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RETI 2.0 TTIG Workshop - CAISO Update
January 22, 2016

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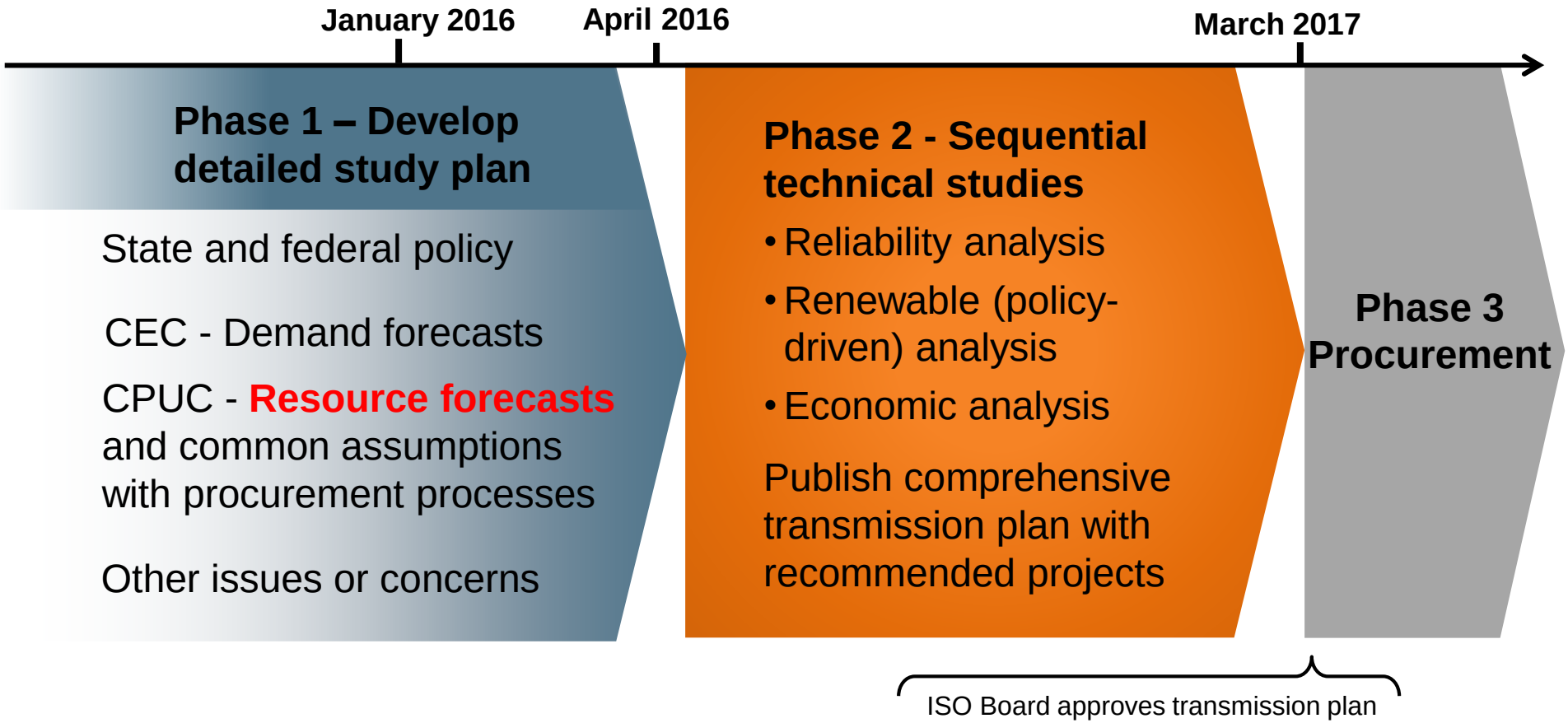
January 22, 2016

CAISO Transmission Planning Process

The CAISO's annual transmission planning process relies on state policy and state agency input and aligns assumptions



CAISO regional planning process aligns with new FERC Order 1000 Interregional Coordination Process that commences in Q1, 2016

The trajectory towards 2020 goals is well established with few changes between recent years

