Proposed IRP Portfolios for the 2019-20 CAISO Transmission Planning Process

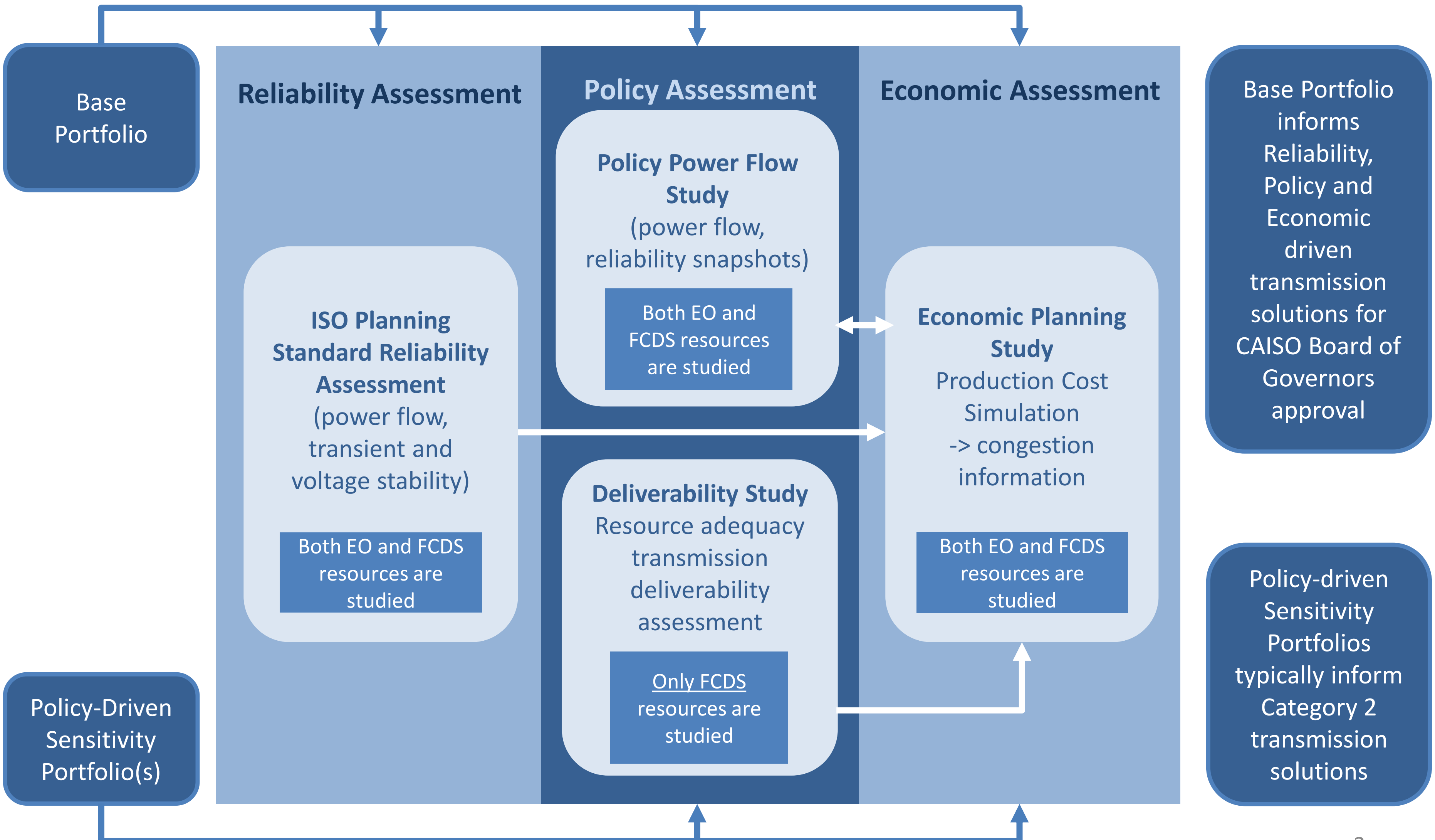
January 7, 2019

California Public Utilities Commission

CPUC IRP Coordination with CAISO TPP

- In accordance with a May 2010 MOU between CAISO and the CPUC, and in coordination with the CEC, the CPUC develops the renewable resource portfolios used by CAISO in its annual Transmission Planning Process (TPP)
- The CPUC typically transmits to CAISO multiple distinct portfolios developed in its IRP process:
  - "Reliability Base Case" portfolio
  - "Policy-Driven Base Case" portfolio (identified transmission solutions are considered Category 1 and go to the CAISO Board of Governors for approval)
  - and/or "Policy-Driven Sensitivity Case" portfolio(s) (identified transmission solutions are considered Category 2 and generally do not go to the CAISO Board of Governors for approval)

How CPUC Portfolios Will be Used in CAISO's 2019-2020 Transmission Planning Process



Reliability Base Case Assessment

- Background
  - The Reliability Base Case informs renewable generation inputs for CAISO's reliability assessments
  - CAISO uses reliability assessments to…
    - Identify facilities with thermal overloads, voltage concerns, and stability concerns
    - Ensure that system performance can be met according to the requirements of the NERC transmission planning standards, the WECC transmission planning system performance criteria, and the CAISO planning standards over a ten (10) year planning horizon.
- 2018-19 TPP
  - In Feb. 2018 the CPUC transmitted the IRP "Default Scenario" (50% RPS by 2030) to the CAISO for the 2018-19 TPP
- 2019-20 TPP
  - In early 2019 the CPUC is expected to transmit to CAISO a new portfolio to be used as the Reliability Base Case in the CAISO 2019-20 TPP.

Policy-Driven Assessments

- Background
  - The "policy-driven" category in TPP is used to plan for renewable grid integration issues and policy goals that may drive the need for new transmission
  - The purpose of policy-driven transmission solutions is to meet state, municipal, county and federal policy requirements and directives
