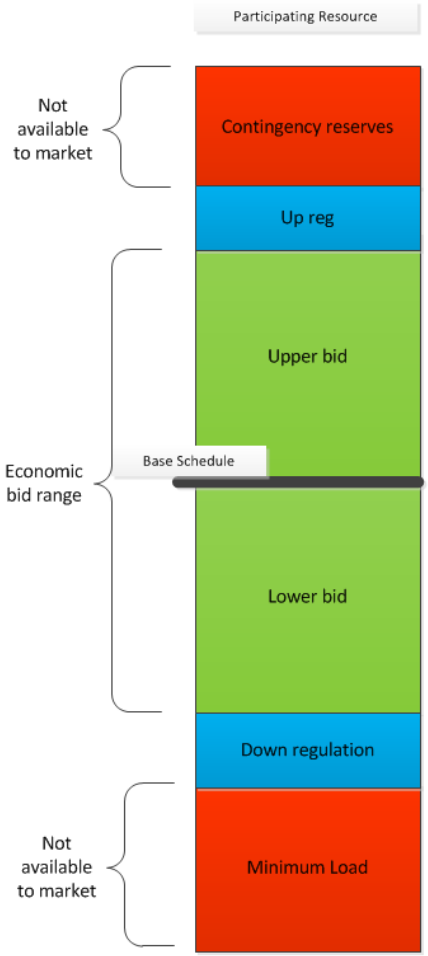
- Entity retains all reliability function responsibility
  - operate transmission, monitor generation, process outages, and balance PACW and PACE

EIM Design Concepts

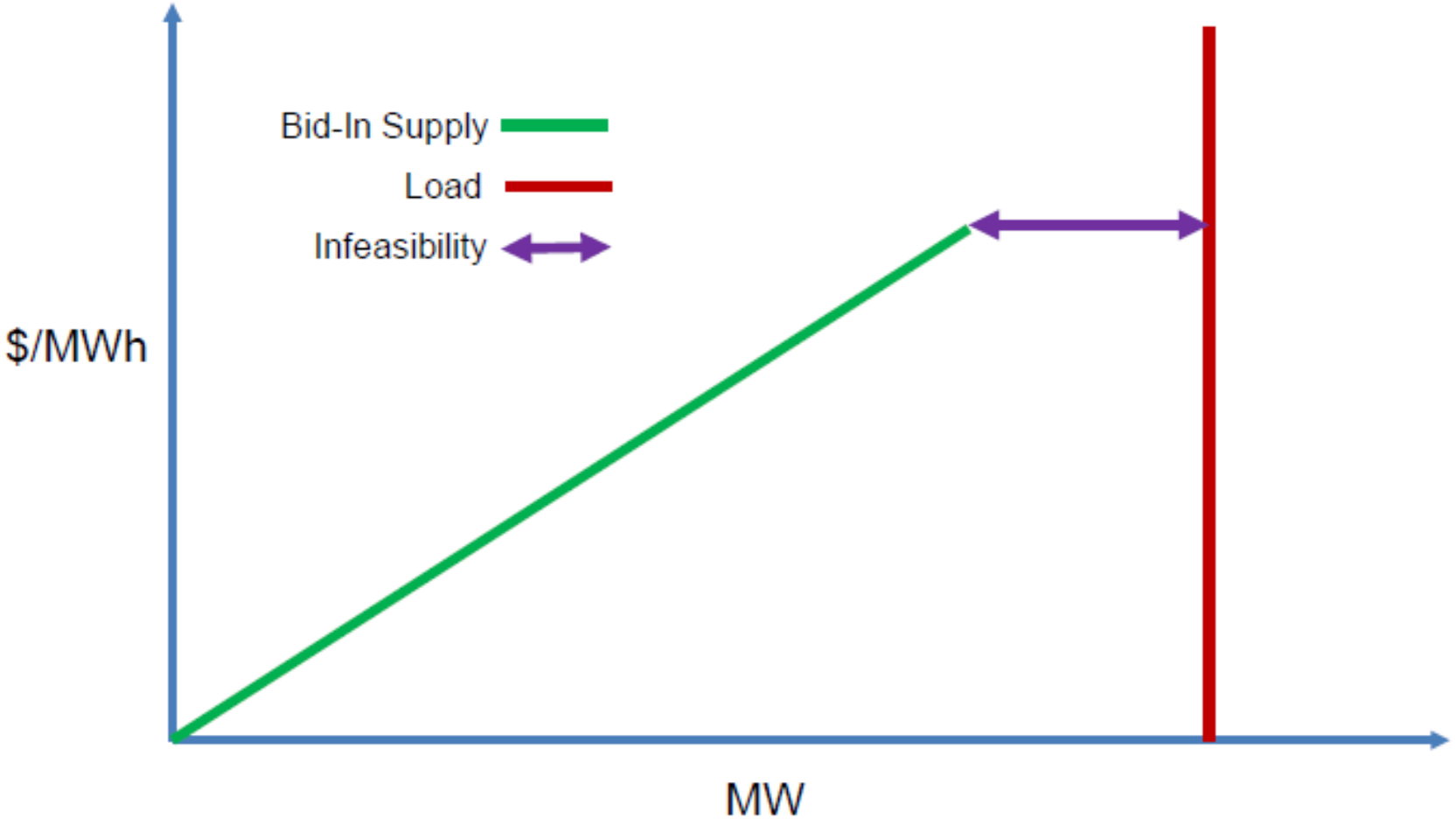
- Allows voluntary participation
- Increased reliability: Provides information that improves situational awareness and responsiveness to grid conditions across its increased footprint
- Improved renewable integration: Helps integrate renewable resources by capturing the benefits of geographic diversity
- Cost savings: Benefits all by serving energy imbalance needs from the most economic resources in a larger pool

ABC and Contingency Reserves

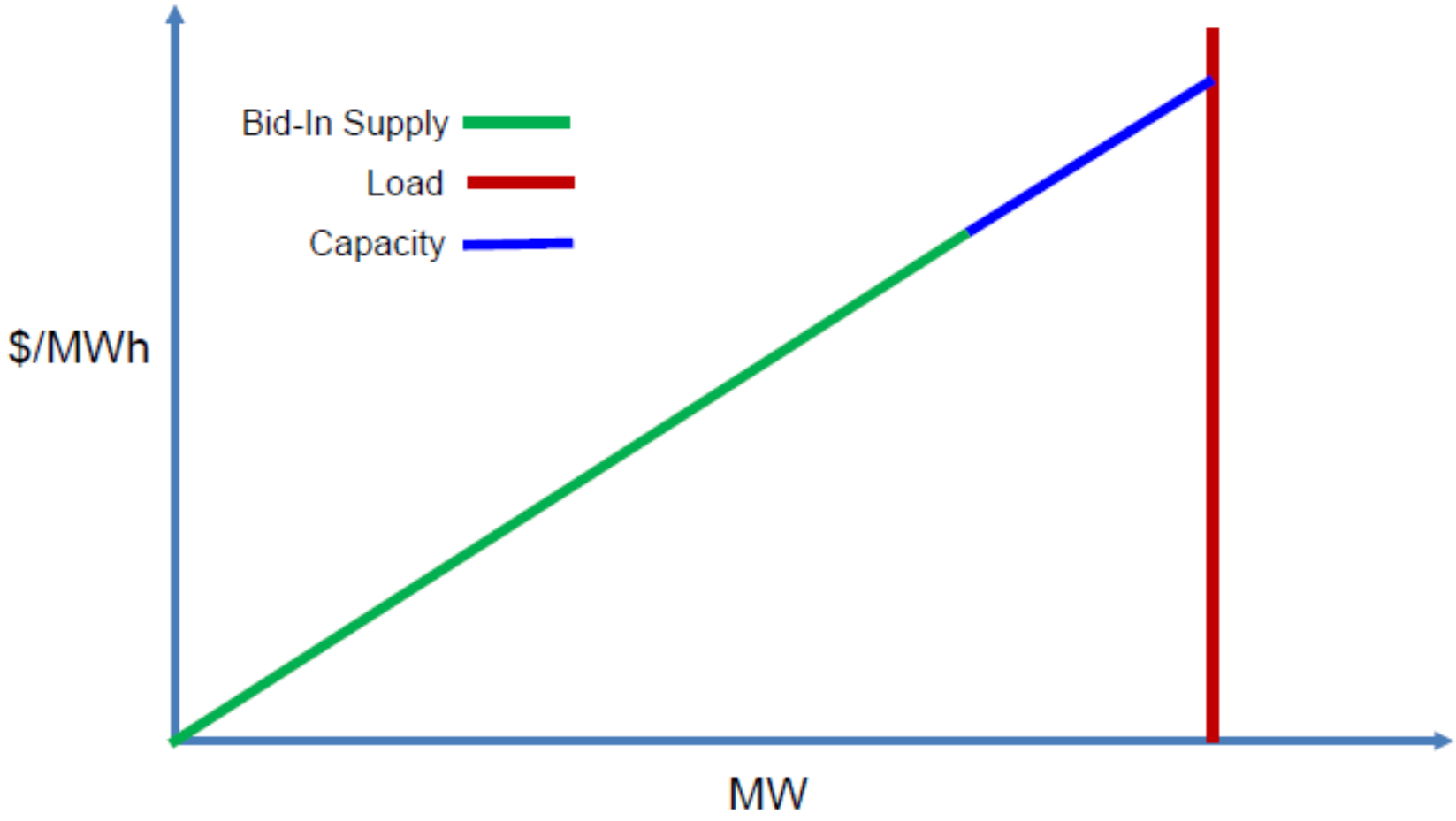
- Visibility of regulating reserves on participating resources
- Visibility of excess capacity on non-participating resources
- Will not utilize contingency reserves on each unit

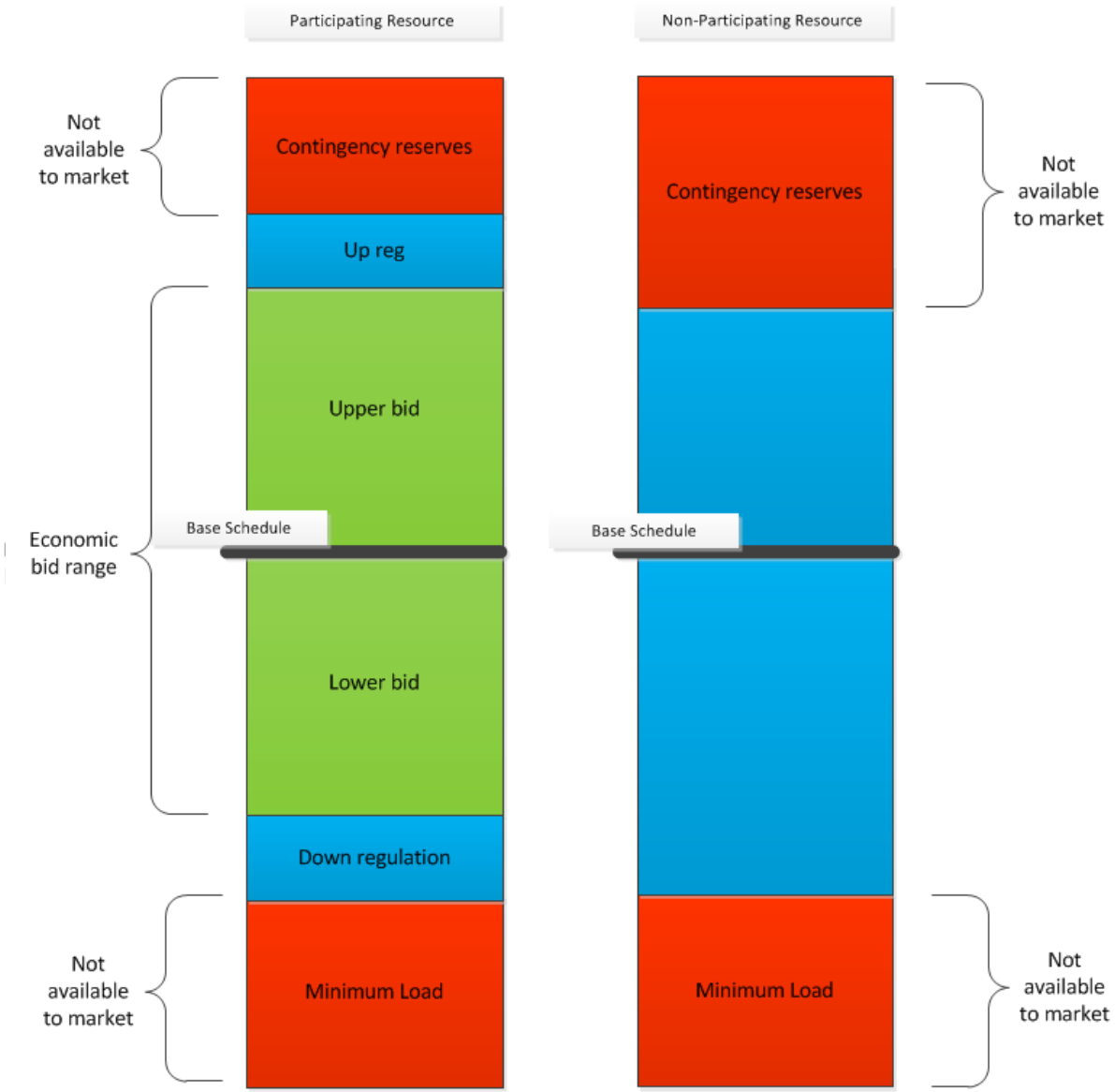


ABC



ABC




Participating Resource
Non-Participating Resource
Not available to market
Contingency reserves
Up reg
Upper bid
Base Schedule
Economic bid range
Lower bid
Down regulation
Not available to market
Minimum Load
Contingency reserves
Not available to market
Base Schedule
Minimum Load
Not available to market

Flexible Ramping Product

- Flexible Ramping Sufficiency Test
- Upward capacity and downward capacity
- FRP is compensation for that capacity
- Basics:
  - Requirement is calculated using load, VER, and uncertainty factor
  - Capacity measured as upward/downward capacity on participating (rampable) resources

NV Energy

- Growing pains
  - Complex nature of EIM
- Lessons Learned
  - Reserves management
  - Hourly load forecast
  - TOP-007-WECC
- What worked
  - Master file for generation
  - Hourly ambient temp derates

Puget Sound Energy

- Learning new operating systems
- Different approach to balance the system
- Adding the Market Operator (MO)
- Outage coordination/planning
- Training operators and customers
- EIM dynamic transfer (ETSR)
- CAISO vernacular

Portland General Electric

- Opportunity to improve internal processes
- Training
- System integrator to manage EIM project
- Increased workload for BA and settlements
- Don’t put the cart before the horse

