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Attachment B:

Descriptions of the Proposed Portfolios for the 2021-2022 TPP

CPUC Energy Division
October 23, 2020

Staff propose to transmit to the CAISO three resource portfolios for the 2021-2022 Transmission Planning Process (TPP). This TPP will be studying 2031 as the tenth year. For this reason, each portfolio will include 2031 as the final resource planning year.[1]

Reliability and Policy-Driven Base Case

Description:

The "46 MMT with 2019 IEPR" portfolio was developed using the same modeling assumptions as were used to develop the 2019 RSP 46 MMT by 2030 portfolio adopted by D.20-03-028,[2] with a few exceptions, including the following updates:

- An updated load forecast using the 2019 IEPR (annual GWh, peak MW, and load and load modifier shapes);
- Updated building electrification shapes developed using a combination of E3's RESHAPE model and CEC shapes, applied to new building electrification load (i.e. the incremental building electrification load assumptions post-2030 from the CEC High Biofuels PATHWAYS scenario)[3];
- An updated gas price forecast based on CEC June 2020 workbook;[4] and
- Additional minor RESOLVE updates and corrections.[5]

The 46 MMT with 2019 IEPR portfolio comprises 15,328 MW of new renewable resources and 11,252 MW of new battery storage, among other resources, by 2030; additionally, all existing thermal generation not already scheduled to retire is retained through 2030. In comparison, the 2019 46 MMT RSP portfolio was comprised of 14,460 MW of new renewable resources, 8,873 MW of new battery storage and did not retain 30 MW of thermal generation. Figure 1 includes a more detailed comparison of the two portfolios.

[1] Estimated 2031 GWh and peak MW loads were calculated by extrapolating the 2019 IEPR's load growth.
[2] Decision 20-03-028, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772681.PDF
[3] E3 updated its RESHAPE model to produce updated space heating and water heating building electrification load shapes and used the CEC California IOU Electricity Load Shapes Report (https://ww2.energy.ca.gov/2019publications/CEC-500-2019-046/CEC-500-2019-046.pdf) for cooking and clothes drying loads. These shapes only apply to the PATHWAYS-based loads modeled in 2045, since the 2019 IEPR contains no explicit building electrification loads. Per the 2019-20 IRP Inputs and Assumptions, the previous assumptions used an older version of RESHAPE for space heating loads and relied on E3 PATHWAYS' load shapes for water heating, cooking, and clothes drying.
[4] https://www.energy.ca.gov/programs-and-topics/topics/energy-assessment/natural-gas-burner-tip-prices-california-and-western
[5] These include re-adding 22 MW of Riverside East and Palm Springs wind left out of the RPS supply curve, properly assigning the transmission zone for Mountain Pass / El Dorado solar PV, and other minor updates.

Figure 1: Capacity Additions (2019 RSP Portfolio Compared to 46 MMT with 2019 IEPR Portfolio)

2019 Reference System Plan (46 MMT with 2018 IEPR)

	Unit	2020	2021	2022	2023	2024	2026	2030	2045
Gas	MW	-	-	-	-	-	-	-	-
Biomass	MW	-	-	-	-	-	-	-	1,147
Geothermal	MW	-	-	-	-	-	-	-	2,308
Hydro (Small)	MW	-	-	-	-	-	-	-	-
Wind	MW	-	34	1,950	1,950	2,737	2,737	2,837	4,837
Wind OOS New Tx	MW	-	-	-	-	-	-	606	3,000
Offshore Wind	MW	-	-	-	-	-	-	-	-
Solar	MW	2,000	4,000	6,000	8,000	8,000	8,000	11,017	77,112
Customer Solar	MW	-	-	-	-	-	-	-	-
Battery Storage	MW	152	2,453	2,453	2,453	3,299	6,127	8,873	54,270
Pumped Storage	MW	-	-	-	-	-	973	973	973
Shed DR	MW	-	222	222	222	222	222	222	222
Gas Capacity Not Retained	MW	-	-	-	-	-	-	*(30)*	(5,168)
In-State Renewables	MW	**2,000**	**4,034**	**7,950**	**9,950**	**10,737**	**10,737**	**13,854**	**85,404**
Out-Of-State Renewables	MW	**-**	**-**	**-**	**-**	**-**	**-**	**606**	**3,000**