CREZ	Base Portfolio	
	2015-2016	2014-2015
Riverside East	3017	3800
Imperial	1750	1000
Tehachapi	1653	1653
Distributed Solar - PG&E	984	984
Carrizo South	900	900
Nevada C	516	516
Mountain Pass	658	658
Distributed Solar - SCE	565	565
NonCREZ	185	185
Westlands	475	484
Arizona	400	400
Alberta	300	300
Kramer	250	642
Distributed Solar - SDGE	143	143
Baja	100	100
San Bernardino - Lucerne	87	87
Merced	5	5

Transmission is well underway to meet 33% RPS in 2020

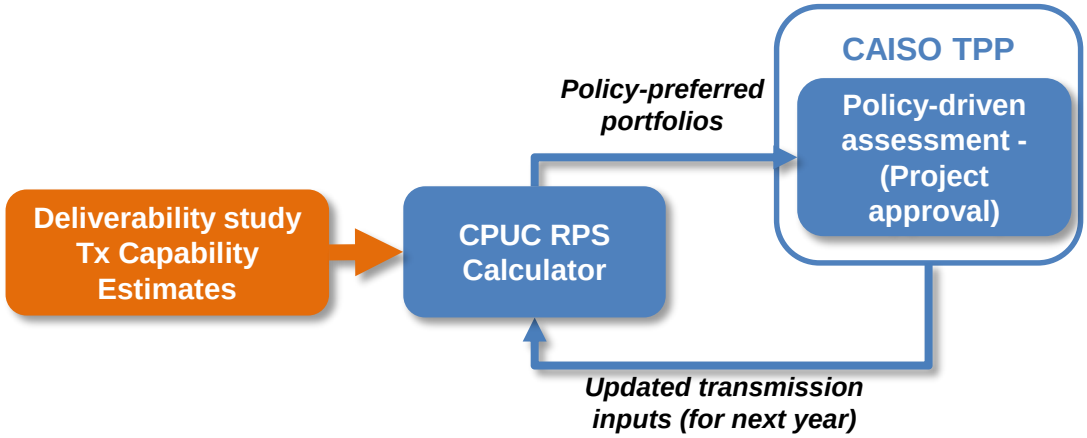
$6.5 B

	Transmission upgrade	Approval status		Online
		ISO	CPUC	
1	Carrizo-Midway	LGIA	NOC effective	energized
2	Sunrise Powerlink	Approved	Approved	energized
	Suncrest dynamic reactive	Approved	Not needed	2017
3	Eldorado-Ivanpah	LGIA	Approved	energized
4	Valley-Colorado River	Approved	Approved	energized
5	West of Devers	LGIA	Pending	2021
6	Tehachapi (segments 1, 2 & 3a of 11 completed)	Approved	Approved	2016
7	Cancelled			
8	South Contra Costa	LGIA	In process	2016
9	Borden-Gregg	LGIA	Not yet filed	2018
10	Path 42 reconductoring	Approved	Not needed	2016
11	Sycamore-Penasquitos	Approved	Not yet filed	2017
12	Lugo-Eldorado line reroute	Approved	Not yet filed	2017
13	Lugo-Eldorado and Lugo-Mohave series caps	Approved	Not needed	2019
14	Warnerville-Bellota recond.	Approved	Not yet filed	2017
15	Wilson-Le Grand recond	Approved	Not yet filed	2020