Questions

Energy Imbalance Market

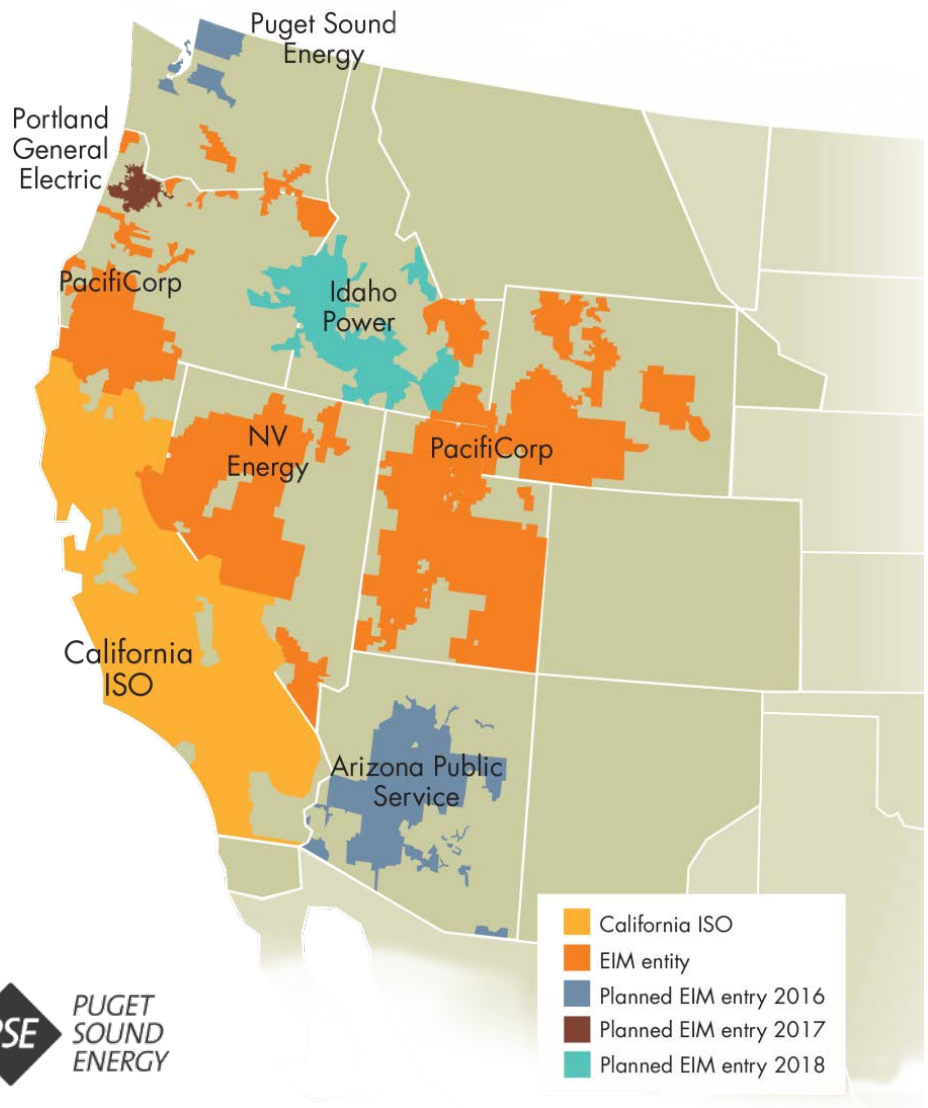
Overview and Tariff Changes

PUGET SOUND ENERGY

October 26, 2016

Steve Schmidt

PSE Fits Into An Expanding CAISO EIM Footprint



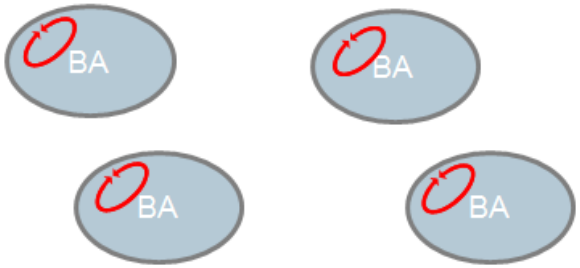
- The CAISO EIM went live with PacifiCorp in November 2014.
- PSE is participating in the CAISO EIM as of October 1, 2016.
- Benefits are adding up:

  The EIM's total benefits now exceed $88 million since the western EIM began on November 1, 2014.

PSE PUGET SOUND ENERGY

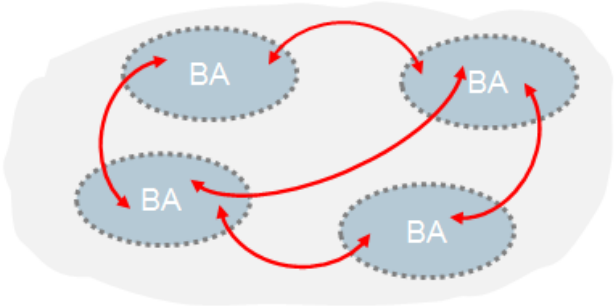
EIM Basics

Today:
Each BA must balance loads and resources w/in its borders.



- Limited pool of balancing resources
- Inflexibility
- High levels of reserves
- Economic inefficiencies
- Increased costs to integrate wind/solar

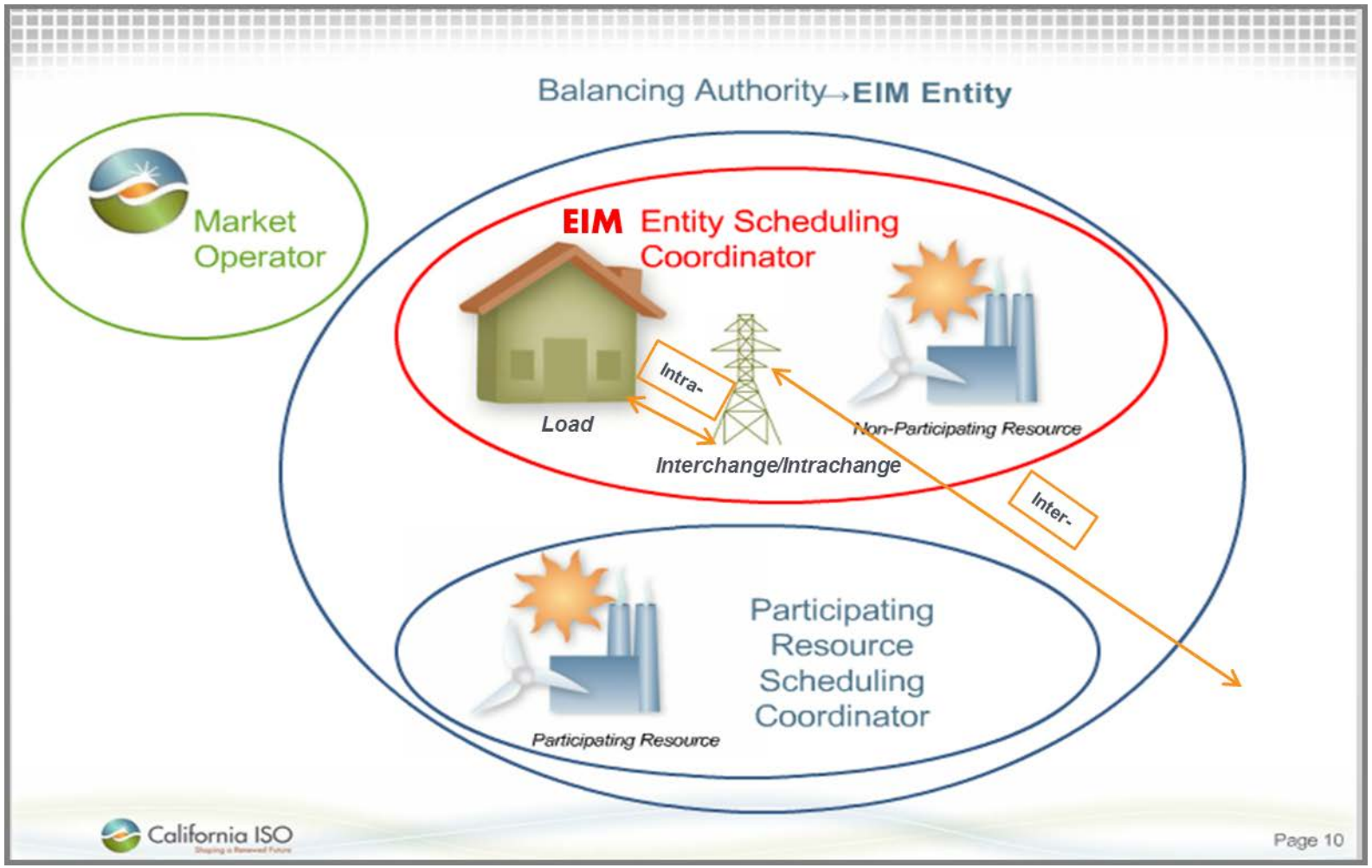
In an EIM:
The market dispatches resources across BAs to balance energy



- Diversity of balancing resources
- Increased flexibility
- Decreased flexible reserves
- More economically efficient
- Decreased integration costs
- Voluntary participation

PSE PUGET SOUND ENERGY

Key Roles in the EIM



PUGET SOUND ENERGY

EIM Roles and Activities

EIM Market Operator (CAISO)

- Runs the EIM market
- Provides instruction to participating resources
- Settles the imbalance market (revenue neutral)

EIM Entity

- Balancing authority responsibilities
- Transmission reliability
- Coordinates and provides / arranges ancillary services

EIM Entity Scheduling Coordinator

- Review, approve and submit resource plans
- Responsible for providing balanced resource schedules to CAISO
- Responsible for scheduling all non-participating resources
- Responsible for settlements with CAISO

EIM Participating Resource Scheduling Coordinator

- Determines and submits participating resource schedules to CAISO
- Creates resource plans for BA
- Submits resource offers to CAISO
- Settles with CAISO and BA for charges

PSE PUGET SOUND ENERGY

Regulatory & the Need for OATT Revisions

Open Access Transmission Tariff (OATT) changes

- References to CAISO Tariff and Business Practices

  Section 29.4 of the CAISO Tariff requires an EIM Entity such as PSE to have provisions in its OATT to enable operation of the EIM in its Balancing Authority Area.

- Limited changes to the Base OATT (as a starting point)
- New Attachment O to PSE's OATT which provides for participation in the EIM and includes:
  - Roles and responsibilities
  - Operations
  - Settlements (Schedules 1a, 4, 4R, 9, 12, and 12a)
  - CAISO Charge codes & Dispute Resolution

PSE PUGET SOUND ENERGY

Tariff Status and Key Changes

Because transmission services and procedures are being revised to accommodate the EIM, PSE revised its Open Access Transmission Tariff (OATT) and filed it with FERC.

- PSE received approval of our updated OATT from FERC.
- PSE proposed revising the energy imbalance, generator imbalance, and losses provisions of its OATT to affect these EIM changes.

Two key changes for transmission customers are:

1. Timing and content of forecasting and data requirements
2. Price at which imbalance and losses are settled

PUGET SOUND ENERGY

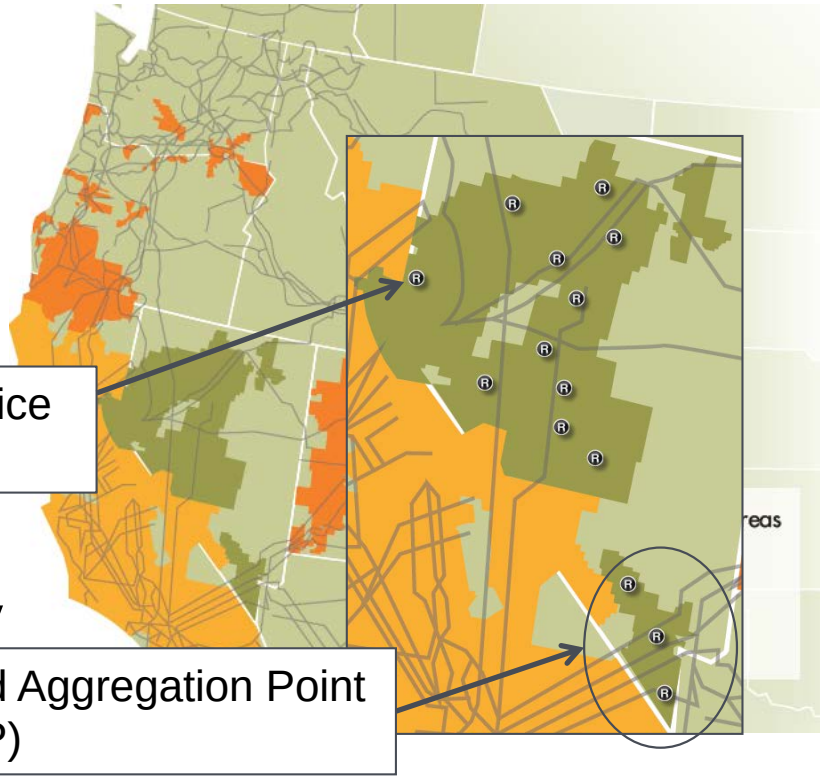
Tariff Changes Continued

Today imbalance is settled at day-ahead Mid-C ICE Index prices.

In the EIM:

Generation and E-tag Changes Settle at a 5 and 15 minute

Locational Marginal Price (LMP).



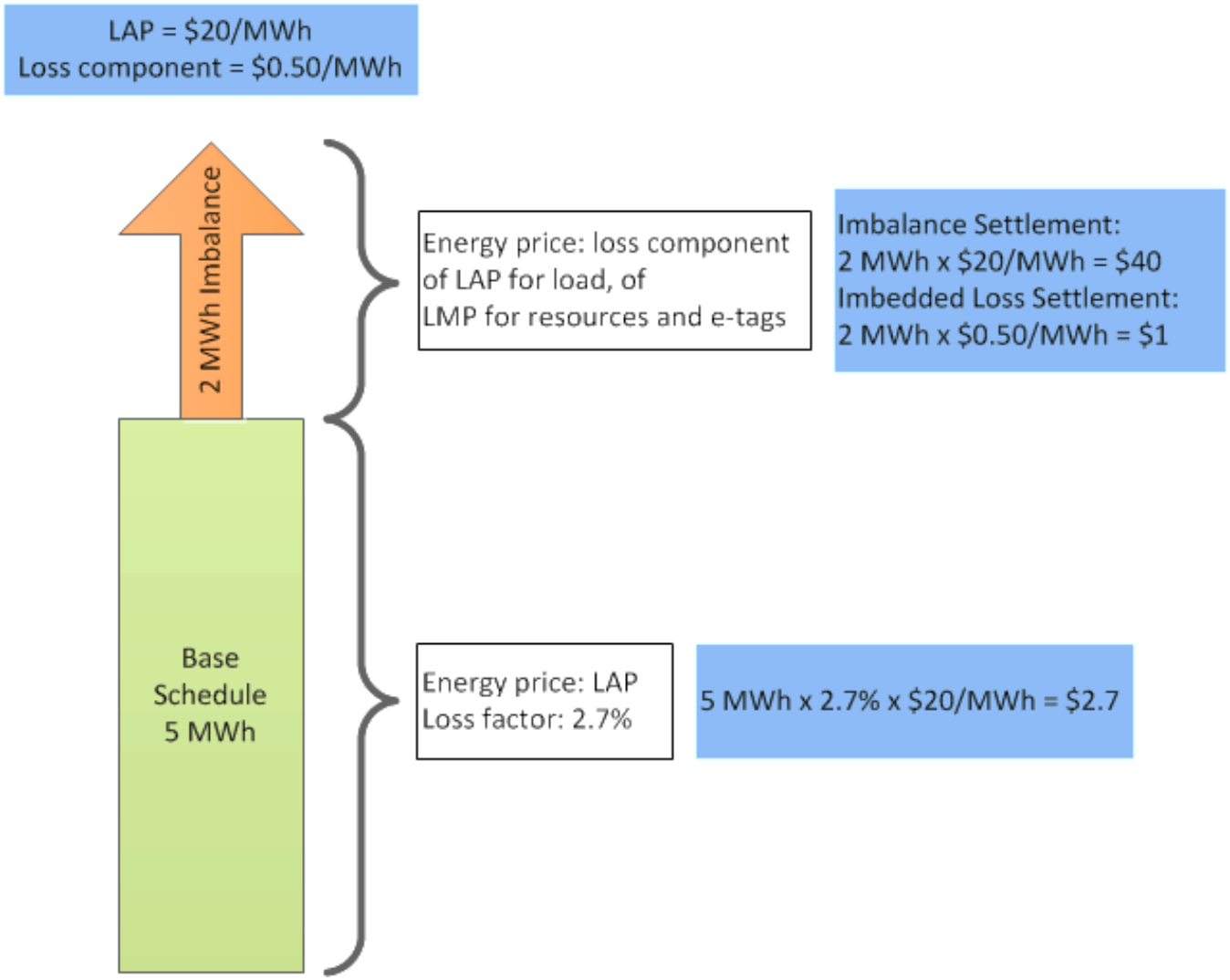
Load Changes Settle at an hourly

Load Aggregation Point (LAP).

