

I-5 Corridor Reinforcement Project

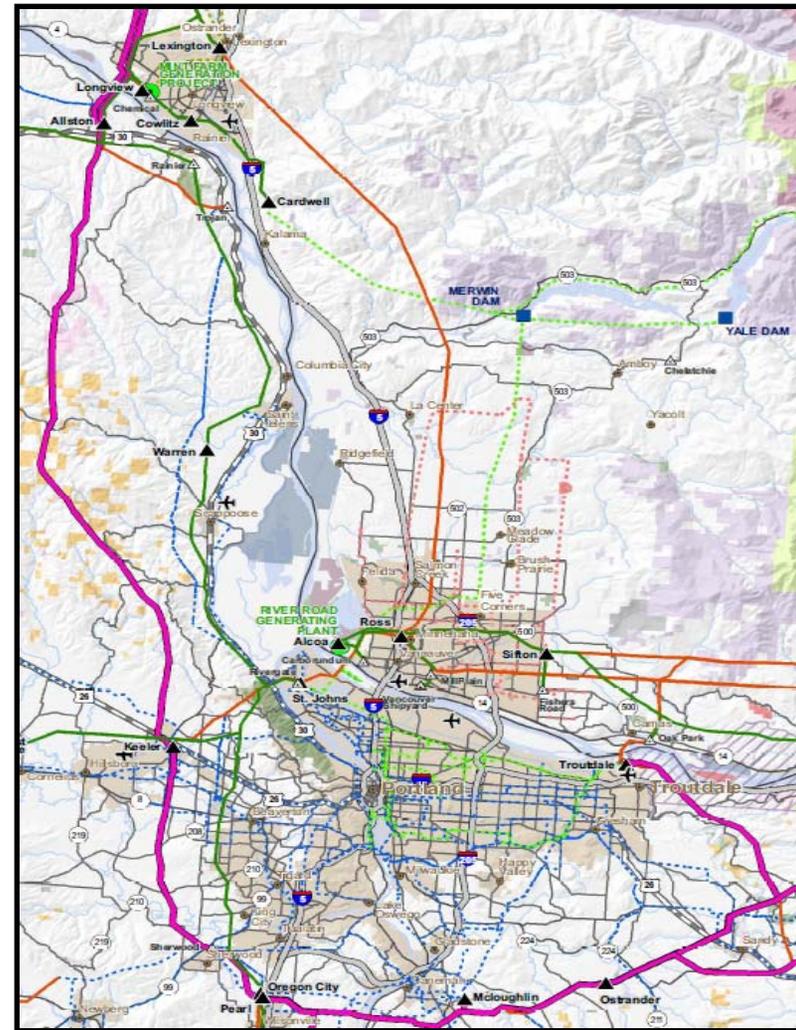
Project Update for the
Non-Wires Round Table