CAISO 50% Renewable “Energy Only” Special Study

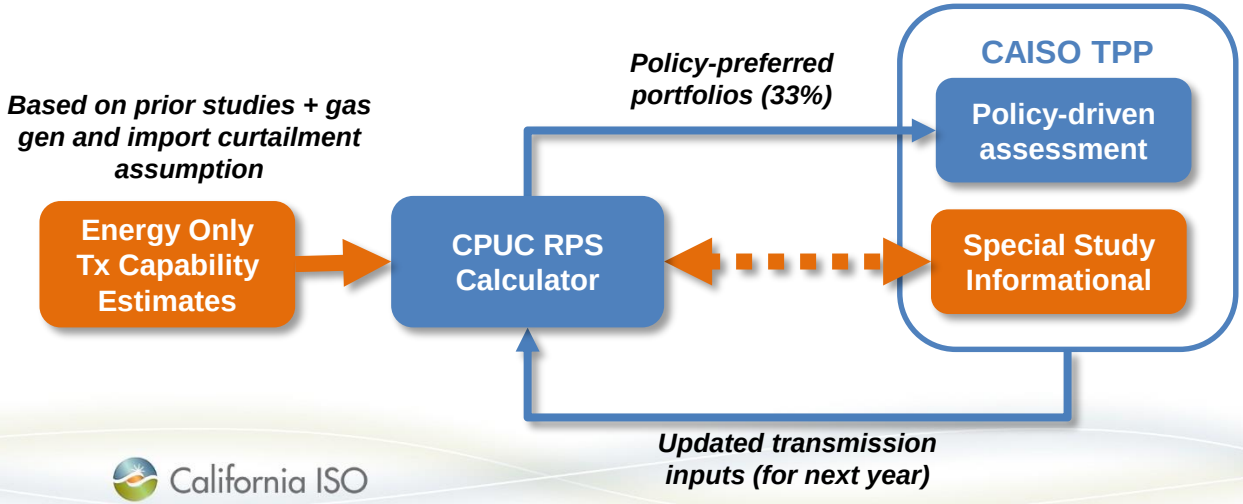
Study tested CAISO estimates of generation that could be delivered on an "energy only" basis – moving to 50%

Existing policy-driven planning process