These examples are not meant to reflect actual resource or load locations.

PUGET SOUND ENERGY

Washington Area Losses in the EIM



PSE PUGET SOUND ENERGY

Base Schedule Basics

Definition
- A forward energy schedule
- Includes hourly forecasts of load, generation schedules, hourly interchange

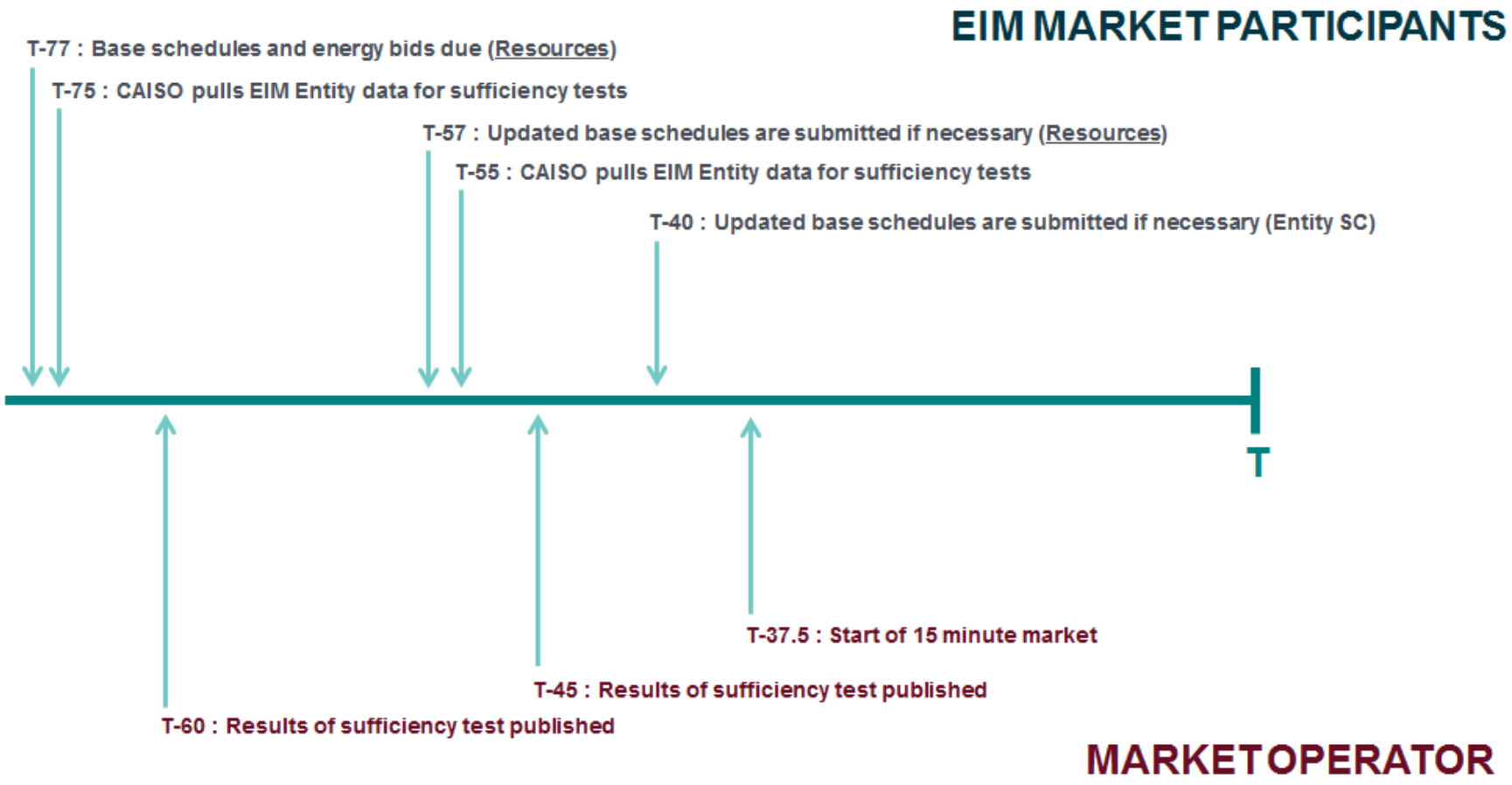
Why
- It communicates the hourly planned operation for participating resources, non-participating resources, imports, exports & load
- Represents a financially binding starting point in the real-time market

Submitted By
- Base Schedule Coordinator
- EIM Entity Scheduling Coordinator
- Participating Resources & Non Participating Resources

Timing
- Day-ahead prior to the 10:00 am PPT the day before the operating day
- Real-time 77 minutes prior to the start of the operating hour

PSE PUGET SOUND ENERGY

EIM Timelines



PUGET SOUND ENERGY

Settlements & Timelines

- CAISO Settlement calendar for EIM Markets
  - **Initial Settlement @ Trade Date (T) + 3 Business Days (B)**
  - **Recalculation Settlement @ Trade Date + 12 Business Days**
  - **Recalculation Settlement @ Trade Date + 55 Business Days**
  - **Optional Recalculation Settlement @ Trade Date + 9 Months (M)**
  - **Optional Recalculation Settlement @ Trade Date + 18 Months**
  - **Optional Recalculation Settlement @ Trade Date + 35 Months**
  - **Optional Recalculation Settlement @ Trade Date + 36 Months**
  - **Optional Unscheduled Recalculation Settlement with 30 day notice**

- **Note: Resettlements can occur after the 36-month settlement. CAISO recently resettled the first day of MRTU for the third time after the 36-month settlement was posted.**

PUGET SOUND ENERGY

Tariff & Change Management

PUGET SOUND ENERGY

Questions

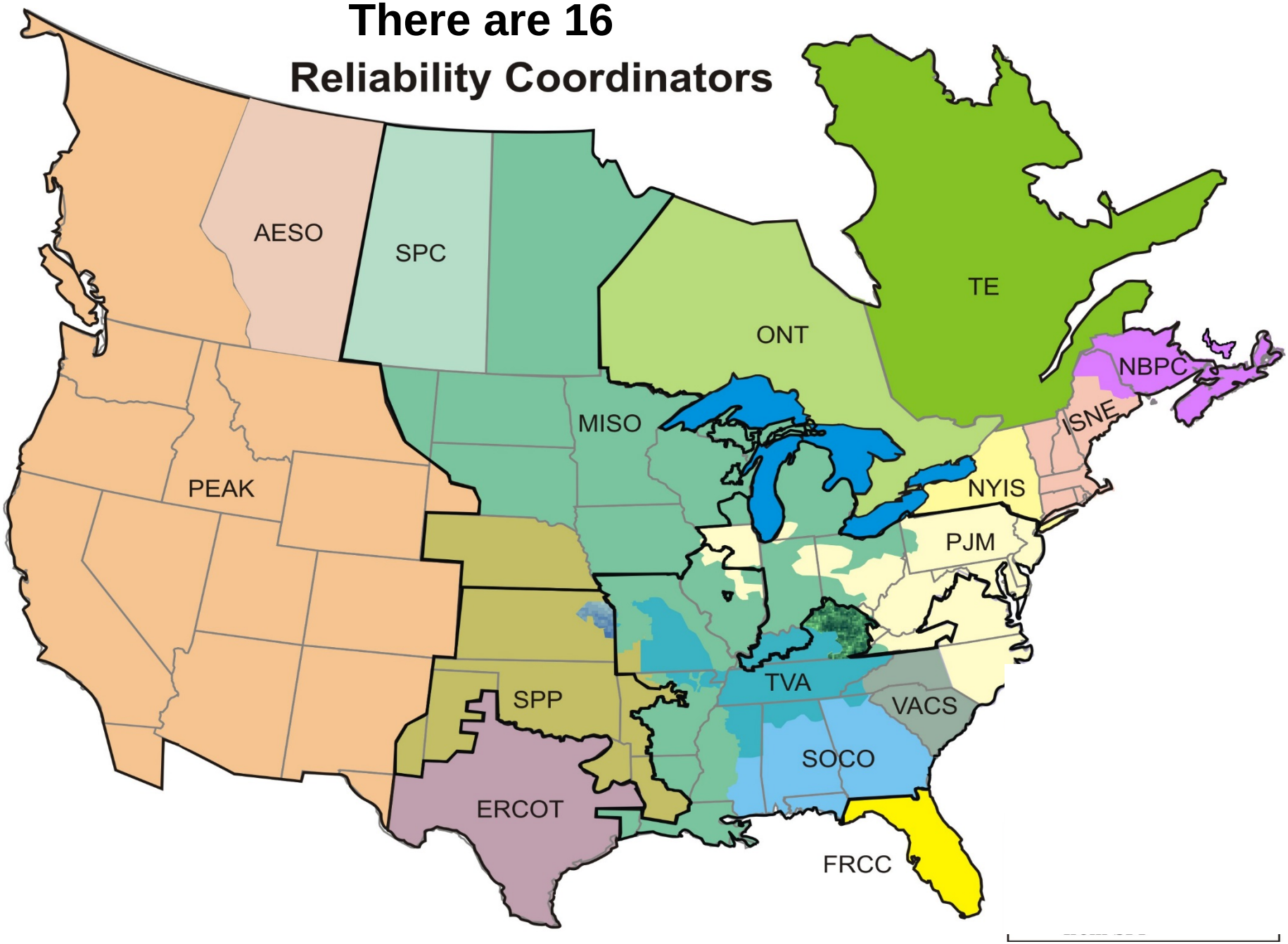
PUGET SOUND ENERGY

Differences Between Peak Reliability and WECC

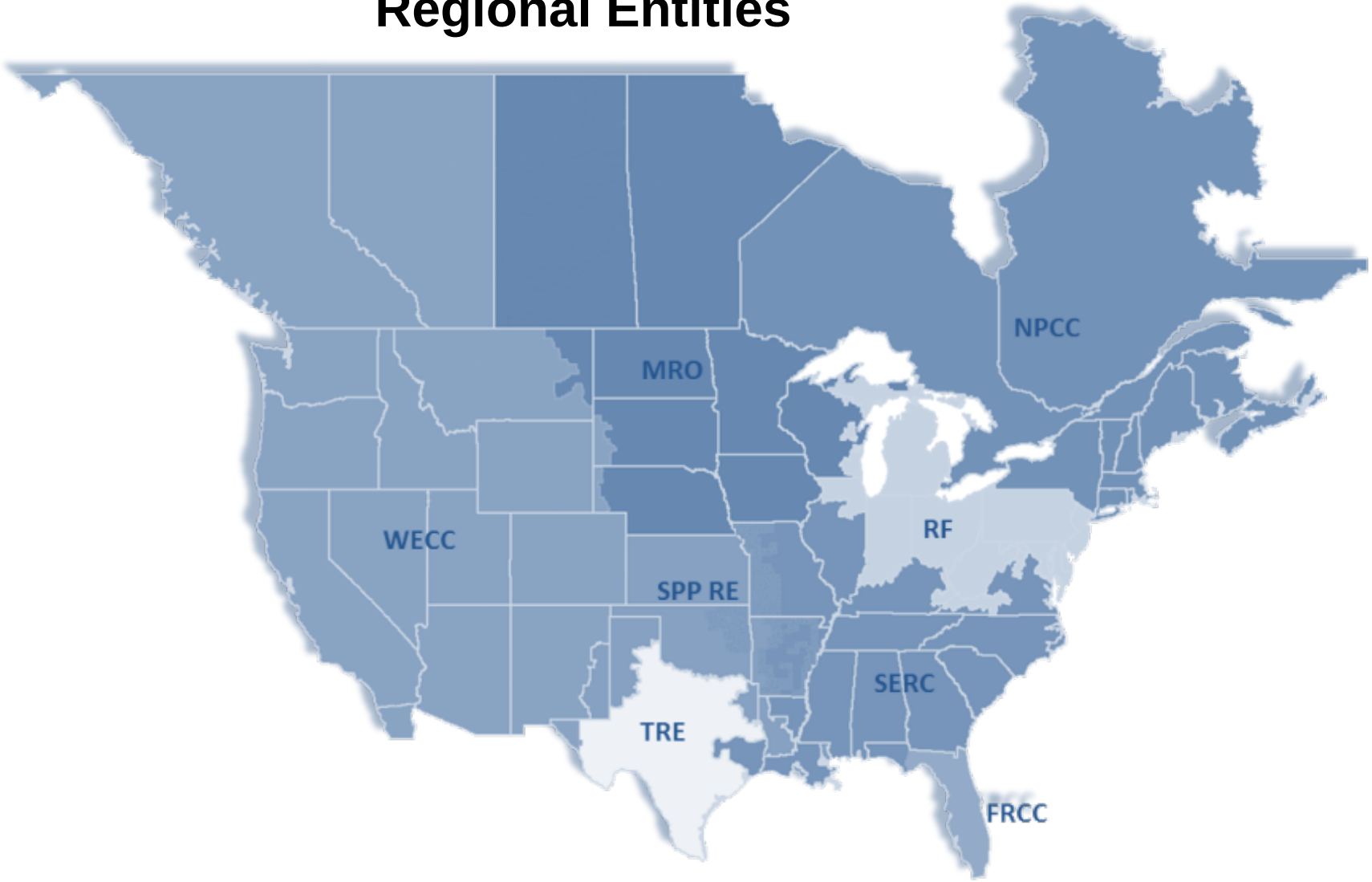
October 26, 2016

PEAKRELIABILITY
assuring the wide area view

There are 16
Reliability Coordinators



And, there are 8 Regional Entities



Creation of Peak

- July 2007 – Mandatory NERC compliance introduced
  - WECC Regional Entity (Compliance Enforcement Authority) for the Western Interconnection
- January 2009 – WECC consolidates three “security coordinators” into a single Reliability Coordinator
  - WECC Reliability Coordinator – Registered Entity subject to compliance with mandatory standards

PEAKRELIABILITY

Creation of Peak

- September 2011 – Southwest blackout focuses attention on potential conflicts:
  - WECC constrained from participating in Event Analyses related to the blackout
  - Was the governance construct inhibiting proper funding?
- May 2012 – FERC/NERC issue Joint Report – "Arizona-Southern California Outages on September 8, 2011: Causes and Recommendations"
  - The construct of WECC comes under increased scrutiny – should WECC continue to be the Regional Entity and Reliability Coordinator?

Creation of Peak

- July 2012 – NERC offers recommendations about WECC organization, governance and potential conflicts arising
- June 2013 – WECC members approve bifurcation into Regional Entity (WECC) and a Reliability Coordinator (Peak Reliability)
- February 2014 – FERC issues final order approving bifurcation and Peak is officially launched

Who is WECC?