46MMT with 2019 IEPR

	Unit	2020	2021	2022	2023	2024	2026	2030	2045
Gas	MW	-	-	-	-	-	-	-	-
Biomass	MW	-	-	-	-	-	-	-	1,147
Geothermal	MW	-	-	-	-	-	-	-	2,308
Hydro (Small)	MW	-	-	-	-	-	-	-	-
Wind	MW	-	-	1,916	1,916	2,639	2,639	2,703	4,737
Wind OOS New Tx	MW	-	-	-	-	-	-	250	3,000
Offshore Wind	MW	-	-	-	-	-	-	-	-
Solar	MW	307	2,307	4,307	6,307	6,307	6,307	12,375	67,822
Customer Solar	MW	-	-	-	-	-	-	-	-
Battery Storage	MW	923	2,773	2,773	2,773	3,462	6,842	11,252	48,261
Pumped Storage	MW	-	-	-	-	-	747	747	747
Shed DR	MW	-	343	343	343	595	595	595	595
Gas Capacity Not Retained	MW	-	-	-	-	-	-	-	(5,239)
In-State Renewables	MW	**307**	**2,307**	**6,223**	**8,223**	**8,946**	**8,946**	**15,078**	**76,014**
Out-Of-State Renewables	MW	**-**	**-**	**-**	**-**	**-**	**-**	**250**	**3,000**

Figure 2 summarizes the resource build out in 2031, the resource planning year needed specifically for the 2021-2022 TPP. The GHG target modeled in 2031 was 44.1 MMT.[6]

[6] Extrapolated from a 46 MMT by 2030 target using the same assumptions that were used for incorporating post-2030 years into select modeling runs to reflect achievement of the Senate Bill (SB) 100 (DeLeón, 2018) 2045 goals in the development of the 2019 RSP.

Figure 2: Capacity Additions in 2031 (46 MMT with 2019 IEPR Portfolio)

46 MMT with 2019 IEPR (2031 Results)

	Unit	2031
Gas	MW	-
Biomass	MW	-
Geothermal	MW	-
Hydro (Small)	MW	-
Wind	MW	3,267
Wind OOS New Tx	MW	1,163
Offshore Wind	MW	-
Solar	MW	12,375
Customer Solar	MW	-
Battery Storage	MW	11,296
Pumped Storage	MW	747
Shed DR	MW	595
Gas Capacity Not Retained	MW	-
In-State Renewables	MW	**15,642**
Out-Of-State Renewables	MW	**1,163**

For the planning year 2031, the portfolio comprises 11,296 MW of battery storage, 15,642 MW of new in-state renewable resources, and 1,163 MW of new out-of-state (OOS) renewable resources on new OOS transmission, among other resources. The CPUC must further assess whether this amount of OOS resources is optimal considering more complete transmission costs.[7] The model does not indicate the need for in-state transmission build to access the OOS resources. RESOLVE identified 645 MW of transmission upgrades needed under the 46 MMT with 2019 IEPR portfolio.

The portfolio does not include the latest baseline resources reported by LSEs in their IRP filings on 9/1/2020 as an updated input assumption. The newly contracted resources reported by LSEs were not used to update the baseline resources assumption in RESOLVE before running the model to select this portfolio. For this reason, staff will identify such resources and reconcile them with the selected generic resources using the methodology described in "Modeling Assumptions: 2020-2021 TPP Report Release 1".[8] Accordingly, a small portion of the selected generic resources will be removed to avoid double-counting in TPP modeling.

[7] RESOLVE is a linear model that applies only the cost of the amount of transmission necessary to deliver the energy to the CAISO system. In this case, RESOLVE selected 1,163 MW of FCDS New Mexico wind. It interconnects into the "SCADSNV-Riverside_Palm_Springs" transmission zone. The transmission costs to reach the CAISO system are $121/kW-yr.