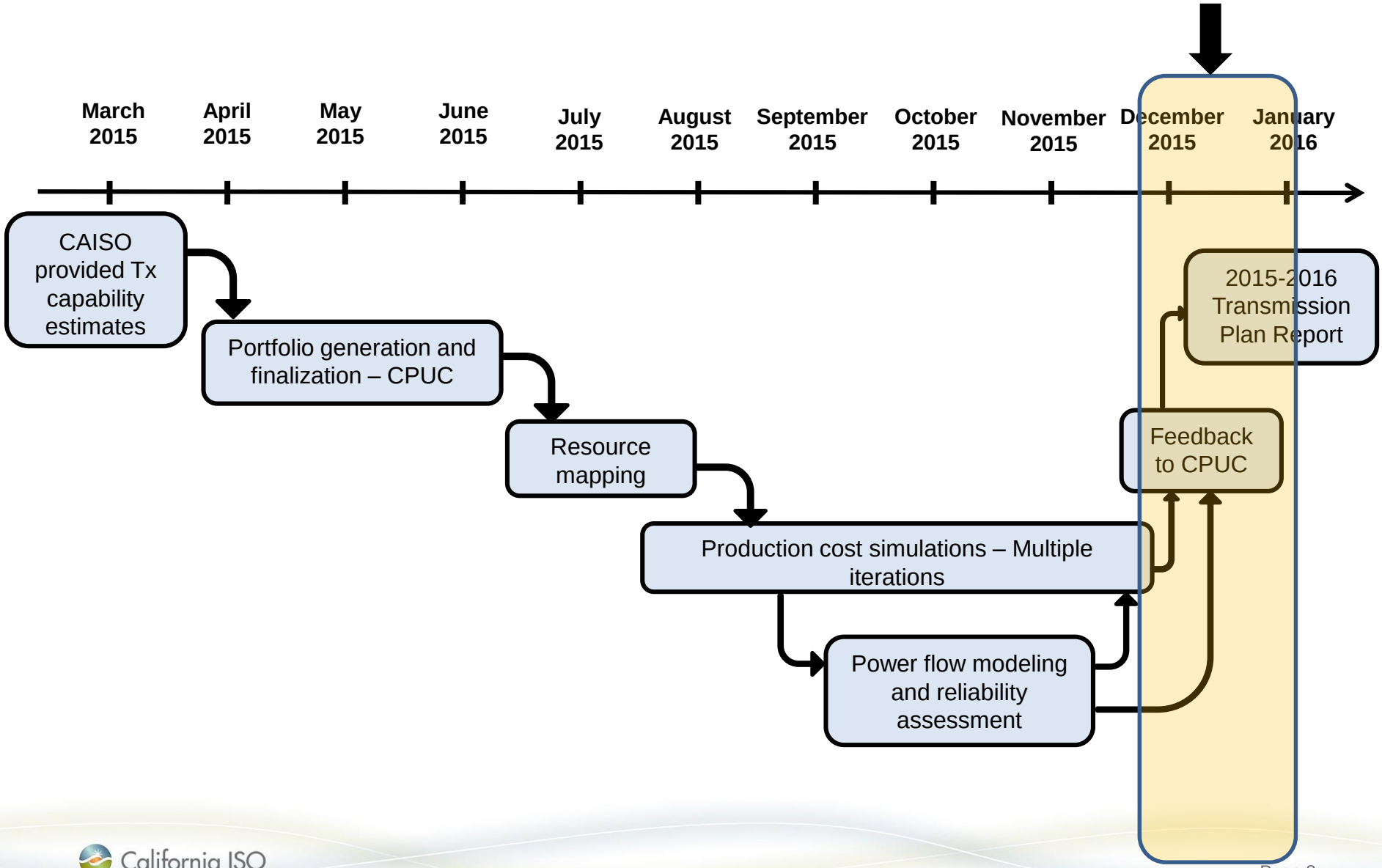
- Iterative process used to achieve 33% RPS goals
- This process results in policy-driven transmission upgrade approval
- Most procured generation assumed to have FCDS