- **Non-profit corporation** that exists to assure a reliable Bulk Electric System in the Western Interconnection
- Approved by FERC as the **Regional Entity** for the Western Interconnection; largest of the eight
- NERC delegated some of its authority to **create, monitor and enforce reliability standards** to WECC through a Delegation Agreement
- Both a **Region and an Interconnection** makes it unique—better ***perspective***

WECC

Incorporated:	*2002*
Business:	*501(c)(4) not-for profit*
Board of Directors:	10 *members, independent*
Employees:	*140*
Members:	*356*
Offices:	*Salt Lake City, UT (HQ)*
	Vancouver, WA

As of October 20, 2016

PEAKRELIABILITY

What WECC does

- **Mission:** To assure the near- and long-term reliability of the Bulk Electric System (BES) in the Western Interconnection
- **Vision:** To serve the public interest by assuring the BES is reliable; to best inform the Region's leaders in their decisions regarding critical electric reliability issues facing the Western Interconnection; and to partner with our stakeholders to help them plan, develop and operate the BES in accordance with industry-accepted reliability standards

How WECC does it

Reliability Planning and Performance Analysis

- Planning Services: *Base Cases, Transmission Studies, Scenario Planning*
- Reliability Assessments: *Power Supply Assessment, State of the Interconnection*
- Performance Analysis: *Event Analysis, Operational Practices Survey*
- Standards Development: *Regional Standards, Variances and Interpretations*
- Training and Education: *Human Performance, System Operation*

How WECC does it

Risk-based Compliance Monitoring and Enforcement

- Entity Registration
- Compliance Risk Assessments:
  - *Inherent Risk Assessment*
  - *Internal Controls Evaluation*
- Monitoring:
  - *Critical Infrastructure Protection*
  - *Operations and Planning*
- Standards Violation Enforcement

Peak's Purpose

Peak empowers exceptional reliability performance in the Western Interconnection.

Reliability Coordination

PEAKRELIABILITY

Reliability Coordination

- FERC/NERC Requirements:
  - Highest level of authority responsible for the reliable operation of the Bulk Electric System (BES)
  - Authority to prevent or mitigate emergencies in day-ahead and real-time
  - Wide-Area view of BES (situational awareness)
- Peak has some of the most sophisticated tools available

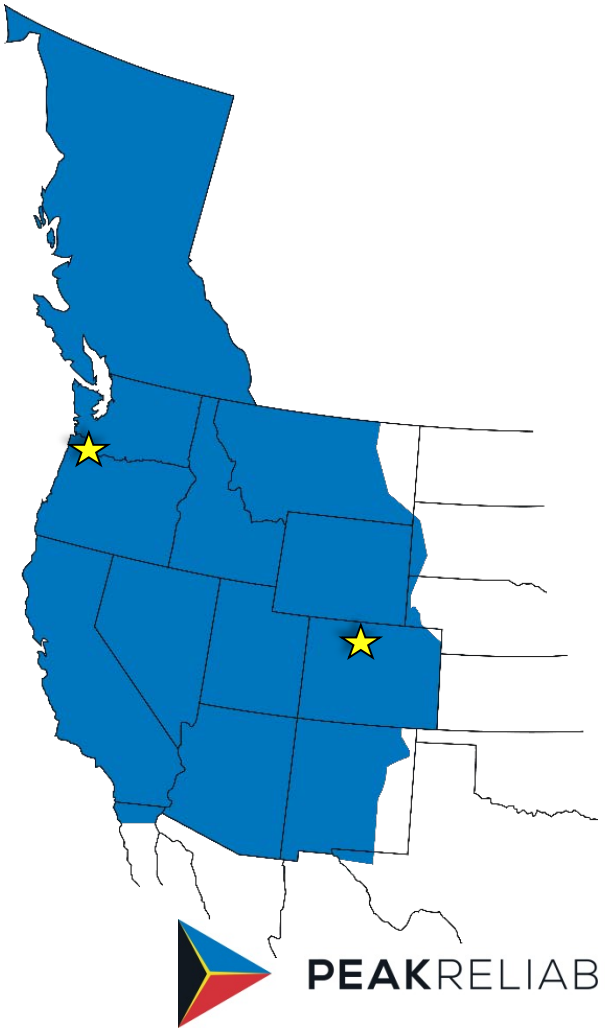
*NERC's RC Standard**

- R3 – The Reliability Coordinator shall have clear decision-making authority to act and to direct actions to be taken to preserve the integrity and reliability of the Bulk Electric System
- R9 – The Reliability Coordinator shall act in the interests of reliability for the overall Reliability Coordinator Area and the Interconnection before the interests of any other entity

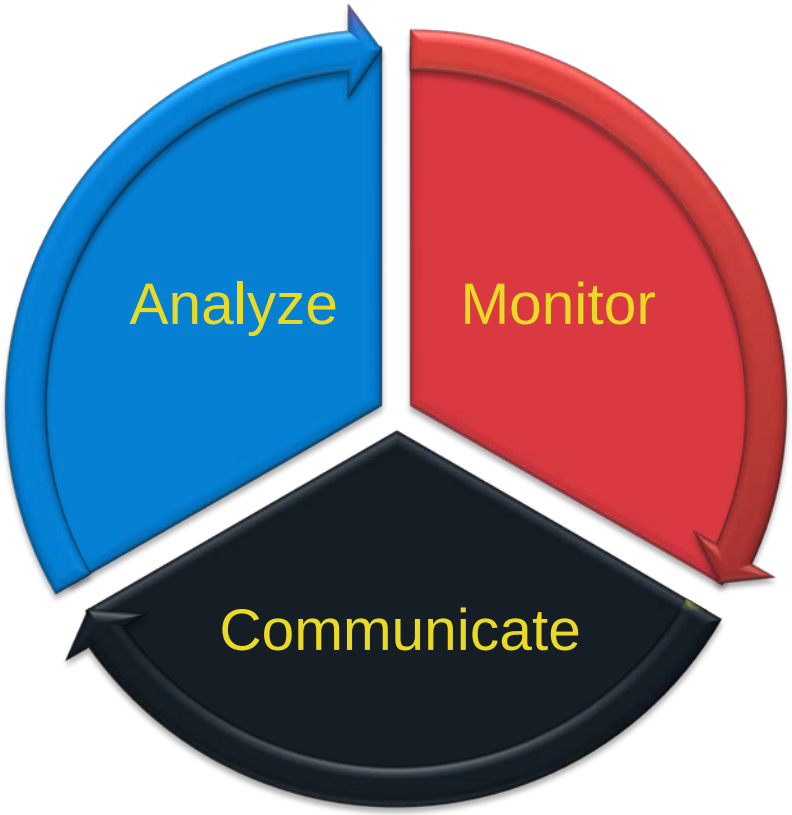
* NERC - IRO-001-1.1

Reliability Coordination

- Two control centers providing situational awareness and real-time supervision of the West:
  - *Loveland, Colorado*
  - *Vancouver, Washington*



What does Peak do?



PEAKRELIABILITY

Analyze

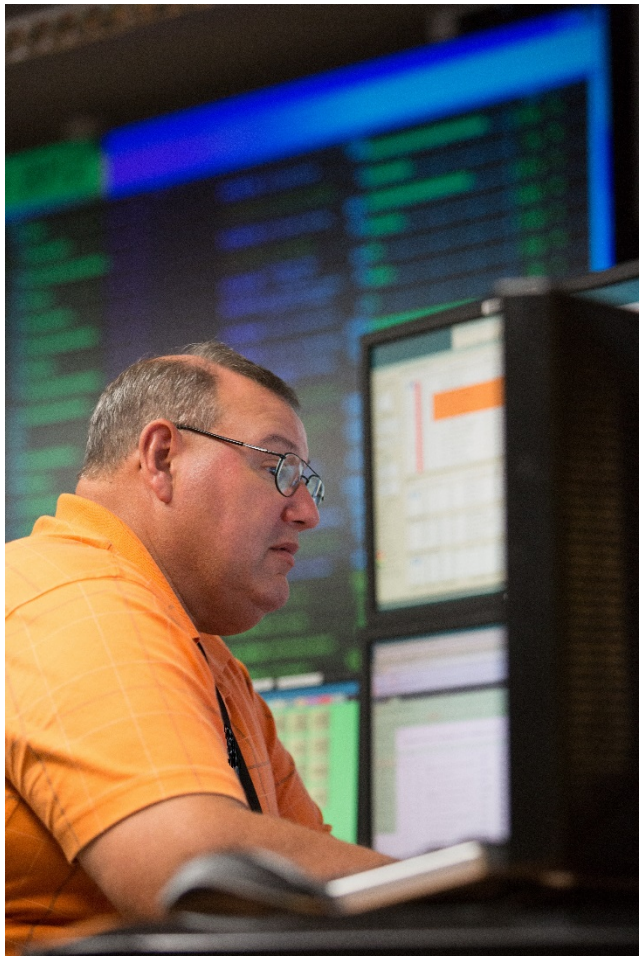
Analyze

- State estimation
- Contingency analysis
- Identify and study mitigation measures
- Week ahead major outage studies
- System Operating Limits (SOL) methodology
- Seasonal study coordination

Monitor

Monitor

- Interconnection Reliability Operating Limits (IROL)
- Path monitoring
- Voltage monitoring
- Frequency monitoring
- Balancing Authority (BA) parameters
- Non-electrical conditions



PEAKRELIABILITY

Communication

- Coordinate in partnership with entities:
  - ✓ 37 BAs
  - ✓ 62 TOPs
  - ✓ Natural gas pipelines
- Disseminate information affecting multiple entities
- Discuss reliability issues and mitigation

PEAKRELIABILITY

Peak Profile

- Employees: 160*
- Members: 129*
- Peak 2016 Budget: $44 million
- Coordinate in partnership with entities:
  - 37 BAs
  - 62 TOPs

*data as of 6-20-16

PEAKRELIABILITY

Structure and Governance

- Structure:
  - 501(c)(4) entity – “best interest of public welfare”
- Governance:
  - Seven-member independent Board of Directors
  - Member Advisory Committee (MAC)
    - Three representatives/member class
    - Independent of Board

PEAKRELIABILITY

New Funding Mechanism

- Previously funded through Section 215 of the Federal Power Act
  - Budget funded by Load Serving Entitles in the Western Interconnection based on entities' Net Energy for Load (NEL)
- January 1, 2016 – budget funded through bilateral contracts with Balancing Authorities and Transmission Operators in Western Interconnection – based on entities' NEL share

Additional services aligned with Peak's mission

Hosted Advanced Applications (HAA)

- A set of reliability tools that can be used to provide enhanced situational awareness
- HAA is a combination of the West-wide System Model, State Estimation, Contingency Analysis and Study Network Applications.

Peak Reliability Synchrophasor Program (PRSP)

- Designed to improve the quality and operationalize synchrophasor data received as a result of the Western Interconnection Synchrophasor Program
- Provides the ability to monitor system stress across wide areas, better detect system events that may lead to an power system instability, and improve system modeling

Welcome

Reliability Messaging Tool (RMT)

PEAKRELIABILITY
assuring the wide area view

Michael Granath,
mgranath@peakrc.com

Manager Operations Coordination

PEAKRELIABILITY
assuring the wide area view

General Information

- Replaced the WECCNet messaging system (June 23, 2016)
- WECCNet messages are archived and available upon request
- Official Messaging Tool for the Western Interconnection
- Web based, no extra equipment to purchase or maintain

General Information

- Used by registered BA/TOPS
- Accessed through peakrc.org or by navigating directly to rmt.peakrc.org
- Send/Receive messages
- Send messages requiring acknowledgements
- Track which individuals have acknowledged a message

General Information

- Create Distribution Lists – Peak has All Reliability/All Balancing Authorities
- Email distributions - Marketing
- Create Message Template
- WebSAS messages
- Accumulated Time Error 1400 PPT Message

General Information

- RMT Administrators
- Messages will be saved on RMT for 4 years – still in development
- Peak is still internally discussing how long messages will be archived for

Support

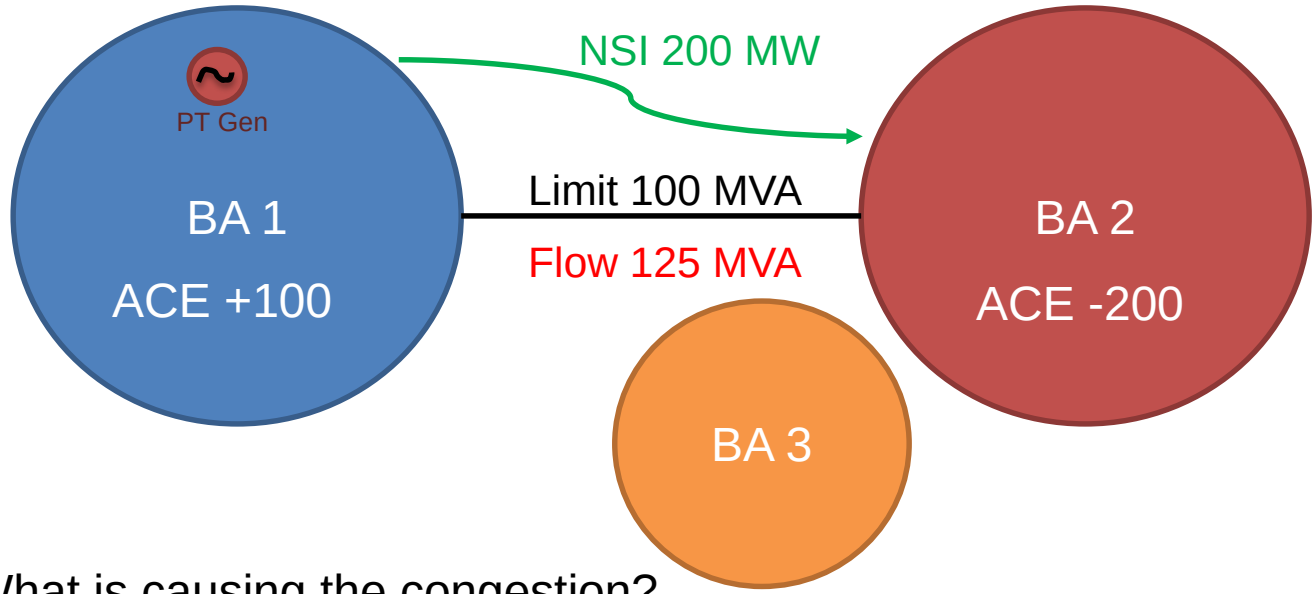
- Forgot Password, but have certificate
- Don’t have certificate, but have password – One Time Passcode (OTP)
- Don’t have certificate or password, contact peak help desk. (Normal business hours)


helpdesk@peakrc.com

Peak Enhanced Curtailment Calculator (ECC)

PEAKRELIABILITY
assuring the wide area view

Congestion Monitoring



What is causing the congestion?

- Flow between BAs (and difference between actual and schedule)?
- Difference between ACE of the BAs?
- Pseudo-Tie generation?
- Other BAs in the area and their flows?

Answer: All contribute, but how does Peak know the composition?