  - Policy-driven portfolios are used to estimate deliverability (unlike the reliability base case)
  - The policy-driven portfolios can include a policy-driven base case (typically Category 1) or policy-driven sensitivities (typically Category 2)
- 2018-19 TPP
  - A <u>Policy-Driven Base Case</u> was not transmitted to CAISO.
  - The CPUC transmitted the IRP "42 MMT Case" (Reference System Portfolio) as a <u>Policy-Driven Sensitivity</u> in the 2018-19 TPP, and identified transmission solutions were considered Category 2.
- 2019-20 TPP
  - In early 2019 the CPUC is expected to transmit to CAISO new portfolio(s) to be used as the <u>Policy-Driven Base Case</u> and/or <u>Policy-Driven Sensitivities</u> in the CAISO 2019-20 TPP.
  - Identified transmission solutions in the Policy-Driven Base Case would be considered Category 1; identified solutions in the Policy-Driven Sensitivities would be considered Category 2 (CAISO conducts Policy-Driven Sensitivities for information-only purposes)

Policy-Driven Sensitivity Portfolio Development with the RESOLVE model

- During a public workshop on Oct. 31, 2018, CPUC staff described two potential options (“SB 100” and “SB 100 plus”) for the Policy-Driven Sensitivity Portfolio.
- CPUC staff used RESOLVE to develop several cases for comparison to more closely examine the “SB 100 plus” option.
- No SERVM production cost modeling will be conducted on these portfolios.
- The portfolios were designed to:
  - Satisfy the SB 100 goal of 60% RPS by 2030
  - Achieve a deeper GHG reduction target by 2030
  - Use inputs and assumptions consistent with the Reference System Plan with the 2017 IEPR
  - Incorporate the 40-year age-based retirement assumption used in the Hybrid Conforming Portfolio
  - Assume higher levels of EV load
  - Produce useful information on differences in cost and optimal resource buildout when focusing primarily on in-state development vs. allowing new transmission to access OOS resources
  - Leverage OOS wind busbar allocation assumptions from an existing power-flow study as a proxy for moderate OOS resource development