Iterative process used to test preliminary 50% RPS portfolios

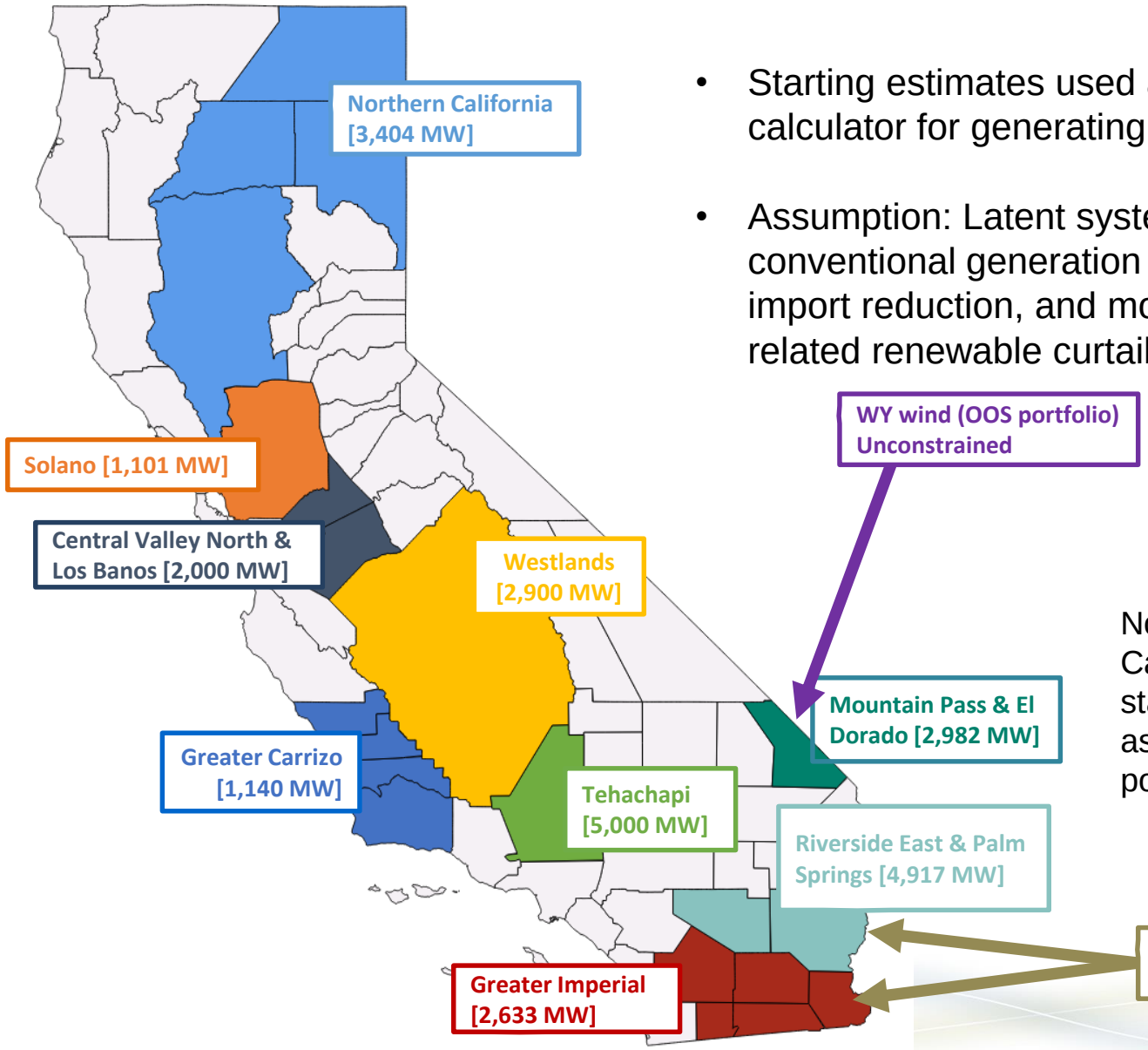


- Strictly an informational effort
- Procured gen assumed to be EO
- ***Objective***
  - To test and revise the transmission (Tx) capability numbers provided by CAISO
  - Preliminary transmission stress-test

50% Special study timeline (in 2015-2016 planning cycle)