November 17, 2011

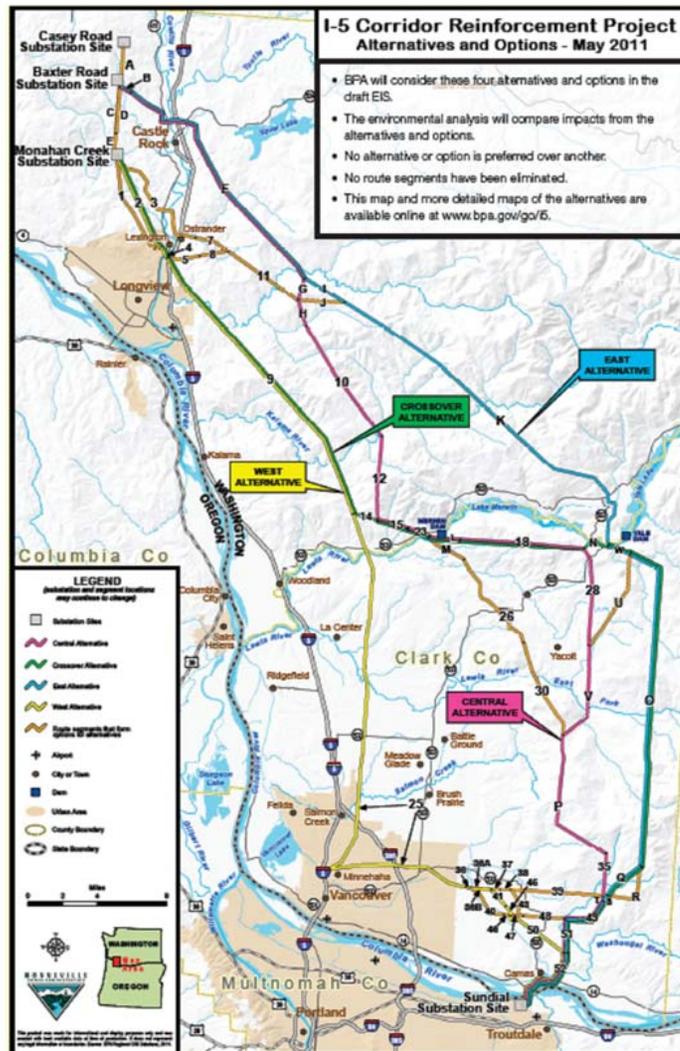


I-5 Corridor Reinforcement Project

- BPA launched the NEPA project in fall 2009
- We see increasing congestion on the 500-kilovolt system
- Increase capacity and strengthen the existing 500-kV system



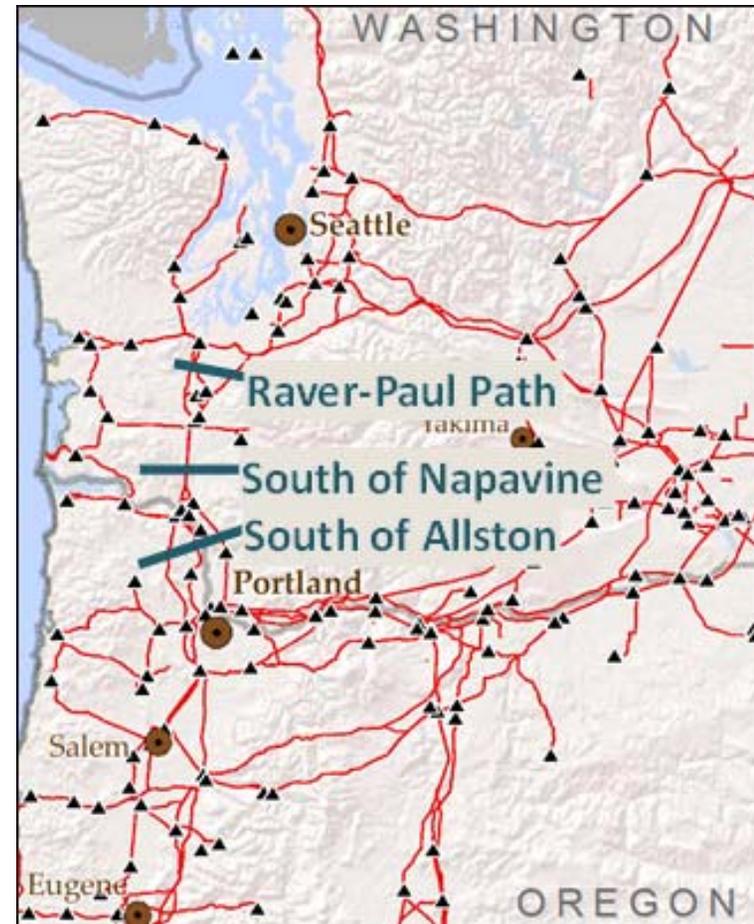
I-5 Project Status



- BPA will host a public meeting Dec. 8
- We now expect draft EIS in spring 2012
 - We're reviewing and responding to public comments and suggestions
 - And we're taking more time to complete our analysis of alternatives

Project Need: I-5 Problem Description

- **Risk of overloads on two critical paths along I-5 Corridor during summer peak with heavy North-South Flows**
- **South of Allston (SoA)**
 - **Limiting Outage:** Loss of Keeler-Pearl or Allston-Keeler 500 kV lines (N-1); could cause thermal overloads on parallel lower voltage facilities
 - Updated studies show criteria violation could occur by **summer 2016** (requiring project energization by spring 2016)
- **South of Napavine (SoN)**
 - **Limiting Outage:** Losses of Paul-Allston #1 and #2 500 kV lines; could cause thermal overloads on parallel lower voltage facilities or voltage instability in Portland area