RESOLVE Cases for Comparison

ID	Name	Description	Rationale
A	42RSPw/2017IEPR	Reference System Plan calibrated to 2017 IEPR demand	Reference point for comparison
B	32w/ExistTXonly (policy driven sensitivity #1)	Lower emissions target, increased EV load, some fossil retirement, 60% RPS, do not build OOS new Tx	Create substantially larger portfolio for transmission studies, focused on in-state development
C	32w/NewTX&WYNM (policy driven sensitivity #2)	Same as B but allowing OOS new Tx to access up to 4,250 MW OOS wind	Study in-state impact of moderate amount of OOS resource development
D	32w/NewTX&anyOOS	Same as B but allowing OOS new Tx to access broad range of potential for OOS resources	Study in-state impact of large amount of OOS resource development

- **Case A**: The (42 MMT) RSP with the 2017 IEPR, included for comparison purposes
- **Case B**: Allows for OOS resource development on existing transmission only.
- **Case C:** Allows OOS resource development but only up to 4,250 MW of NM and WY wind. This constraint enables the CAISO to reuse busbar allocations for OOS resources from CAISO's 50% RPS OOS portfolio policy-sensitivity study that was completed in 2017.
- **Case D**: Relative to Case C, allows access to broad range of OOS resource potential. This case is for information only and intended to assess the range of differences between in-state and OOS focused development. Transmission studies of Case D would require additional new analysis to develop busbar allocations for power flow analysis.

NOTE: Resource and transmission costs are highly uncertain and modest cost changes for competing resources can affect whether RESOLVE selects more in-state or more OOS resources as the optimal buildout.

Input Changes Common to the New RESOLVE Cases

- GHG emission target
  - 32 MMT CO_2e statewide by 2030 was chosen as a target that could drive more GHG-free resource development in amounts sufficient enough to provide new and useful information about potential transmission implications.
- RPS target
  - RESOLVE is constrained to meet at least 60% RPS by 2030 to meet SB 100 requirements.
- EV Load
  - Staff used the "High" transportation electrification case of the CEC's 2017 IEPR demand forecast as an off-the-shelf proxy for higher EV load by 2030
  - Approximately 15,900 GWh statewide in 2030, or 12,879 GWh for CAISO load
    - Corresponds to about 3.9 million light-duty EVs statewide in 2030, or about 3.2 million in the CAISO area
    - Source: https://efiling.energy.ca.gov/getdocument.aspx?tn=223244 Page 43, Figure 21
  - Default RESOLVE input assumptions for other EV-related parameters (such as workplace and flexible charging, etc.) were retained