Initial transmission capability estimates for “energy only” resources

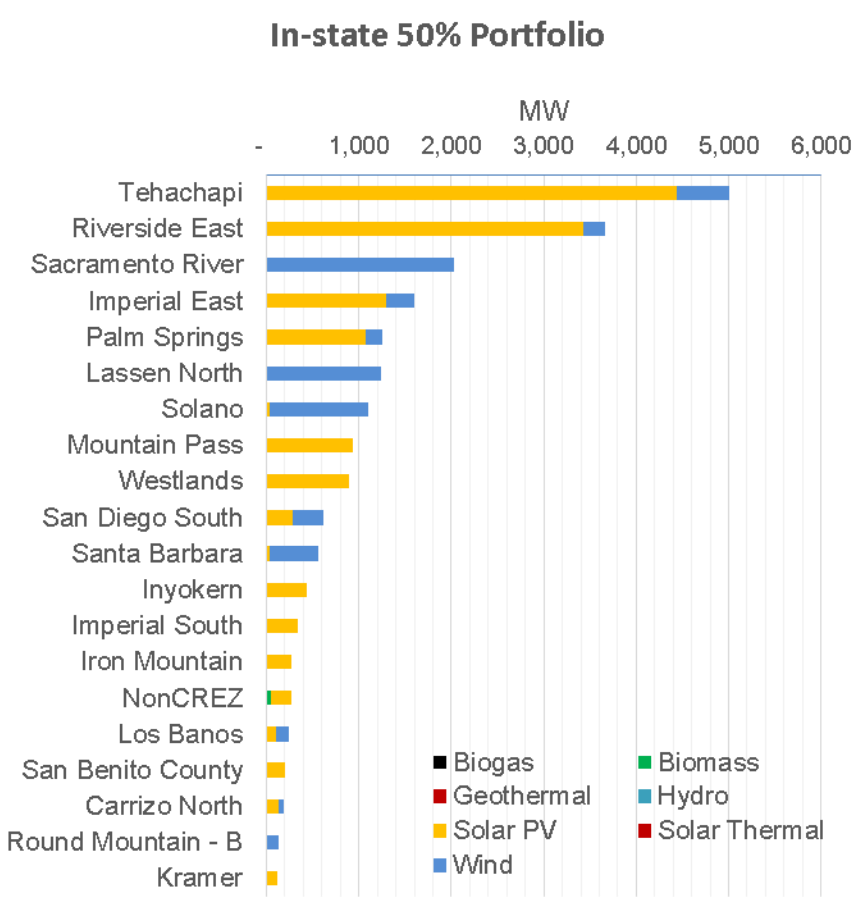


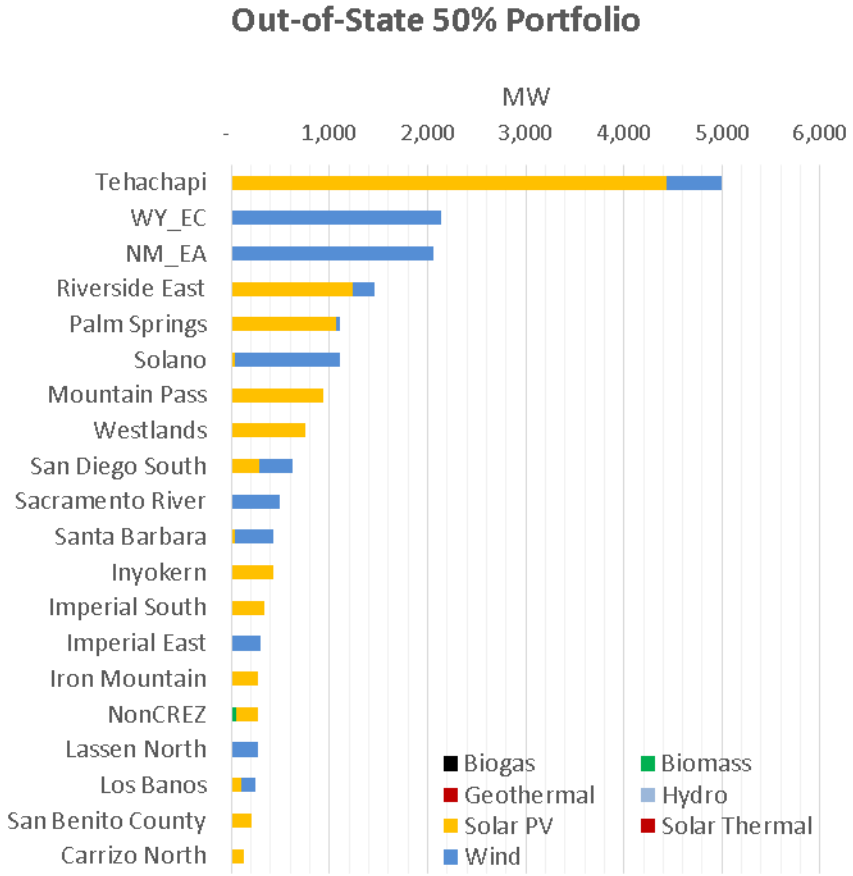
- Starting estimates used as an input to RPS calculator for generating the 50% portfolios
- Assumption: Latent system capacity, conventional generation curtailment, some import reduction, and modest transmission-related renewable curtailment

Note – impacts on the California system of out of state imports were tested by assuming specific injection points into California