I-5 Corridor Overview

Non-Wires Analysis

I-5 Non-Wires Analysis

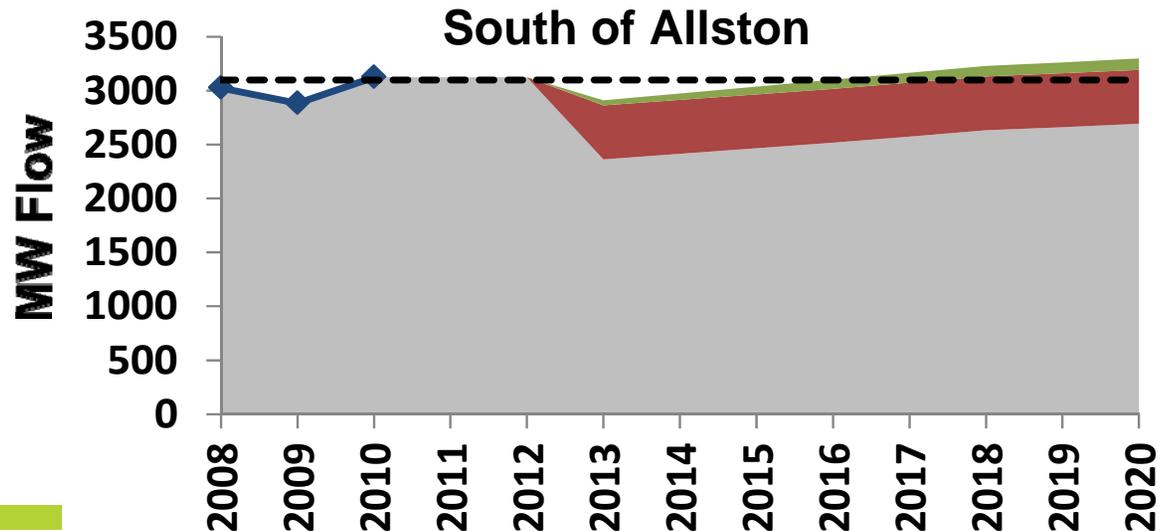
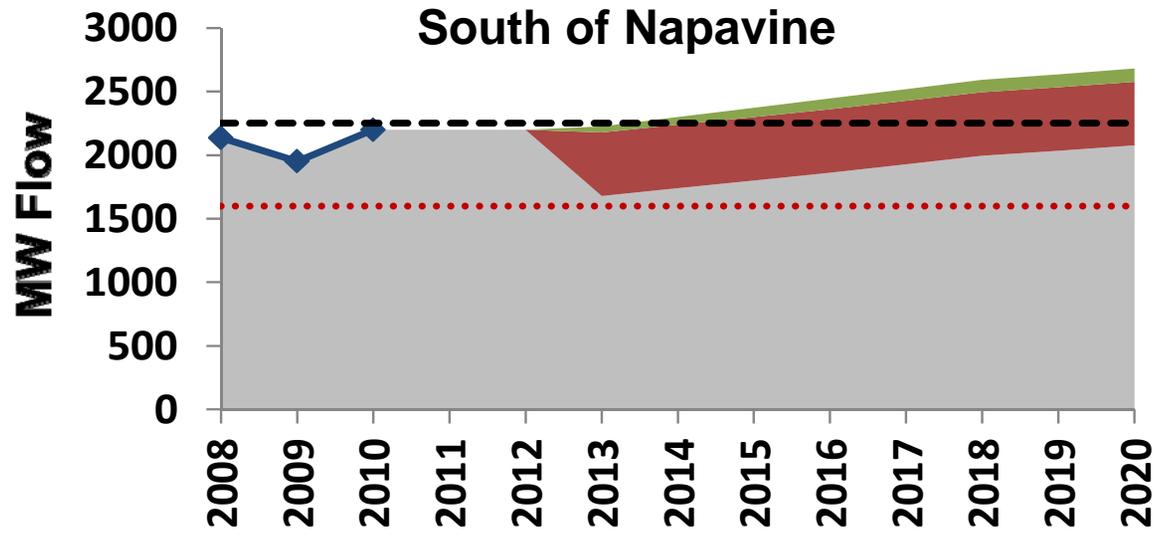
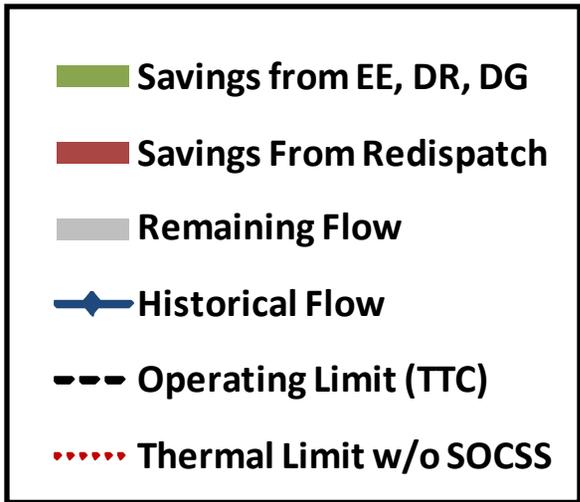
- Focus
 - Can non-wires measures enable BPA to defer I-5 Corridor Reinforcement project construction while maintaining adequate reliability (equivalent to current levels)
 - Non-wires not meant to replace transmission project
- Process
 - Phase 1 Analysis: Initial screen of potential
 - Phase 2 Analysis: Implementation feasibility