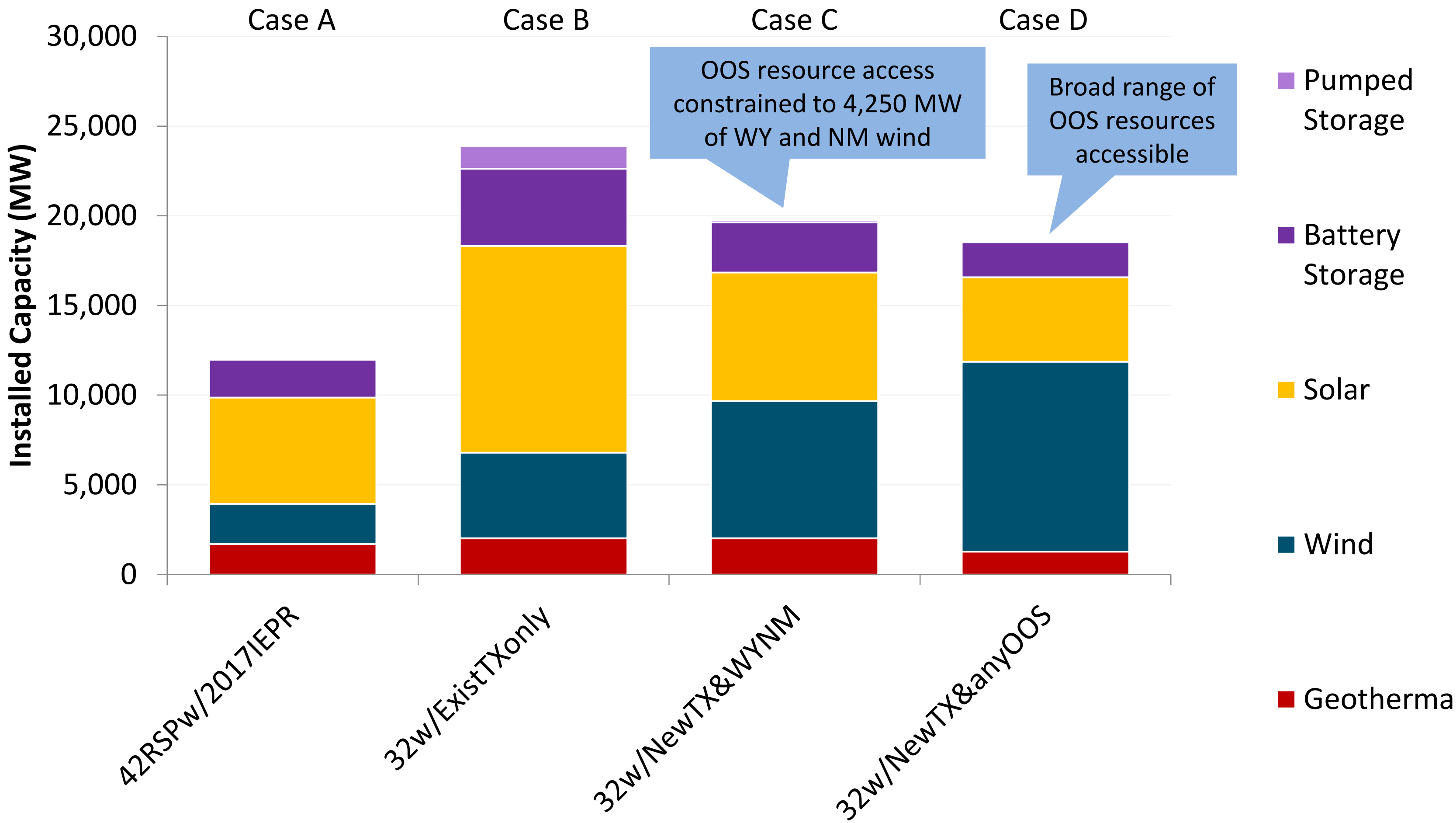
CAISO area EV load assumptions	2018	2022	2026	2030
CEC 2017 IEPR – Mid, annual GWh	1,618	4,533	7,987	11,261
CEC 2017 IEPR – High, annual GWh	1,618	5,372	9,125	12,879

Retirements Assumptions in the New RESOLVE Cases

- Configured RESOLVE to retire gas generation and cogeneration older than 40 years old, consistent with Hybrid Conforming Portfolio assumption
  - No contract data was used to extend life of resources with existing contracts
  - This simple 40-year retirement assumption does not consider the local capacity value a resource might have, and does not replace any local capacity removed by it
  - Inland Empire Energy Center Unit 2 (INLDEM_5_UNIT2, 366 MW CCGT) was left unretired, consistent with all previous RESOLVE scenarios. This unit was retired in the Hybrid Conforming Portfolio.

Resource type	Original nameplate MW, no retirements	Nameplate MW, after 40 year age retirement	Nameplate MW of units retired
	2030	2030	2030
CAISO_CHP	1,685	446	1,239
CAISO_ST	652	12	640
CAISO_CCGT1	13,703	13,507	196
CAISO_CCGT2	2,974	2,974	-
CAISO_Peaker1	5,555	4,754	802
CAISO_Peaker2	2,729	2,034	696
CAISO_Reciprocating_Engine	263	255	8
	27,561	**23,982**	**3,580**

2030 Selected Resource Mix Comparison



- With a more stringent GHG target, significant amounts of new GHG-free energy were selected; geothermal was selected even when access to OOS resources was not constrained
- As access to OOS resources was more constrained, RESOLVE selected more in-state resources, mainly solar and storage
- With less diversity from OOS wind, more battery storage and some pumped storage were selected