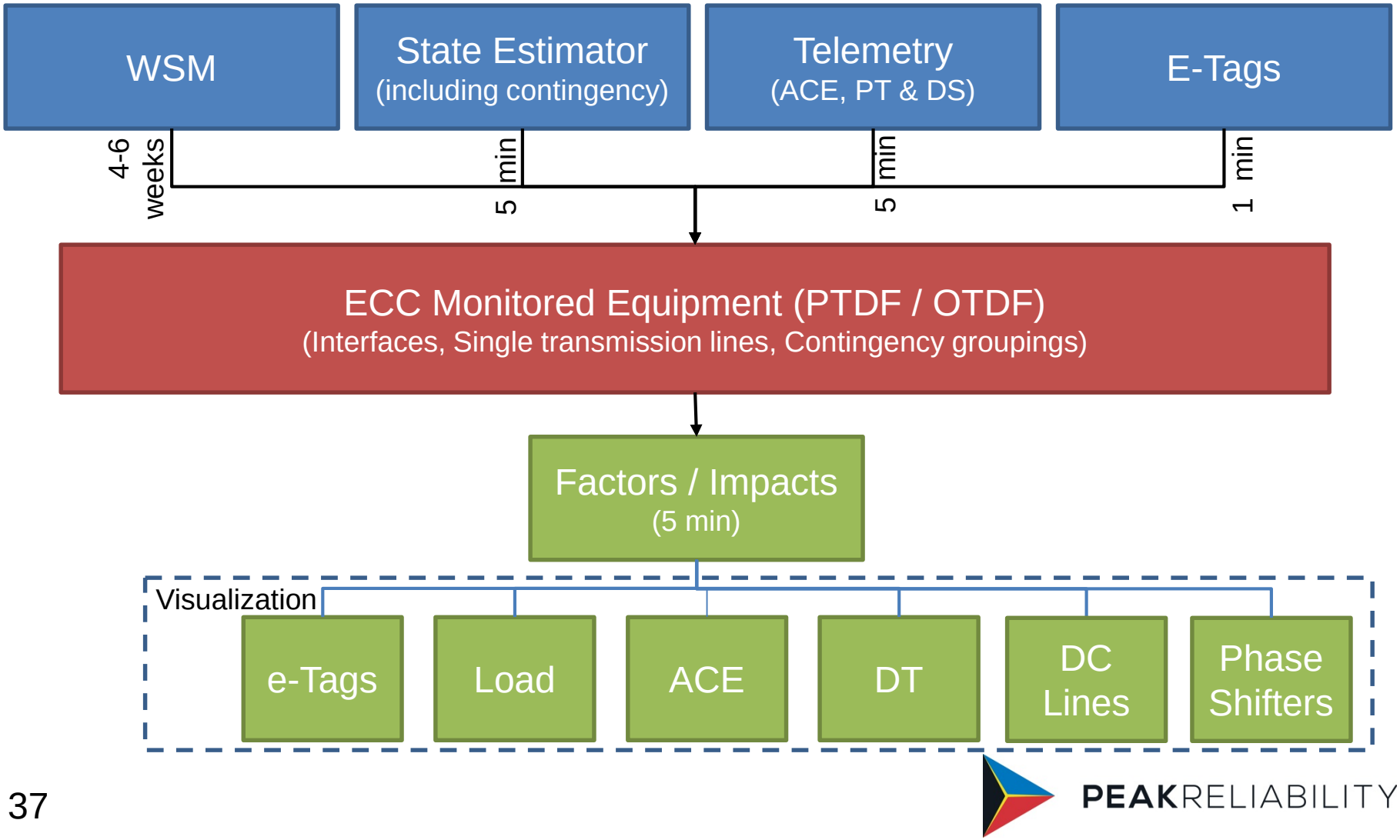
PEAKRELIABILITY

ECC Current Hour Situational Awareness Functionality

- Tool to show congestion and composition
- Foundation for current and future tool design
- Uses Peak's WSM and State Estimator as primary inputs
- Provides visualization of congested "elements" with details on composition
- Collaborative platform

PEAKRELIABILITY

How Does ECC Work?

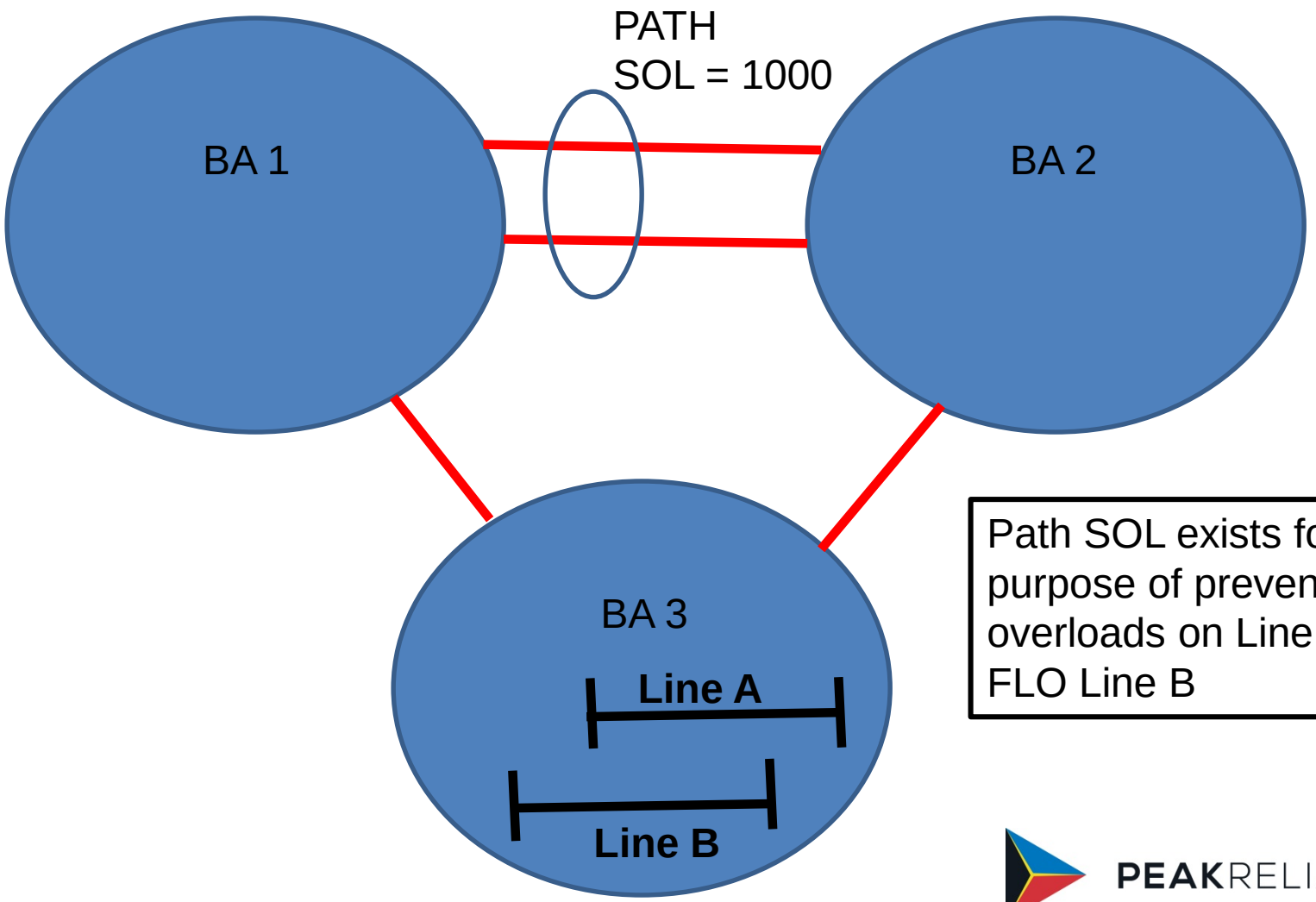


PEAKRELIABILITY

ECC Element Types

- Element Definitions – two types
  - Power Transfer Distribution Factor (PTDF) - Monitored facilities
    - Pre-contingent flows
    - Monitor against thermal limits
    - Single lines, WECC Paths
  - Outage Transfer Distribution Factor (OTDF) - Contingencies
    - Monitor pre- and post-contingent flows
    - Similar to what RTCA performs