Phase 1 Non-Wires Analysis

- Preliminary screen of non-wires measure potential for deferring I-5 project
 - Based on load-flow distribution factors & regional cost test economic screen for local non-wires measures
- Results
 - EE/DR/DG alone insufficient for deferral, but deferral through 2021 possible if combined with contracts for generator redispatch
- Recommendations
 - Continue on current I-5 project schedule
 - Investigate feasibility of identified non-wires measures for deferral, especially generator redispatch

Phase 1 Load Forecast

- **2020 Flows remain below operating limits after NWA measure of:**
 - Flow reduction effect of Efficiency, DG, DR, & DSE
 - 1450 MW Generator Redispatch (inc. CA, dec. I-5 & BC gen)



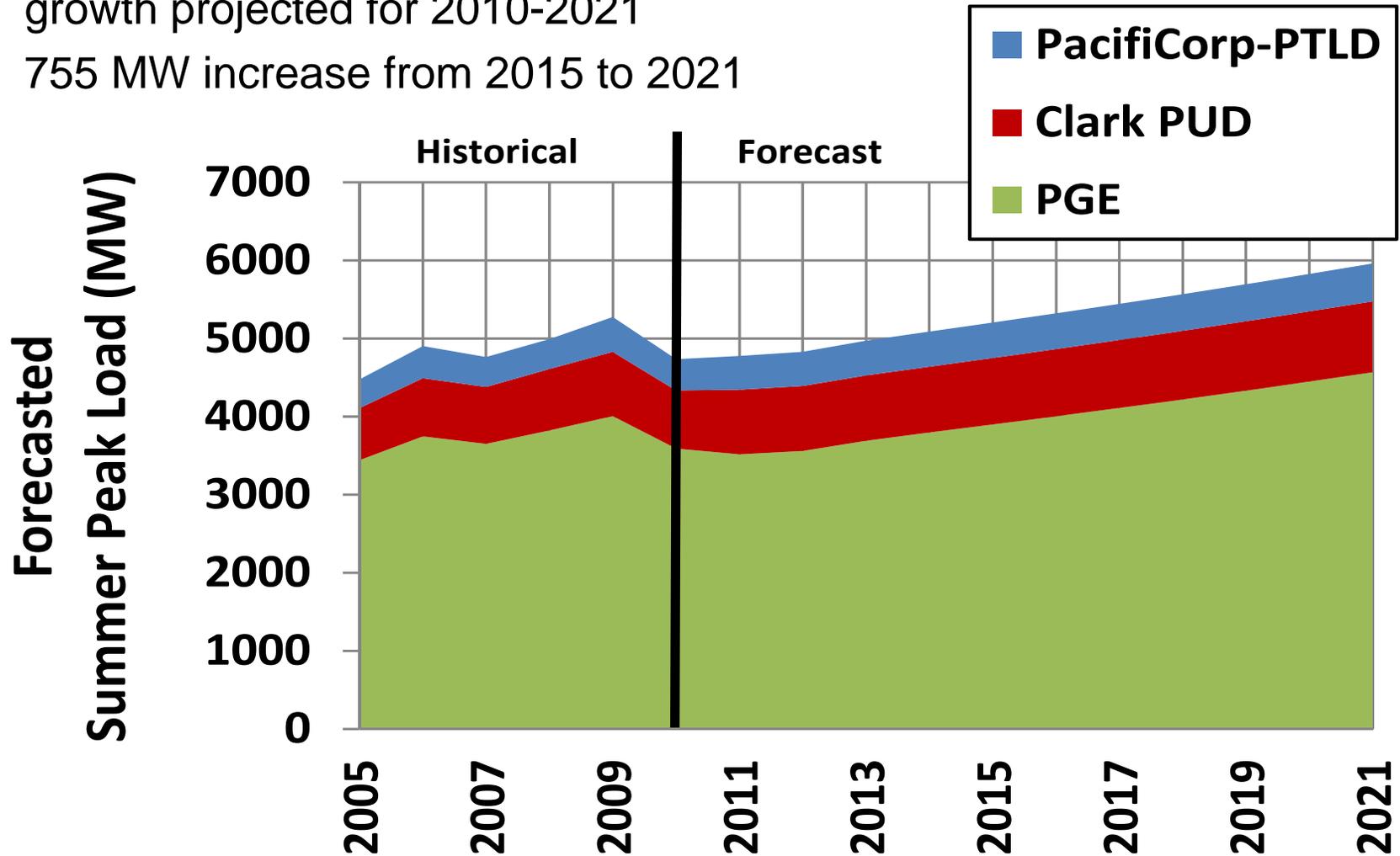
DSM and Redispatch keeps Raver-Paul flows under 1450 MW

Phase 2 Methodology

- Update local area load forecast
- Update power flow base case analysis
- Develop redispatch assessment
 - Screen & select potential redispatch cases (eliminate obviously infeasible options)
 - Rerun power flow cases with redispatch
 - Identify new project need date based on criteria for NERC and WECC planning standards
- Develop demand side measure assessment
 - Analyze demand side measure (EE/DR/DG) cost & potential
 - Analyze flow impact of demand side measures