2030 Selected Resources Comparison Table

	Case	A	B	C	D
	Name	42RSPw/2017IEPR	32w/ExistTXonly	32w/NewTX&WYNM	32w/NewTX&any OOS
Selected Resource Types	***Unit***	**2030**	**2030**	**2030**	**2030**
Geothermal	*MW*	1,700	2,020	2,020	1,275
Wind	*MW*	2,246	4,775	7,648	10,584
Solar	*MW*	5,916	11,529	7,163	4,714
Battery Storage	*MW*	2,104	4,299	2,795	1,947
Pumped Storage	*MW*	-	1,246	116	-
Battery Storage Hours	*Hours*	1.3	3.7	2.5	1.3
In-State Renewables	*MW*	**5,754**	**13,254**	**9,515**	**6,505**
Out-of-State Renewables	*MW*	**4,107**	**5,069**	**7,315**	**10,069**

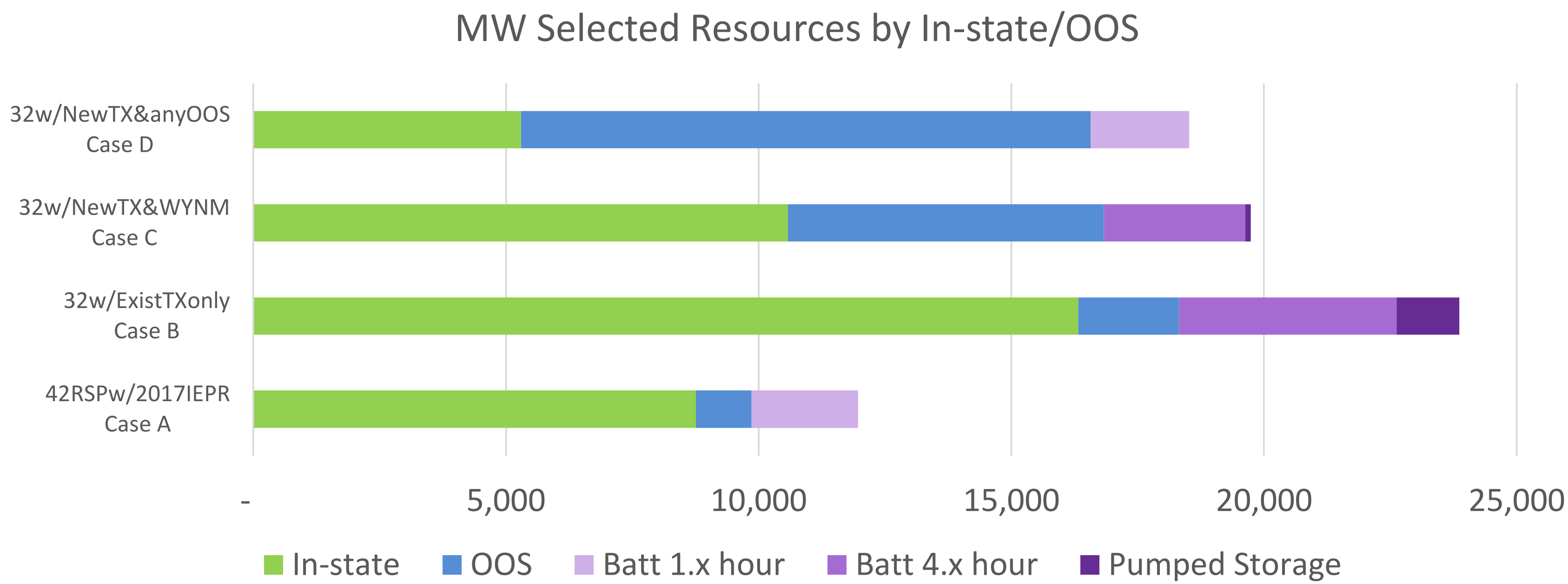
- Same data as preceding slide in tabular form
- Actual battery storage durations selected by RESOLVE are shown above. In Case B, longer duration storage was selected to help integrate the larger amounts of in-state solar.