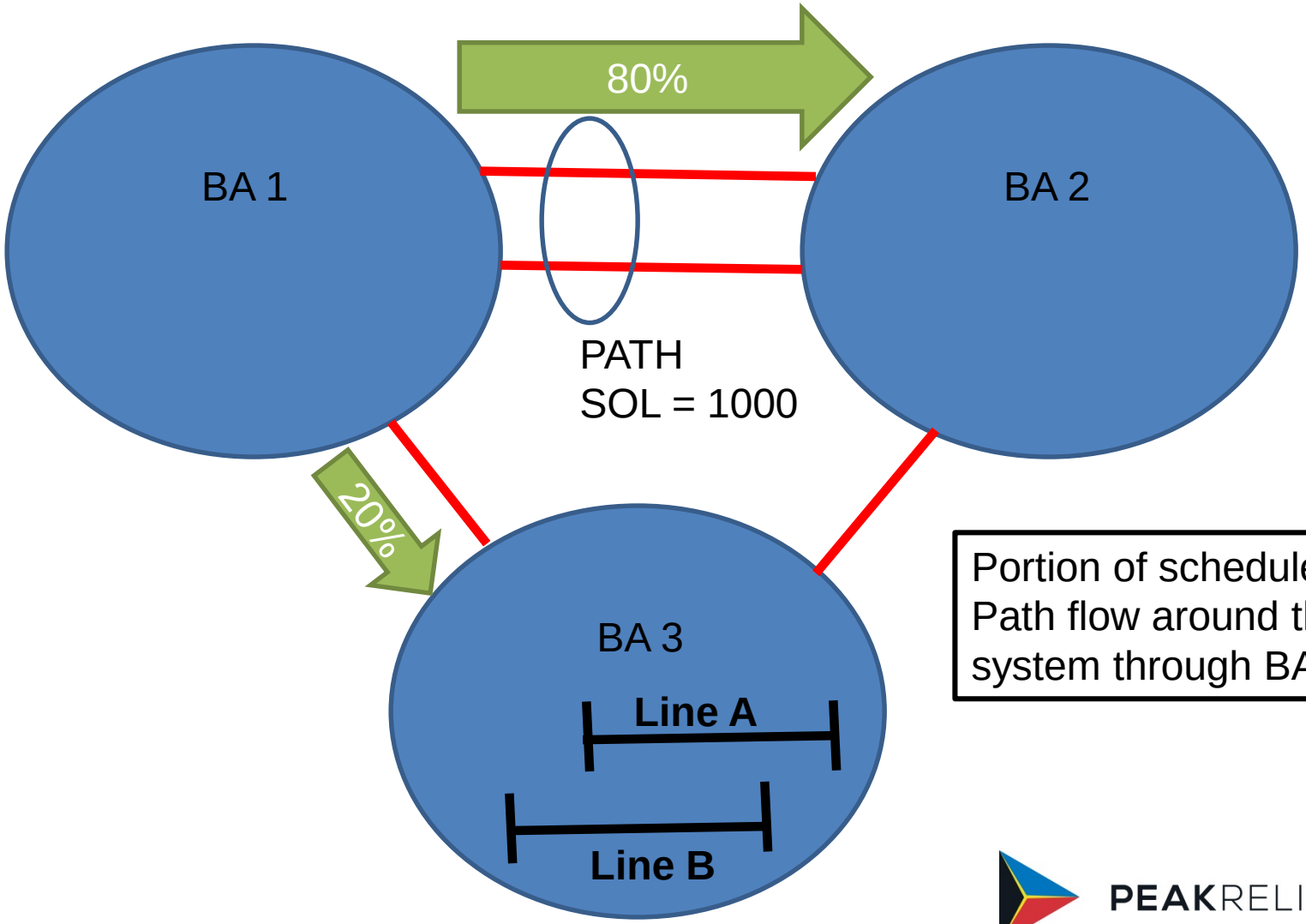
Congestion Example



Path SOL exists for the purpose of preventing overloads on Line A FLO Line B

PEAKRELIABILITY

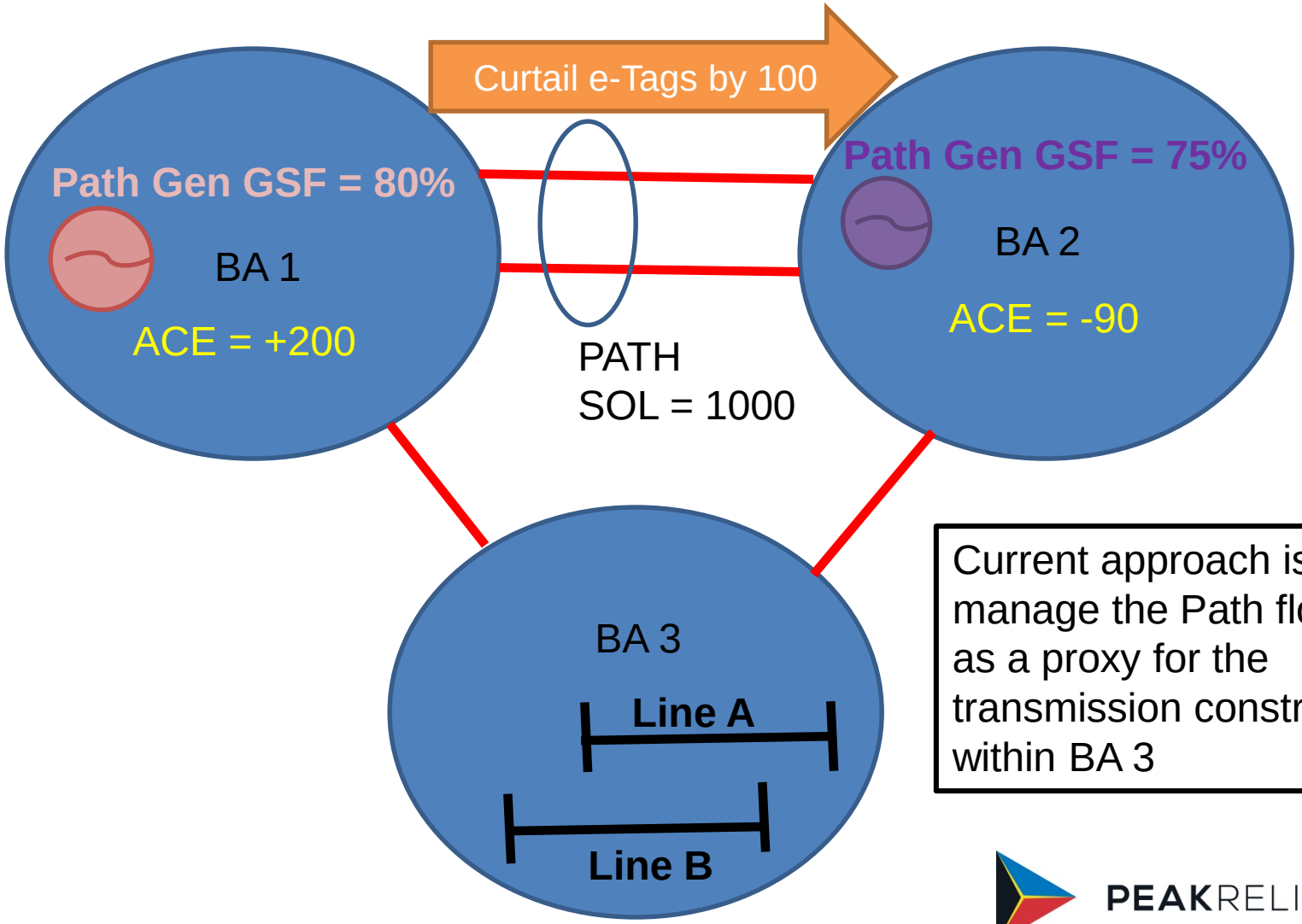
Congestion Example



Portion of schedules on Path flow around the system through BA 3

PEAKRELIABILITY

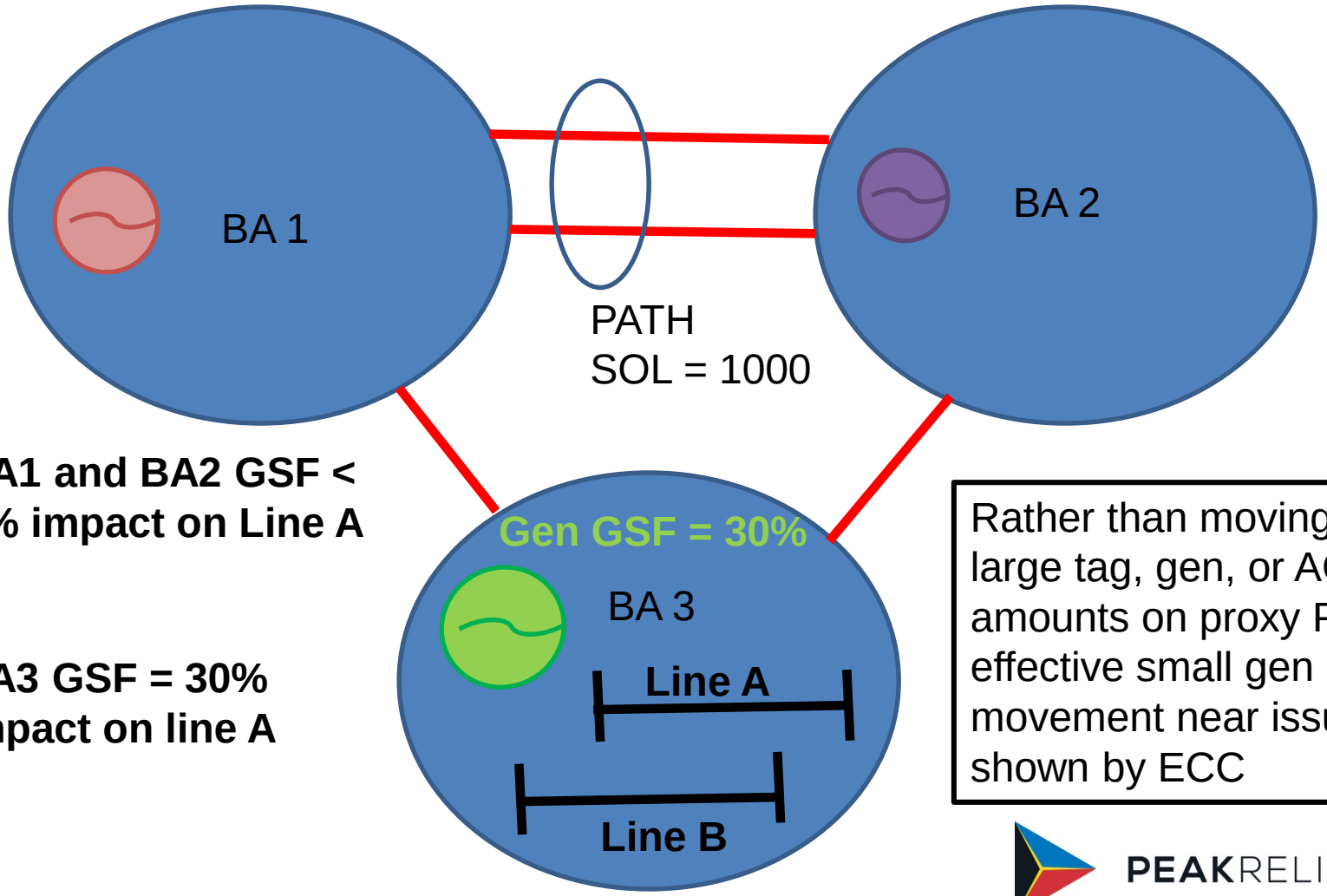
Congestion Example – Today's Practices



Current approach is to manage the Path flow as a proxy for the transmission constraint within BA 3

PEAKRELIABILITY

Congestion Example – Future State Based on Real-time Assessments



BA1 and BA2 GSF < 5% impact on Line A

BA3 GSF = 30% impact on line A

Rather than moving large tag, gen, or ACE amounts on proxy Path, effective small gen movement near issue is shown by ECC

PEAKRELIABILITY

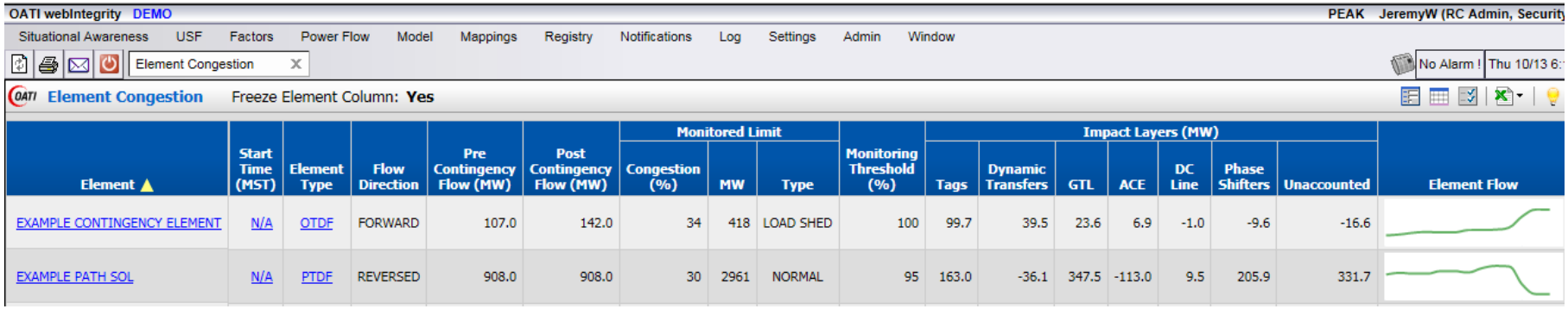
Contributions to Congestion

- ACE/Gen
- Tagged flows
- Market/BA load serving
- DC injections
- Phase shifter tap

MW Flow	Tags	Dynamic Transfers	GTL	ACE	DC Lines	Phase Shifters	Unaccounted
338.9	135.2	44.1	142.3	5.7	0.5	2.0	9.2
336.1	134.1	44.2	141.8	1.3	0.5	2.0	12.2
334.5	135.5	44.0	145.6	-3.2	0.5	2.0	10.1
332.5	135.5	43.8	144.8	-2.9	0.5	2.0	8.7
334.4	137.6	44.3	144.1	-0.4	0.5	2.0	6.2
332.8	137.3	44.6	143.9	-1.5	0.6	2.0	6.0
333.0	136.9	44.2	143.7	-0.5	0.6	2.0	6.1
333.5	137.4	45.9	142.9	0.5	0.6	2.0	4.2
333.8	137.2	49.0	143.1	-2.1	0.5	2.0	3.9
332.3	136.9	49.2	142.0	0.0	0.6	2.0	1.6
				0	0.6	2.0	-0.6
				1	0.5	2.0	0.5
				4	0.5	2.0	2.7
				3	0.5	2.1	3.0
				8	0.5	2.1	1.0
				4	0.5	2.1	-0.9

PEAKRELIABILITY

Congestion Example in ECC - Dashboard



Element	Start Time (MST)	Element Type	Flow Direction	Pre Contingency Flow (MW)	Post Contingency Flow (MW)	Monitored Limit			Monitoring Threshold (%)	Impact Layers (MW)							Element Flow
						Congestion (%)	MW	Type		Tags	Dynamic Transfers	GTL	ACE	DC Line	Phase Shifters	Unaccounted	
EXAMPLE CONTINGENCY ELEMENT	N/A	OTDF	FORWARD	107.0	142.0	34	418	LOAD SHED	100	99.7	39.5	23.6	6.9	-1.0	-9.6	-16.6	
EXAMPLE PATH SOL	N/A	PTDF	REVERSED	908.0	908.0	30	2961	NORMAL	95	163.0	-36.1	347.5	-113.0	9.5	205.9	331.7	

PEAKRELIABILITY

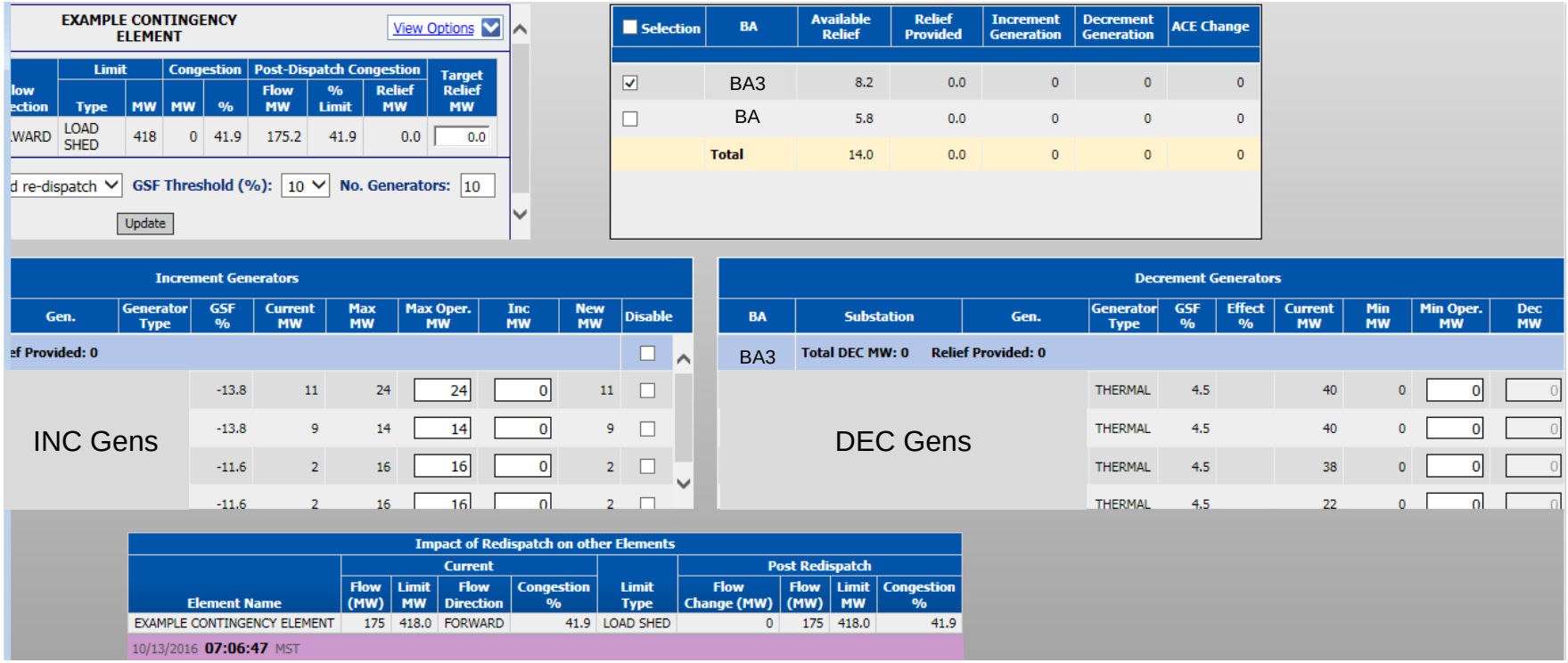
Congestion Example in ECC – Tag Impacts on Contingency Element

EXAMPLE CONTINGENCY ELEMENT	FORWARD	N/A	N/A	107.6	142.5	34.1	N/A	Load Shed

	Element Impacts	Source	Sink	Impact MW 10/13 06:10	Actual MW 10/13 06:10	TDF (%) 10/13 06:10
	Total Impact			**142.5**		
−	**Total Tags**			**99.7**		
−	**Total Off-Path Tags**			**99.7**		
+	**Total Off-Path Tags (1-NS)**			**29.5**		
+	**Total Off-Path Tags (2-NH)**			**2.2**		
+	**Total Off-Path Tags (3-ND)**			**-1.0**		
+	**Total Off-Path Tags (5-NM)**			**0.0**		
−	**Total Off-Path Tags (6-NN)**			**58.2**		
	Tag 1			2.5	25.0	10.0
	Tag 2			1.7	17.0	10.0
	Tag 3			7.8	78.0	10.0
	Tag 4			0.6	6.0	10.0
	Positive Impact (TDF < 10%)			46.6		
	Counter-Flow Impact (Negative TDF)			-1.0		
−	**Total Off-Path Tags (7-FIRM)**			**10.9**		
	Tag 5			0.6	6.0	10.0
	Tag 6			0.8	8.0	10.0
	Positive Impact (TDF < 10%)			67.7		
	Counter-Flow Impact (Negative TDF)			-58.2		

PEAKRELIABILITY

Congestion Example in ECC – Gen Worksheet on Contingency Element



EXAMPLE CONTINGENCY ELEMENT — View Options

low ection	Limit Type	Limit MW	Congestion MW	Congestion %	Post-Dispatch Congestion Flow MW	Post-Dispatch Congestion % Limit	Post-Dispatch Congestion Relief MW	Target Relief MW
WARD	LOAD SHED	418	0	41.9	175.2	41.9	0.0	0.0

d re-dispatch | GSF Threshold (%): 10 | No. Generators: 10 | Update

Selection	BA	Available Relief	Relief Provided	Increment Generation	Decrement Generation	ACE Change
☑	BA3	8.2	0.0	0	0	0
☐	BA	5.8	0.0	0	0	0
	Total	14.0	0.0	0	0	0

Increment Generators

Gen.	Generator Type	GSF %	Current MW	Max MW	Max Oper. MW	Inc MW	New MW	Disable
ef Provided: 0								☐
INC Gens		-13.8	11	24	24	0	11	☐
		-13.8	9	14	14	0	9	☐
		-11.6	2	16	16	0	2	☐
		-11.6	2	16	16	0	2	☐

Decrement Generators

BA	Substation	Gen.	Generator Type	GSF %	Effect %	Current MW	Min MW	Min Oper. MW	Dec MW
BA3	Total DEC MW: 0	Relief Provided: 0							
DEC Gens			THERMAL	4.5		40	0	0	0
			THERMAL	4.5		40	0	0	0
			THERMAL	4.5		38	0	0	0
			THERMAL	4.5		22	0	0	0

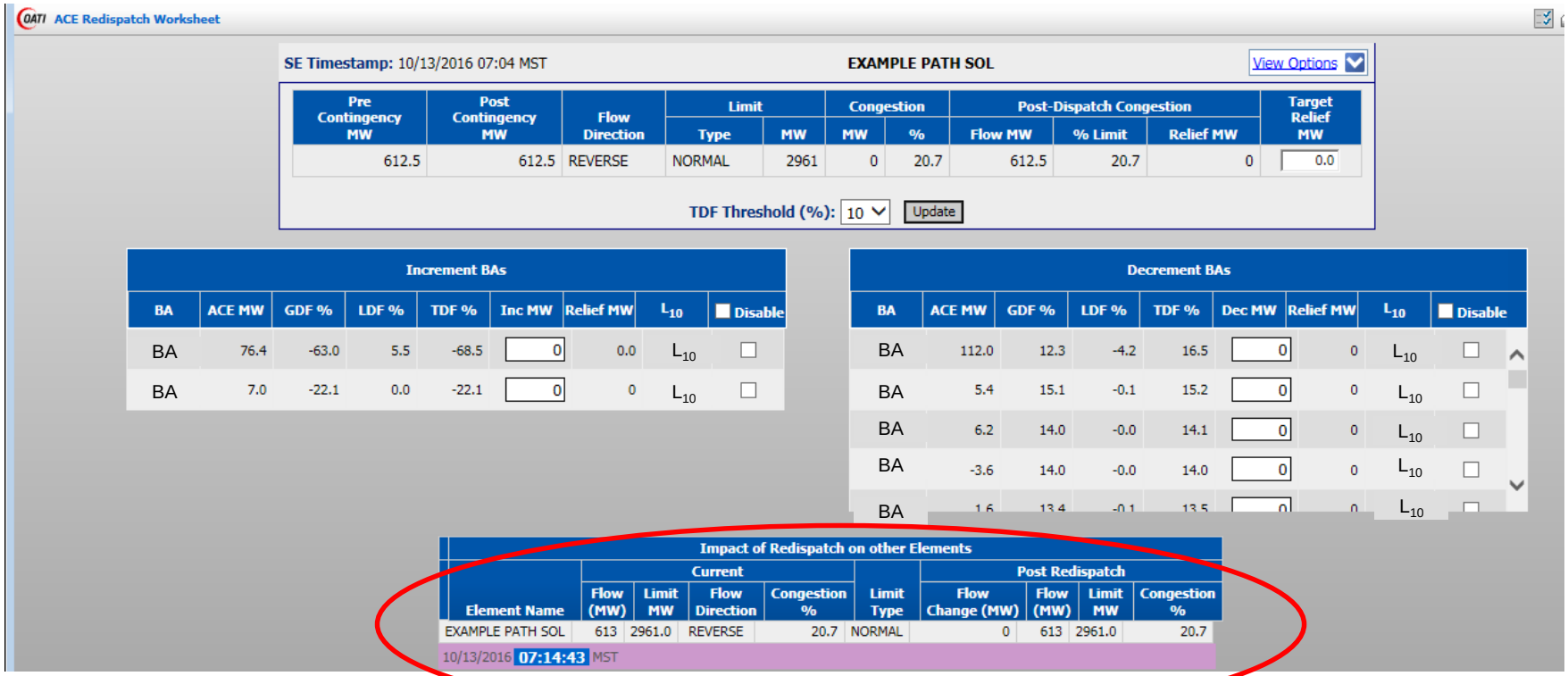
Impact of Redispatch on other Elements

Element Name	Current Flow (MW)	Current Limit MW	Current Flow Direction	Current Congestion %	Limit Type	Post Redispatch Flow Change (MW)	Post Redispatch Flow (MW)	Post Redispatch Limit MW	Post Redispatch Congestion %
EXAMPLE CONTINGENCY ELEMENT	175	418.0	FORWARD	41.9	LOAD SHED	0	175	418.0	41.9