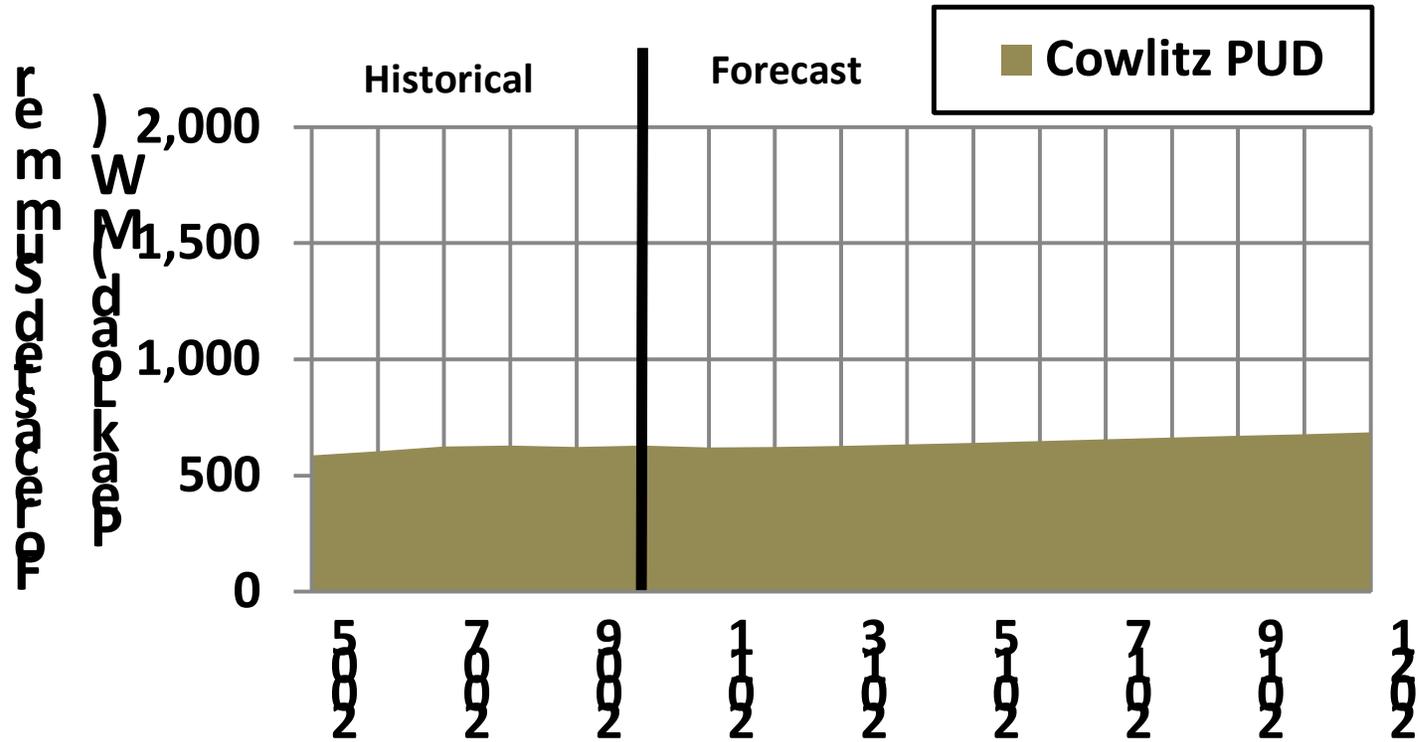
Phase 2 Updated Load Forecast

- **Greater Portland Area:** 2.1% in-area load growth projected for 2010-2021
- 755 MW increase from 2015 to 2021



Phase 2 Updated Load Forecast

- **Cowlitz PUD:** 1.0% load growth projected for 2010-2021
- Cowlitz load growth reduces South of Allston Transmission flow, increases South of Napavine Flow



Updated Powerflow Base Case

- BPA Transmission Planning 2016 and 2021 cases
 - WECC Heavy summer cases
 - Updated local load forecast
 - Stress case with maximum transfers on southern interties to reflect contractual obligations and California-Oregon Intertie (COI) upgrades
- Indicates I-5 project energization needed by spring 2016
- Sensitivity Cases:
 - **Pearl Substation Breaker Upgrades**: Can defer project need 2 years or extend effectiveness of redispatch options
 - **Centralia Unit Retirement for 2021**: To reflect Washington state legislation approved in April 2011.