2030 Portfolio Metrics Comparison Table

	Case	A	B	C	D
	Name	42RSPw/2017IEPR	32w/ExistTXonly	32w/NewTX&WY NM	32w/NewTX&any OOS
Annual Cost Metrics	*Unit*	2030	2030	2030	2030
New Renewables Fixed Costs	*$MM*	$ 2,422	$ 4,000	$ 4,485	$ 4,512
New Storage Fixed Costs	*$MM*	$ 162	$ 1,064	$ 379	$ 154
New Transmission Fixed Costs	*$MM*	$ -	$ 83	$ -	$ -
Total Operating Costs	*$MM*	$ 4,605	$ 3,601	$ 3,582	$ 3,523
Total New Resource Costs + Operating Costs	*$MM*	$ 7,189	$ 8,747	$ 8,447	$ 8,189
Delta relative to Case B	*$MM*			$ (300)	$ (558)
Delta % relative to Case B	*$MM*			-3.4%	-6.4%
Operational Portfolio Metrics	*Unit*	2030	2030	2030	2030
System Greenhouse Gas Emissions	*MMtCO2*	34.0	25.9	25.9	25.9
Marginal GHG Cost	*$/tCO2*	$ 190	$ 287	$ 251	$ 187
Effective RPS (incl. banked RECs)	*% of Retail Sales*	60%	71%	71%	71%
Renewable Curtailment	*% of RPS Gen.*	5.9%	6.6%	6.5%	6.4%
Actual Reserve Margin	*%*	22%	25%	18%	17%
Load	*GWh*	255,038	256,784	256,784	256,784

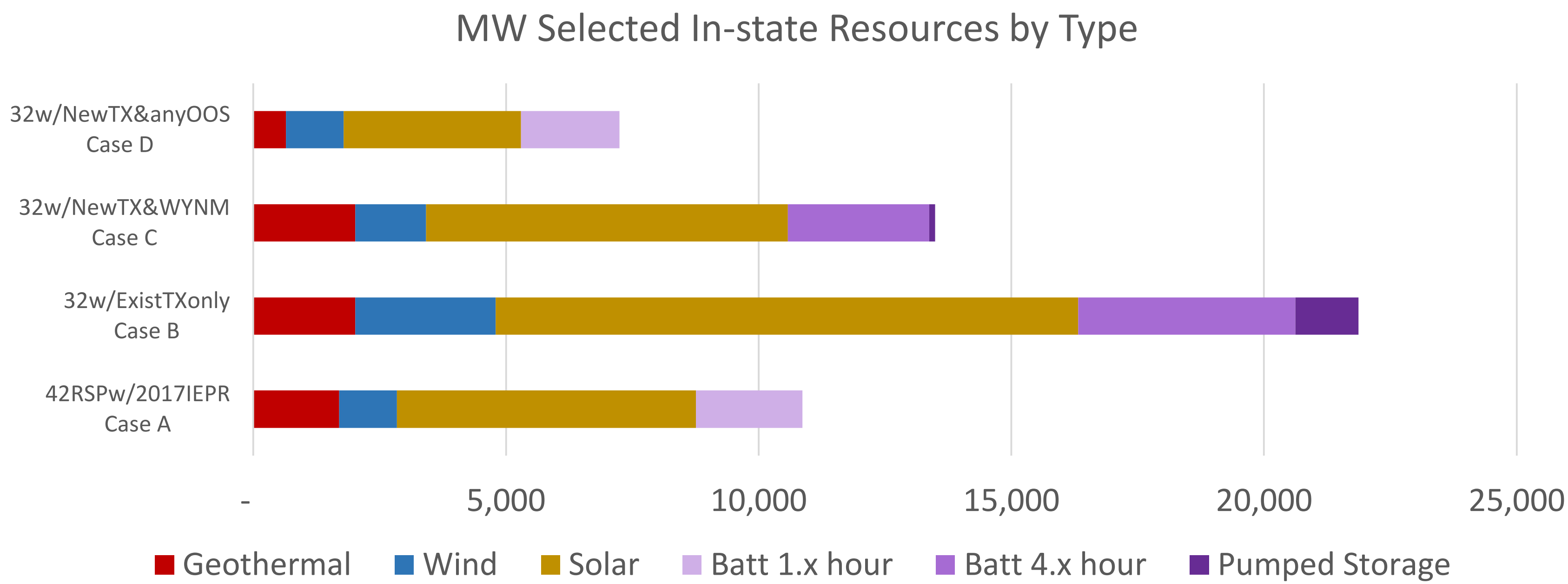
- Benefits of accessing OOS resources warrant further examination via CAISO's TPP
  - 2030 fixed costs of new resources and 2030 operating costs for all resources decrease as constraints on OOS resource access are relaxed.
  - Comparing Case A and B, the more stringent GHG target is a main contributor to higher marginal GHG abatement cost in 2030. However, comparing Case B to Cases C and D, allowing increased access to OOS resources may substantially reduce the marginal GHG abatement cost because lower cost GHG-reduction solutions were made available.