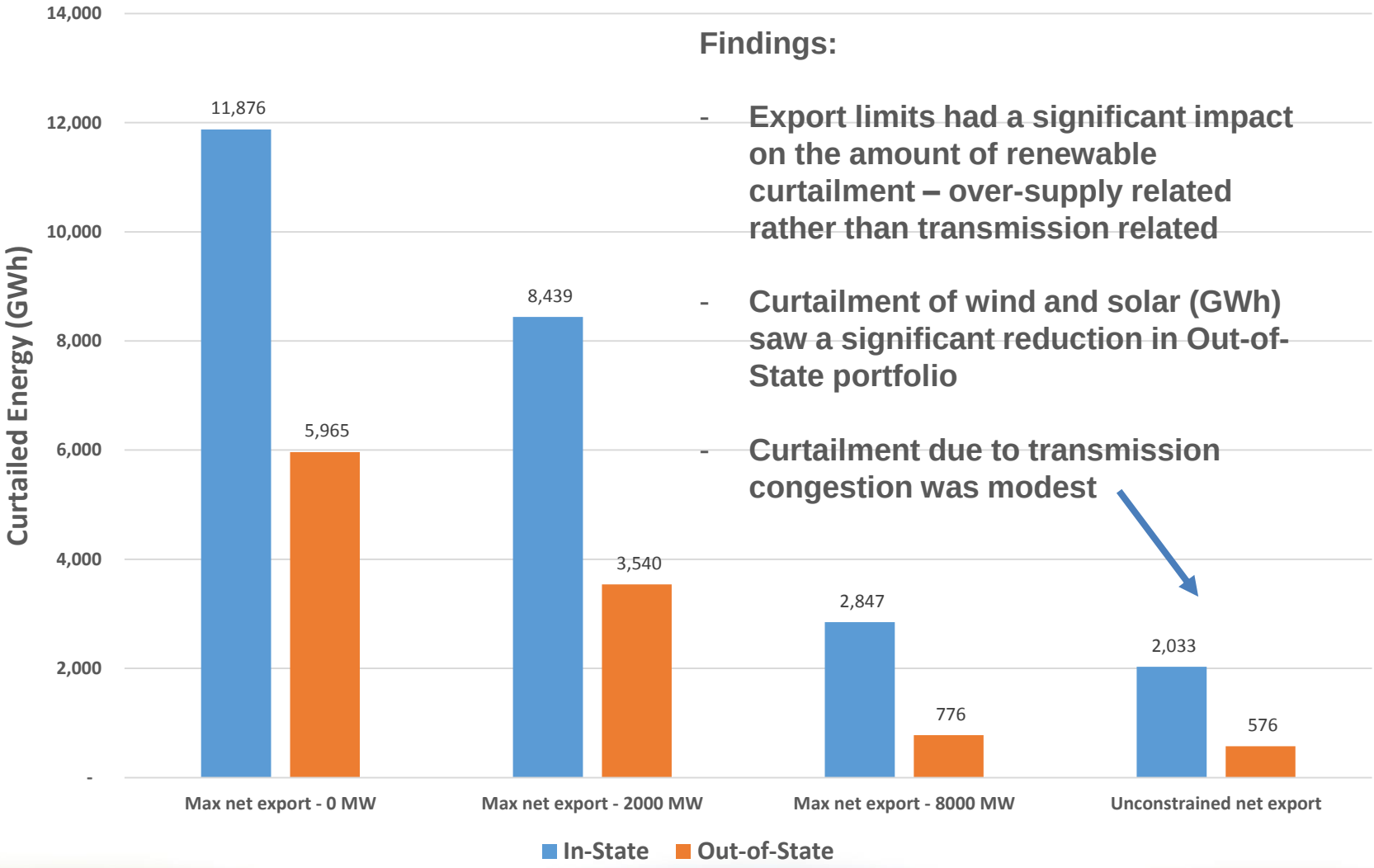
Portfolios selected for the special study