Phase 2 Results: Redispatch

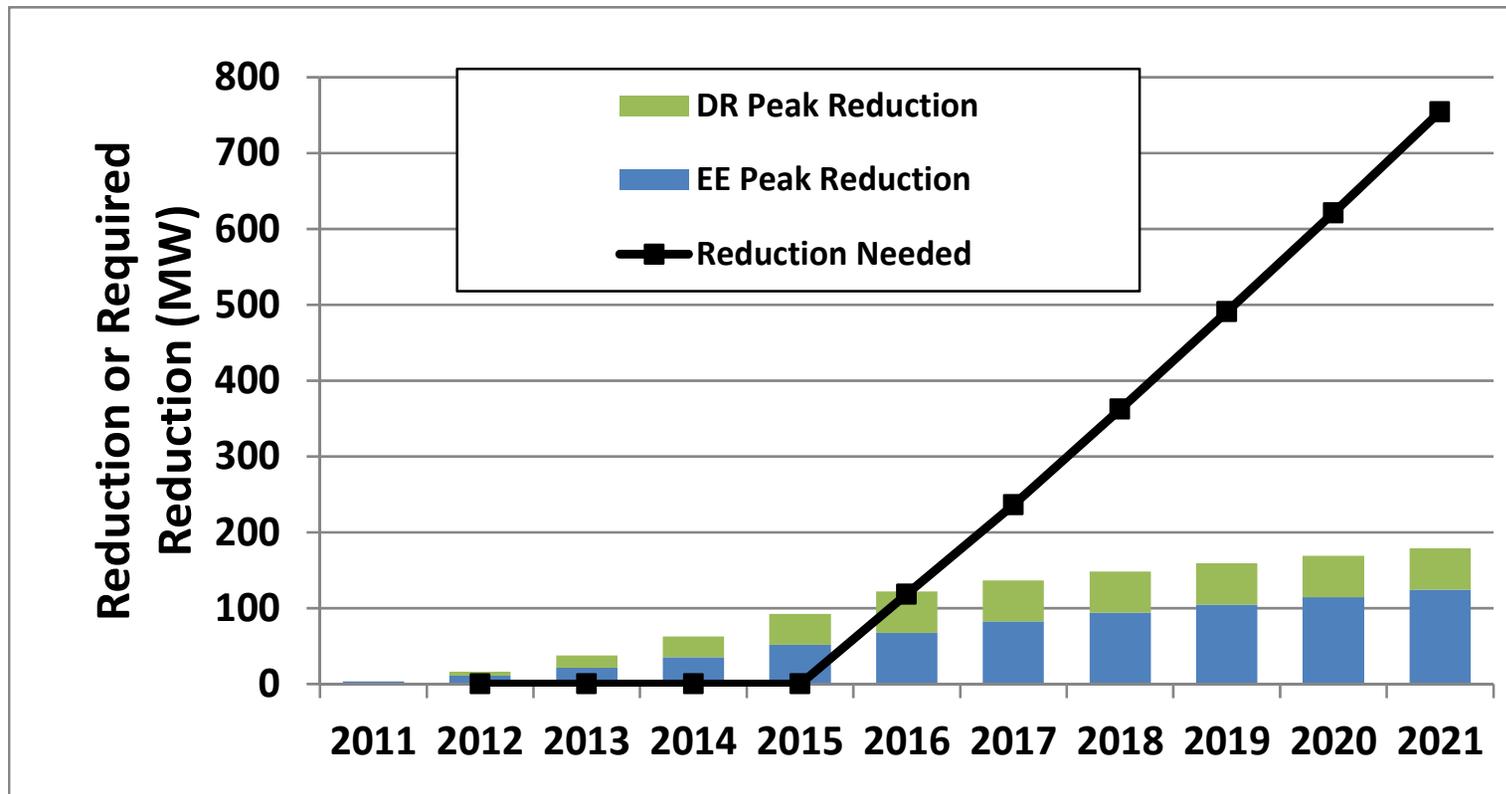
- 17 redispatch cases analyzed with multiple combinations of generators and intertie transfer changes
- Range of capacity analyzed
 - **300 to 1400 MW**
- Longest possible deferral
 - **Up to spring 2022** (with Pearl upgrades & both Centralia units online)
 - **Up to spring 2024** (with one Centralia unit retired)
- Cost-effectiveness:
 - High-level analysis of existing market prices (generator opportunity cost) indicates redispatch cost is likely less than the savings from deferral of the I-5 project

Phase 2: Redispatch Cautions

- Could maintain minimum planning criteria with deferral to 2021-23, but I-5 transmission project would provide greater operational flexibility & reliability
- Redispatch studied at planning level. Did **not** evaluate how to incorporate into operational protocol
- Requires willing participation from certain regional generators at cost-effective contract price; counterparty interest not yet assessed
- May limit level of exports to California over COI at times

Phase 2 Results: Demand Side

- Screen cost-effective potential for summer peak reduction by 2021 below deferral requirement
 - 124 MW from conservation; 55 MW from demand response



Phase 2: Implications & Recommendations

- Evaluate cost and feasibility of Pearl substation upgrades
- Redispatch - Internal BPA Assessment
 - How to incorporate into operational protocols?
 - Are generator counterparties willing to participate?
- Demand side – Long-term improvements
 - Explore program mix focus on summer peak reduction in long-term
 - Explore greater information coordination for DR use by regional utilities