2030 Selected Resources In/Out State Comparison



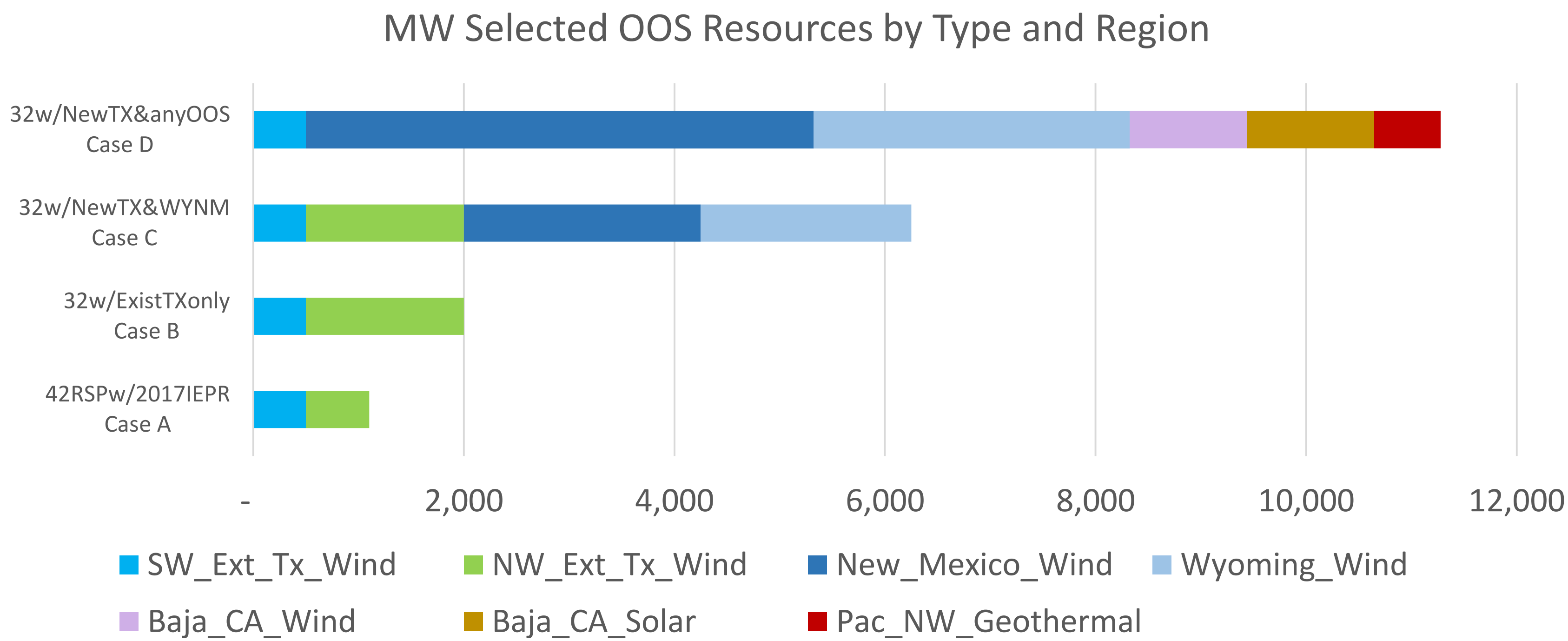
- Staff grouped in-state and OOS resources selected by RESOLVE to contrast the change in mix across cases
- Given the cost assumptions in RESOLVE, as greater access to OOS resources is allowed, the model selects more OOS resources and less in-state resources as part of the optimal solution
- Staff grouped the battery storage selected by RESOLVE into ~one hour (1.x) or ~four hour (4.x) duration categories to show that higher reliance on new in-state (mainly solar) resources requires longer duration storage