- RPS calculator v6 was used to generate the portfolios





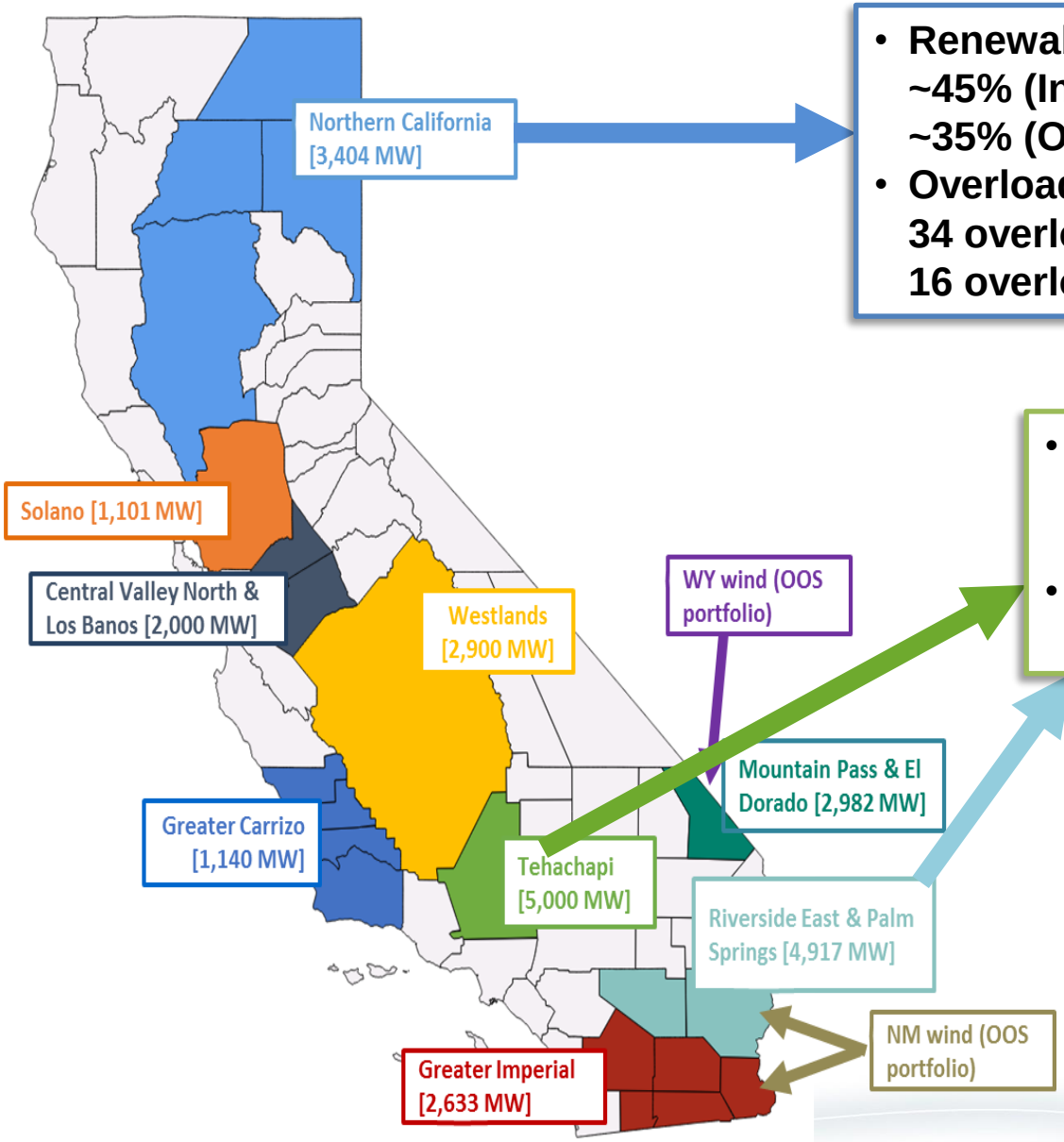
Curtailment was tested for a range of export assumptions



Findings:

- **Export limits had a significant impact on the amount of renewable curtailment – over-supply related rather than transmission related**
- **Curtailment of wind and solar (GWh) saw a significant reduction in Out-of-State portfolio**
- **Curtailment due to transmission congestion was modest**

Salient observations



- **Renewable Energy curtailed:**
  ~45% (In-state)
  ~35% (OOS)
- **Overloads:**
  34 overloads (In-state)
  16 overloads (OOS)

- **Several N-1-1 and a few N-2 issues require pre-contingency renewable curtailment (>1,000 MW)**
- **Maintenance conditions could pose challenges**

Solano, Santa Barbara, Westlands, Northern CA

- Wide-spread overloads on sub-transmission
- Curtailment due to this congestion – not captured

Conclusion

- Transmission capability estimates for the all the zones appear to be reasonable for developing future portfolios for additional transmission studies, with the following refinements –

  - **Northern California zone:**
    - We recommend splitting this zone into smaller zones and updating the transmission capability numbers

  - **Tehachapi and Riverside zones:**
    - At risk of substantial renewable curtailment (>1000 MW) under maintenance scenarios
    - But RPS calculator seems to treat these as high value resources, so we do not want to reduce the transmission capability estimate at this point.

  - **Solano, Westlands, Santa Barbara zones:**
    - Obvious issues on <230 kV system
    - As long as local upgrades or collector stations deliver these resources to 230 kV system in these zones, the transmission capability numbers are good.
    - Incorporate specific delivery points in RPS calculator

Next steps

- CAISO will provide desirable delivery points for resources in zones which resulted in widespread local reliability issues

- The results will be published in the draft 2015-2016 Transmission Plan (January 2016)

- 2016-2017 Special Study:
  - We do anticipate further special studies
  - Detailed scope will consider the CPUC's decisions regarding the next steps for the RPS calculator, study objectives, and consideration of the final results of 2015-2016 special study
  - We will need to consider the potential impact of transmission related curtailment on conventional generation

Thank you!