Redispatch: Commercial Feasibility

Keys Features of Redispatch

- All firm transmission schedules are accepted on preschedule
- If congestion is anticipated based on projected loads and actual generator schedules, BPA implements bi-lateral agreements to redispatch individual generators to mitigate any anticipated congestion
- If BPA implements a redispatch, all schedules remain intact and no schedules are curtailed (BPA actions remain behind the scenes)
- No firm transmission customers are adversely affected by BPA redispatch actions, and redispatched generators benefit from their participation in the redispatch

Scenario 1: Within-Hour

- System Operating Limit (SOL) Violation: 30 minutes to get flow below limit
- 30-minute Re-dispatch: *Only modest changes feasible*
 - Centralia ramps down at 10 MW/minute, so best 30 minute downward dispatch is 300 MW
 - Reducing BC imports significantly can increase Puget Sound and Northern Intertie (PSANI) problems
 - BPA / Schedule holder can't cut specific CA exports for in-hour economic re-dispatch

Assumes All Lines in Service. If not, could need much more re-dispatch energy.

Scenario 2: 2+ hours ahead (pre-emptive)

- Forecast likely SOL exceedances, and act early to prevent them:
 - Expected costs of redispatch appear reasonable near term, but significant upside risk over time
 - More often: ~ 15 days pre-emptive vs. ~ 5 days actual until we're experienced in believing a forecast
 - Hard to justify: When congestion event doesn't happen, can't prove it would have happened if no payments.

Commercial Issues

- Need cooperation from other northwest BA's to get:
 - the right generation resources into this arrangement,
 - additional information for forecasting flows

- California BA's (CAISO and BANC) can be important to the "inc" side and have additional requirements to work with.

- CAISO Hour-ahead (HASP) prices at Malin will be our likely settlement price for bilateral arrangements at COI. These can get HIGH.

Commercial Issues: Next Steps

- Negotiate pro-forma term sheets with most viable redispach participants via bilateral discussions
- Develop supportable estimates of implementation costs based on commercial provisions detailed in pro-forma term sheets

Redispatch: Operational Feasibility

Operational Issues

- Redispatch can be theoretically implemented in two different time frames:
 - In real-time in response to actual violations of operating limits.
 - Several hours to several days ahead of time in order to pre-empt loading problems before they occur.

- In either case, redispatch requires resources that can be lowered on one side of the constraint (dec) and a like amount raised on the other side (inc).

Operational Issues (Cont.)

- The specific locations of the resources is critical. Resource location determines how powerflows distribute over a transmission grid.
- Actual operating experience has shown that about 100MW of generation has to be moved in order to obtain about 15MW of relief on the I-5 corridor.
 - The location of the generation that can be ramped down quickly (i.e., dec resources) is generally remote from the I-5 paths.
 - There is a lack of resources near the south end of the I-5 corridor paths that can be readily brought on-line to provide the inc portion of the redispatch.

Requirements for Real-Time

- Inc and dec resources that are available to start moving on 5 minutes notice
- Resources used for incs and decs have to be able to fully provide their commitment within 20 minutes. This is so NERC standards concerning violation of operating limits can be met.

Requirements for Hour/Day Ahead Redispatch

- A means for forecasting powerflows over the constrained path for the desired time horizon is required. This will require the following data:
 - Load and generation forecasts for both BPA's system and neighboring systems. BPA does not have access to other utilities' load and generation forecasts.
 - Planned outages of transmission facilities (both BPA and non-BPA) down to at least the 230kV level and possibly down to the 115kV level.
 - Scheduled transactions (both BPA and non-BPA). It should be noted that these transactions can change up to 20 minutes before the start of the delivery hour. BPA does not have access to schedules that do not use BPA's facilities.
 - Hourly temperature forecasts for the areas the lines pass through.

Requirements for Hour/Day Ahead Redispatch (Cont.)

- The model would probably need to be run at the completion of preschedule and then rerun on an hourly basis during the actual operating day in order to account for updates to the various inputs.
- Inc and dec resources would have to be prepared to be in a redispatched state for hours or possibly even days on a continuous basis.

Operational Issues: Next Steps

- Assess and document system development requirements required to effectively implement redispatch protocols
- Assess willingness of other Balancing Authorities to cooperate with BPA and the logistics of implementing the required coordination