2030 Selected In-State Resources by Type Comparison



- When no OOS new transmission is allowed (Case B, 32w/ExistTXonly), RESOLVE found it would be valuable to pay for some in-state transmission upgrades to access larger amounts of in-state wind.
- Though not shown on this chart, Mountain_Pass_El_Dorado, Greater_Imperial, and Riverside_East_Palm_Springs are zones where transmission capacity is filled across all cases, either with in-zone renewables or as the entry point for OOS renewables.

2030 Selected OOS Resources by Type and Region Comparison



When access to OOS resources is increased:

- RESOLVE selects those resources instead of new in-state solar, geothermal, and storage.
- RESOLVE selects New Mexico and Wyoming wind and if available, wind and solar in Baja, Mexico until transmission availability limits are reached in each area. RESOLVE also selects some Pacific Northwest geothermal – possibly to make use of available Northern CA transmission capacity and free up Greater Imperial transmission capacity to interconnect Baja, Mexico resources.

NOTE: NW_Ext_Tx_Wind and SW_Ext_Tx_Wind represent Northwest and Southwest, respectively, wind resources that can interconnect on existing transmission to serve CAISO load.

Conclusions and Recommendation for the CAISO TPP Reliability Base Case and Policy-Driven Base Case

Conclusions:

- The Hybrid Conforming Portfolio reflects the planning preferences of LSEs, which modeled their plans based off the Commission-adopted 2017 Reference System Portfolio.
- The Hybrid Conforming Portfolio also reflects some adjustments made by CPUC staff to align with the resource potential and transmission availability assumed in the RESOLVE model.
  - The new resource build data is posted to the CPUC website here.
- Staff conducted production cost modeling to demonstrate that the Hybrid Conforming Portfolio is a reliable and operable portfolio.
  - For information on the results please refer to Production Cost Modeling Study section of the slide deck, “Proposed Preferred System Portfolio for IRP 2017-18: System Analysis and Production Cost Modeling Results.”
- Uncertainty with regard to the feasibility of LSE Plans is a natural part of the IRP process and should continue to be explored by CPUC staff and parties in future IRP cycles.

Staff Recommendation:

- The Commission should transmit to CAISO the Hybrid Conforming Portfolio to be used as the Reliability Base Case and Policy-Driven Base Case in the CAISO 2019-20 TPP.

Conclusions and Recommendation for the CAISO TPP Policy-Driven Sensitivities

Conclusions:

- Allowing selection of OOS resources that may require new transmission appears to provide value over restricting resource selection to only those resources that can be built with existing transmission capacity.
- Without the ability to select OOS resources (mostly high quality wind in WY and NM), more new installed capacity overall (geothermal, in-state solar, battery and pumped storage) is selected at higher overall cost.
- However, it is important to keep in mind that resource and transmission costs are highly uncertain and modest cost changes for competing resources can affect whether RESOLVE selects more in-state or more OOS resources as the optimal build-out.
- It is important to understand the tradeoffs in pursuing near-term investments based exclusively off the 2017 Reference System Plan, which is focused on in-state development, if new transmission to OOS resources continues to pose a viable and cost-effective alternative in the longer term.

Staff Recommendations:

- The Commission should transmit to CAISO two portfolios for Policy-Driven Sensitivities in the 2019-20 TPP cycle:
  1. 32 MMT by 2030 statewide GHG planning target with only existing transmission available to interconnect out-of-state (OOS) resources (i.e., Case B)
  2. 32 MMT by 2030 statewide GHG target allowing new transmission build to interconnect up to 4,250 MW of New Mexico and Wyoming wind (i.e., Case C)