10/13/2016 **07:06:47** MST

PEAKRELIABILITY

Congestion Example in ECC – ACE Worksheet on Path Element



PEAKRELIABILITY

Reliability Objectives with webIntegrity

- Real-time assessments based on
  - Real-time data (topology, gen, load, etc.)
  - Full interconnection model
- Reliably and efficiently address SOL exceedances (pre- and post-contingency)
- Look ahead features to support operator awareness of coming issues
- Reliably address seams issues

Evolution in Progress

- TOP/IRO standards: Real-time Assessments, retirement of TOP-007-WECC-1
- NERC SOL Whitepaper: Defines SOLs
- Path Operator Task Force: Created new paradigm
- SOL methodology changes

Peak Vision for ECC

- ECC will be
  - Used by all BAs and TOPs to have a common understanding of SOLs
  - The primary tool for assigning mitigation responsibilities for those elements modeled in the tool
    - Assumes only those facilities that are impacted > X% by multiple BAs and/or market footprints are modeled as “coordinated” elements
    - Other facilities can be defined as elements for the purpose of situational awareness

WIUFMP Implementation in ECC

- Unscheduled Flow Mitigation Plan (UFMP) is the current congestion management for Western Interconnection
- Currently has four Qualified Paths
  - Paths 30, 31, 36, 66
- Four steps for mitigation
  - Step 3 = Coordinated Operation of Phase Shifters
  - Step 4 = e-Tag Curtailments
- Path Operators primarily issue events
  - CAISO, WACM

WIUFMP Implementation in ECC

- Peak wants to consolidate congestion management efforts in the ECC tool
- Capability exists to monitor the four Qualified Paths but have to transition UFMP functions
- Other benefits from ECC platform (following slides)

WIUFMP Implementation in ECC

- Improvement of accuracy in TDF calculations
  - webSAS TDF factor are static, calculated twice per year from planning models
  - In ECC the factors are calculated every five minutes from real-time State Estimator and Power Flow solutions
- More accurate Curtailment Calculations during USF procedures
  - More accurate TDF yields more equitable and tag curtailment lists that better respond to reliability problems

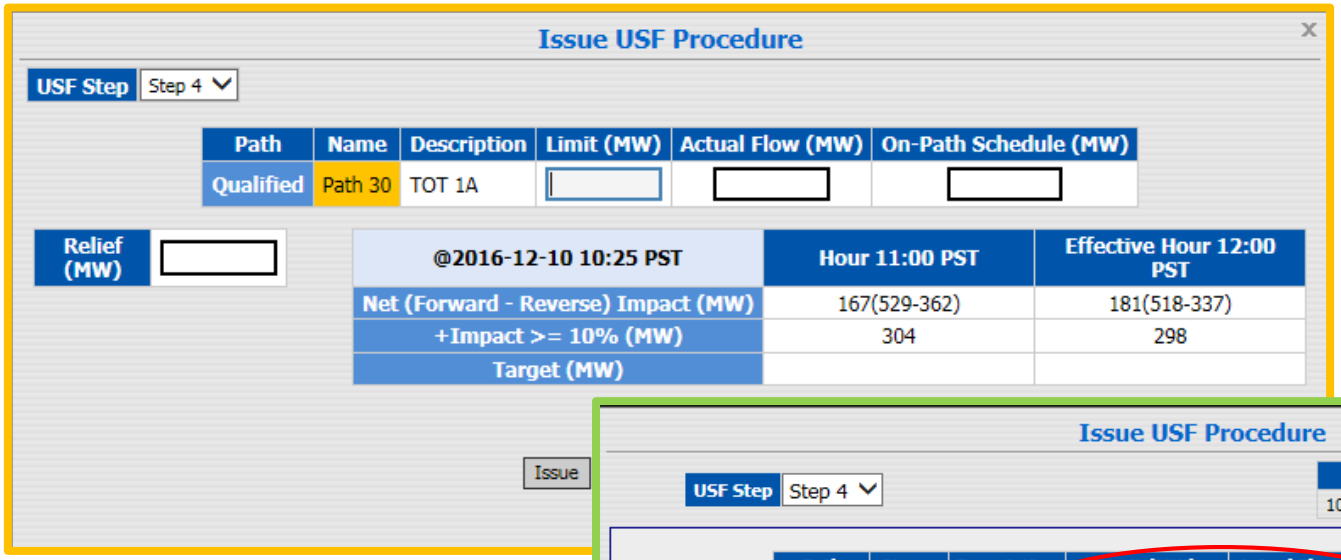
WIUFMP Implementation in ECC

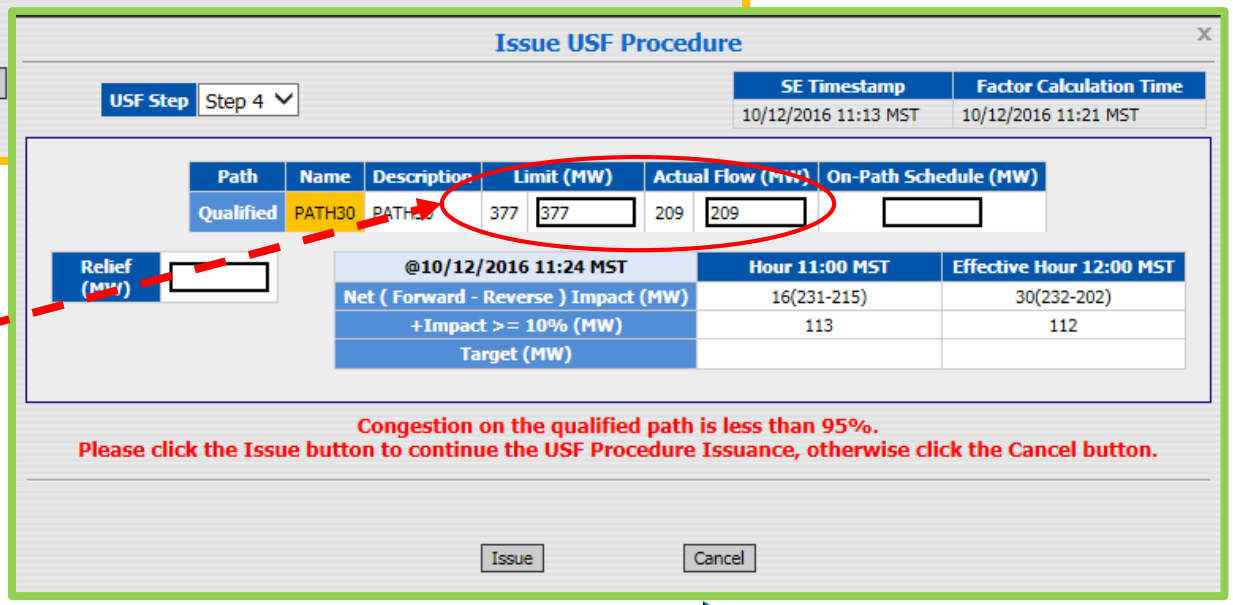
- No modifications needed to the Unscheduled Flow Mitigation Plan (Filled with FERC)
  - No changes in the curtailment methodology
- Minimize the modifications on the Graphical User Interface
  - Minimize USFM User training
  - Lower risk
  - Maintain the current process to issue USFMP and conform with curtailment process currently in webSAS

What does not change from webSAS?

- Workflow for issuance USF procedures
  - Timing for TOP issuance
  - Timing for the RC to Approve
  - Timing for BA Curtailment acknowledgements
- USF Calculations do not change (except for using more accurate TDFs)
- Competing Path methodology remains the same as currently implemented in webSAS
- Reports and GUI for USF procedures have very minimal changes

webSAS vs ECC USF – Issue USF

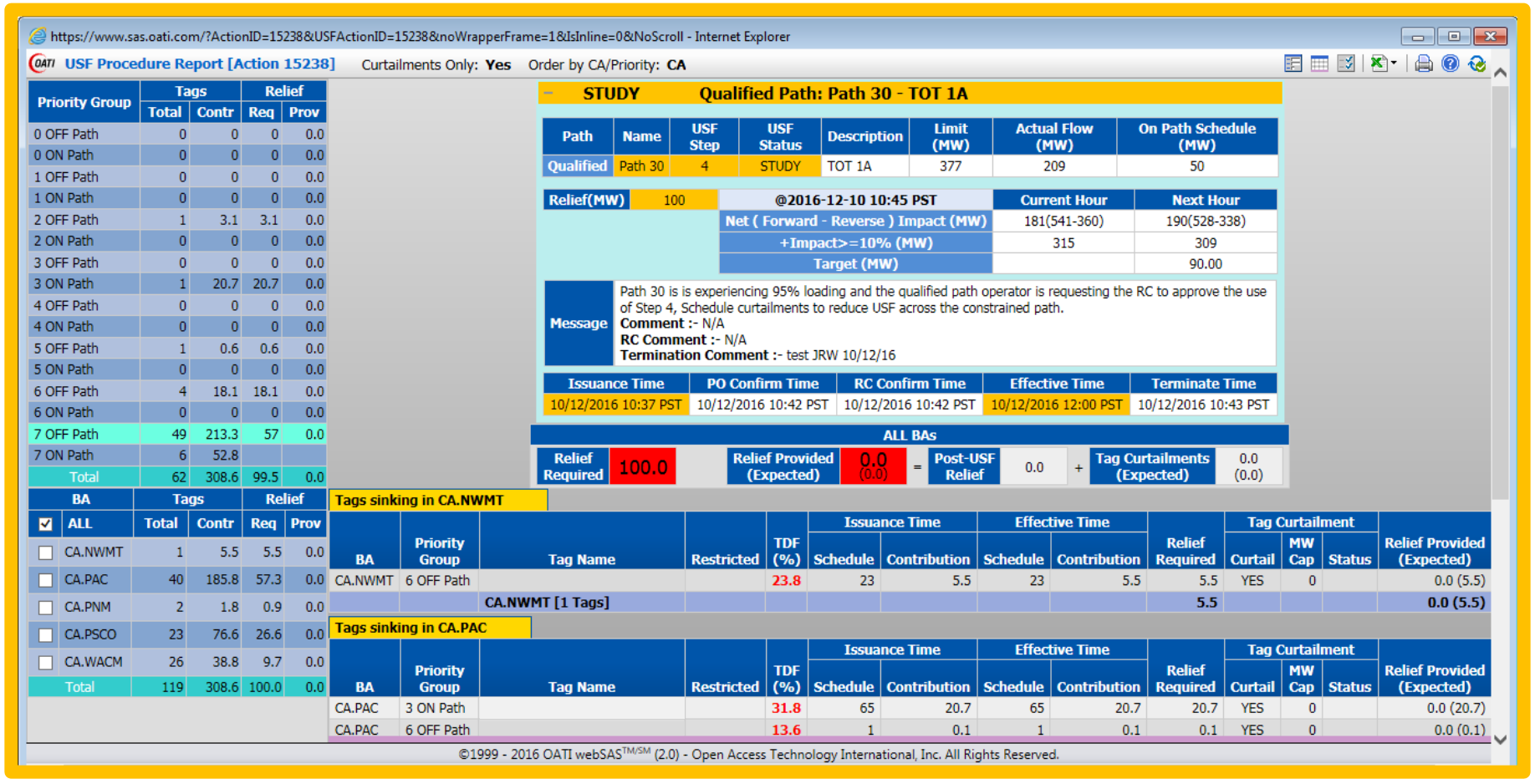




ECC populates limit and flow but can be edited manually

PEAKRELIABILITY

webSAS vs ECC USF – USF Procedure Report



https://www.sas.oati.com/?ActionID=15238&USFActionID=15238&noWrapperFrame=1&IsInline=0&NoScroll - Internet Explorer

USF Procedure Report [Action 15238] Curtailments Only: Yes Order by CA/Priority: CA

Priority Group	Tags Total	Tags Contr	Relief Req	Relief Prov
0 OFF Path	0	0	0	0.0
0 ON Path	0	0	0	0.0
1 OFF Path	0	0	0	0.0
1 ON Path	0	0	0	0.0
2 OFF Path	1	3.1	3.1	0.0
2 ON Path	0	0	0	0.0
3 OFF Path	0	0	0	0.0
3 ON Path	1	20.7	20.7	0.0
4 OFF Path	0	0	0	0.0
4 ON Path	0	0	0	0.0
5 OFF Path	1	0.6	0.6	0.0
5 ON Path	0	0	0	0.0
6 OFF Path	4	18.1	18.1	0.0
6 ON Path	0	0	0	0.0
7 OFF Path	49	213.3	57	0.0
7 ON Path	6	52.8		
Total	62	308.6	99.5	0.0

STUDY Qualified Path: Path 30 - TOT 1A

Path	Name	USF Step	USF Status	Description	Limit (MW)	Actual Flow (MW)	On Path Schedule (MW)
Qualified	Path 30	4	STUDY	TOT 1A	377	209	50

Relief(MW) 100	@2016-12-10 10:45 PST	Current Hour	Next Hour
	Net (Forward - Reverse) Impact (MW)	181(541-360)	190(528-338)
	+Impact>=10% (MW)	315	309
	Target (MW)		90.00

Message: Path 30 is is experiencing 95% loading and the qualified path operator is requesting the RC to approve the use of Step 4, Schedule curtailments to reduce USF across the constrained path.
Comment :- N/A
RC Comment :- N/A
Termination Comment :- test JRW 10/12/16

Issuance Time	PO Confirm Time	RC Confirm Time	Effective Time	Terminate Time
10/12/2016 10:37 PST	10/12/2016 10:42 PST	10/12/2016 10:42 PST	10/12/2016 12:00 PST	10/12/2016 10:43 PST

ALL BAs

Relief Required	Relief Provided (Expected)	=	Post-USF Relief	+	Tag Curtailments (Expected)
100.0	0.0 (0.0)	=	0.0	+	0.0 (0.0)

BA	Tags Total	Tags Contr	Relief Req	Relief Prov
ALL				
CA.NWMT	1	5.5	5.5	0.0
CA.PAC	40	185.8	57.3	0.0
CA.PNM	2	1.8	0.9	0.0
CA.PSCO	23	76.6	26.6	0.0
CA.WACM	26	38.8	9.7	0.0
Total	119	308.6	100.0	0.0

Tags sinking in CA.NWMT

BA	Priority Group	Tag Name	Restricted	TDF (%)	Issuance Time Schedule	Issuance Time Contribution	Effective Time Schedule	Effective Time Contribution	Relief Required	Tag Curtailment Curtail	Tag Curtailment MW Cap	Tag Curtailment Status	Relief Provided (Expected)
CA.NWMT	6 OFF Path			23.8	23	5.5	23	5.5	5.5	YES	0		0.0 (5.5)
		CA.NWMT [1 Tags]							5.5				0.0 (5.5)

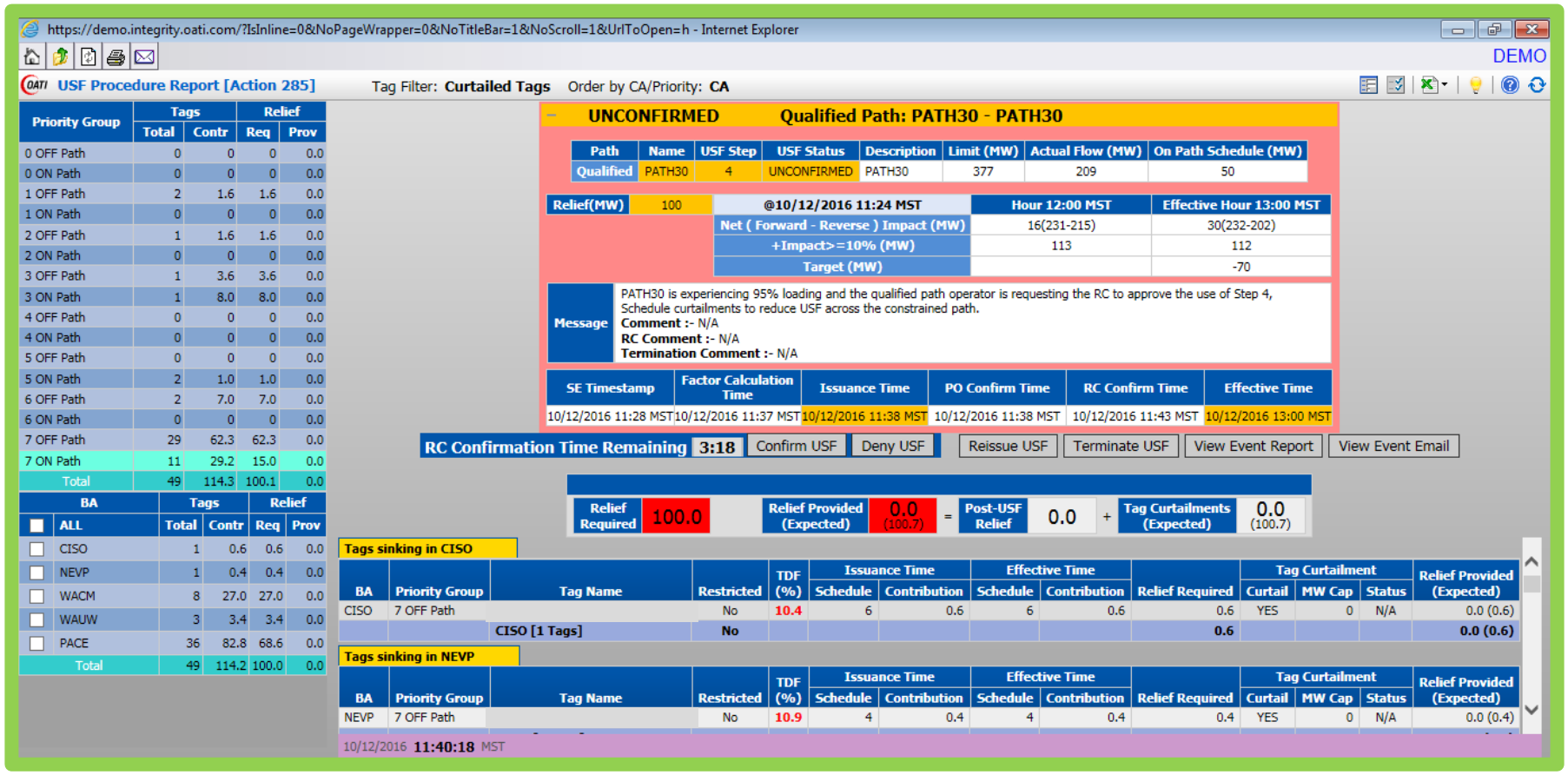
Tags sinking in CA.PAC

BA	Priority Group	Tag Name	Restricted	TDF (%)	Issuance Time Schedule	Issuance Time Contribution	Effective Time Schedule	Effective Time Contribution	Relief Required	Tag Curtailment Curtail	Tag Curtailment MW Cap	Tag Curtailment Status	Relief Provided (Expected)
CA.PAC	3 ON Path			31.8	65	20.7	65	20.7	20.7	YES	0		0.0 (20.7)
CA.PAC	6 OFF Path			13.6	1	0.1	1	0.1	0.1	YES	0		0.0 (0.1)

©1999 - 2016 OATI webSAS™/SM (2.0) - Open Access Technology International, Inc. All Rights Reserved.

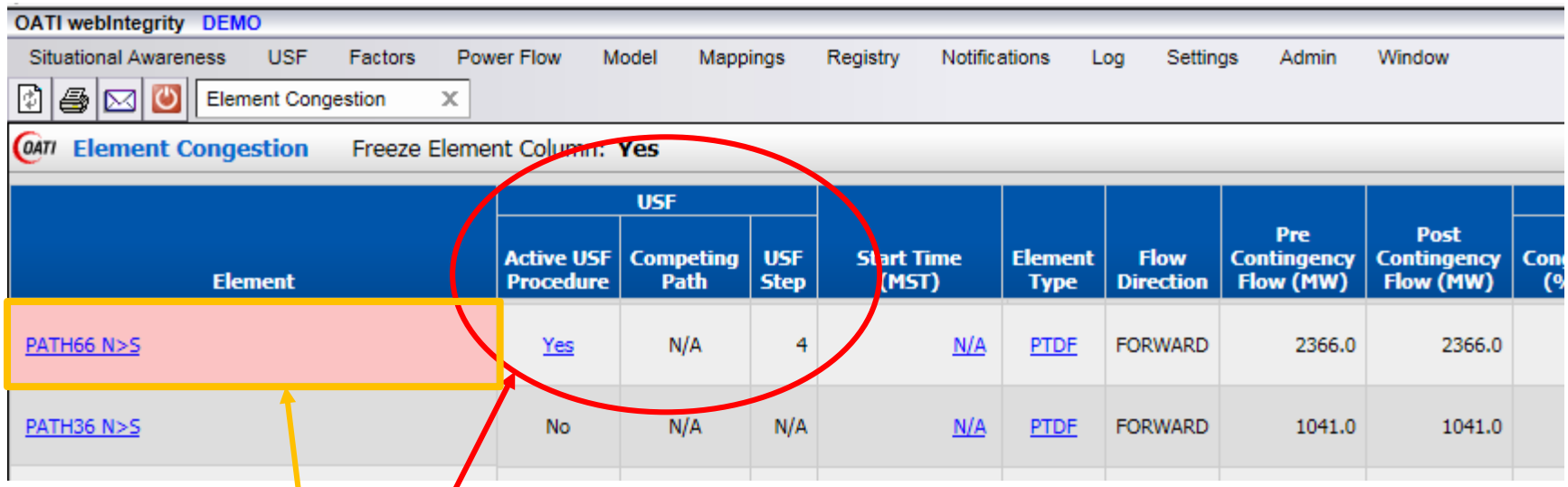
PEAKRELIABILITY

webSAS vs ECC USF – USF Procedure Report



PEAKRELIABILITY

ECC USF Dashboard with USF



New USF section showing details of Qualified Paths in an Event

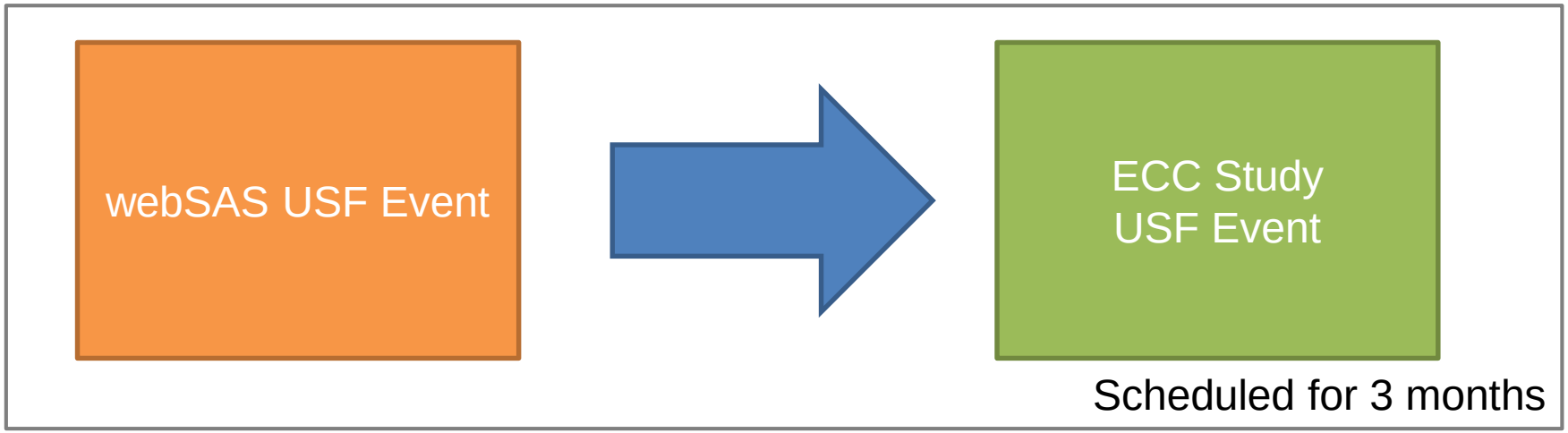
Element name shaded to show active USF event

PEAKRELIABILITY

Upcoming Efforts with Stakeholders for Successful USF Migration

- Registration – need all BAs, TOPs, and PSEs with access to ECC
- Training – will hold webinars for industry to educate and prepare
- Mappings – work to have proper source / sink definitions to use ECC design
- Parallel operations – next slide

ECC / webSAS Parallel Operations



Benefits:

- Allows validation of actual USF events
- Stakeholders gain familiarity with ECC prior to being active system

PEAKRELIABILITY

Future Congestion Management

- Today's SOLs in the future will be TTCs – and trigger detailed Real-time Assessments
- Understand key contributing factors
  - ACE, unscheduled flow, market or BA load serving, tagged transactions
- Clear knowledge of actual constraints
- Consistent seams coordination across interconnection
- Data available and actionable by operators

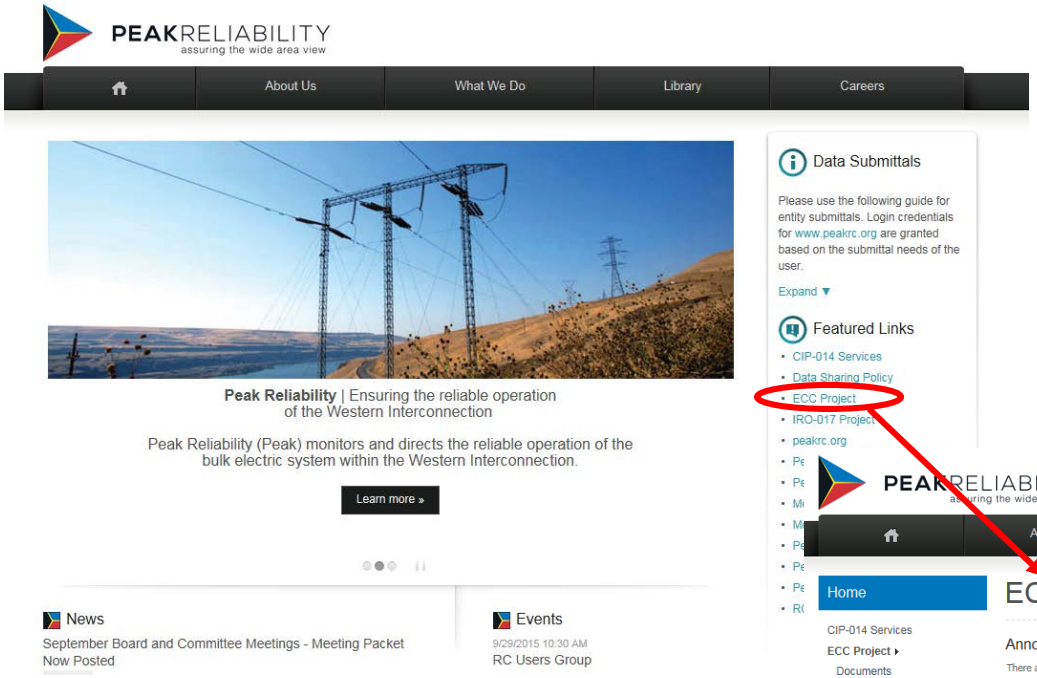
ECC Timeline – Key Milestones

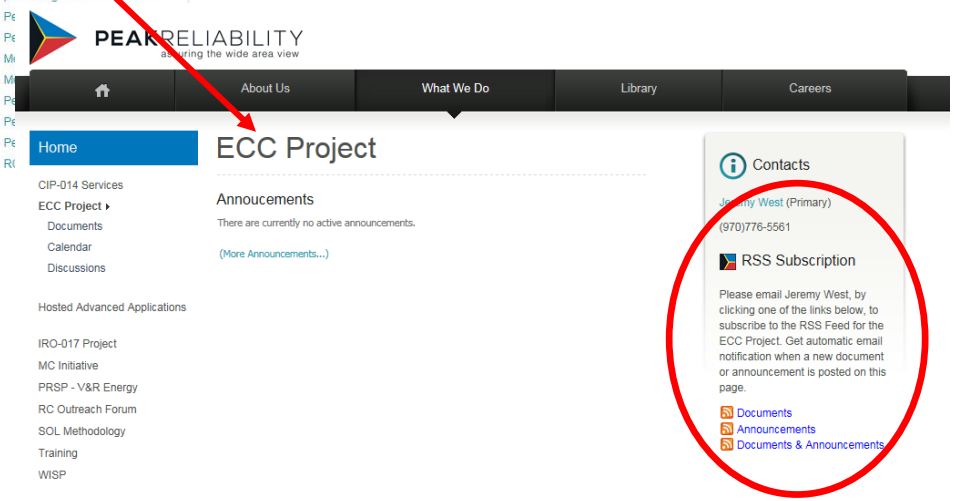
- June 2016 – ECC Real-time Situational Awareness released
- Q4 2016 – Q4 2017 – congestion management plan developed
- Q2 2017 – webSAS functionality migrated to ECC
- April 2017 – IRO/TOP standards in place
- Q4 2017 – Future hour situational awareness
- Q4 2018 – ECC upgraded to manage congestion on facilities & Paths beyond Qualified Paths

Key Impacts to Schedulers

- Current ECC = Greater Situational Awareness of e-Tag Impacts for Peak, TOPs, BAs
- webSAS Integration = ECC becomes “tool of record” for UFMP Events
- Future Hour / Expanded ECC Mitigation = TBD

ECC Project Page





https://www.peakrc.com/whatwedo/ECC/Pages/default.aspx

PEAKRELIABILITY

Thank you!

Jeremy West
jwest@peakrc.com

PEAKRELIABILITY

Next Meeting…

October 24-25, 2017 – location to be determined Portland / Las Vegas?

If you are interested in participating on the Agenda Committee please contact:

charee@nwpp.org

NORTHWEST PowerPool

I strive to make this meeting beneficial to all meeting attendees so please feel free to provide any constructive feedback you might have back to me.

Thank you kindly!

ChaRee DiFabio

charee@nwpp.org