[8] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

Objective and Rationale:

The objective of transmitting this portfolio to the CAISO for the TPP base case studies is to ensure that transmission planning and development aligns with resource planning and development. The design of this portfolio achieves this objective by closely reflecting what the LSEs are currently planning towards, but updating it to the most recent load forecast.

The RESOLVE portfolio indicates the need for 645 MW of transmission upgrades in 2031 to accommodate the generation resources. However, RESOLVE is a system level model with simplified transmission capability and cost assumptions. For this reason, the CPUC will transmit this portfolio to the CAISO to conduct detailed transmission planning to assess the exact transmission needs. CAISO TPP results will indicate whether any reliability or policy-driven transmission upgrades are found necessary, and if so, those transmission upgrades may be recommended to the CAISO Board of Governors for approval. If any of the approved transmission upgrades are investments made specifically to accommodate the resource development future reflected by the CPUC in this portfolio, this portfolio will have helped ensure that transmission and generation resources are developed concurrently. This should minimize risk of stranded generation assets later being discovered to be undeliverable to load due to a lack of available transmission capability. To ensure this is a bidirectional minimization of ratepayer costs, the CPUC expects to receive information from the CAISO regarding which approved transmission projects are developed to accommodate policy-driven resource planning. The CPUC can then act accordingly to encourage the development of those resources to avoid stranded transmission assets.

Although a loss of load expectation (LOLE) study has not yet been performed on this portfolio, the portfolio is a comprehensive reflection of the resources being planned for and meets the RESOLVE 15% Planning Reserve Margin (PRM) constraint (as well as the 2 GW calibration adjustment added in 2026 and later years). Furthermore, this 46 MMT with 2019 IEPR portfolio contains more renewable resources, battery storage, and shed demand response than the 2019 RSP 46 MMT by 2030 portfolio. The new portfolio also retains an additional 30 MW of existing thermal generation. All of these differences are very likely to improve the reliability of the portfolio. Considering the LOLE results for the 46 MMT RSP portfolio were as follows, 0.03 in 2022, 0.11 in 2026, and 0.11 2030, all at about or below 0.1 expected outage events per year, the updated portfolio should adequately represent a reliable resource planning future for the purpose of the TPP.

Policy-Driven Sensitivity #1

Description:

The "2019-2020 38 MMT, with 2019 IEPR" portfolio was developed using the same modeling assumptions as were used for the 2019-2020 38 MMT by 2030 portfolio included in D.20-03-028 with the same updates as described for the base case portfolio above. Chiefly, this includes an updated load forecast using the 2019 IEPR.

The portfolio comprises 21,179 MW of new renewable resources and 11,006 MW of new battery storage by 2030; 773 MW of existing thermal generation is not retained. In comparison, the 38 MMT portfolio in D.20-03-028 was comprised of 20,274 MW of new renewable resources, 9,714

MW of new battery storage and did not retain 2,046 MW of thermal generation. RESOLVE identified 1,599 MW of transmission upgrades in 2030 under the new portfolio. Figure 3 includes a more detailed comparison of the two portfolios.

Figure 3: Capacity Additions (38 MMT with 2018 IEPR Compared to 38 MMT with 2019 IEPR)

38 MMT with 2018 IEPR

	Unit	2020	2021	2022	2023	2024	2026	2030	2045
Gas	MW	-	-	-	-	-	-	-	-
Biomass	MW	-	-	-	-	-	-	-	1,147
Geothermal	MW	-	-	-	-	-	-	-	2,308
Hydro (Small)	MW	-	-	-	-	-	-	-	-
Wind	MW	-	34	2,924	2,924	3,811	3,811	5,279	5,279
Wind OOS New Tx	MW	-	-	-	-	-	-	3,000	3,000
Offshore Wind	MW	-	-	-	-	-	-	-	-
Solar	MW	2,000	4,000	6,000	8,000	8,000	8,684	11,995	76,736
Customer Solar	MW	-	-	-	-	-	-	-	-
Battery Storage	MW	152	2,453	2,453	2,453	3,107	5,036	9,714	53,344
Pumped Storage	MW	-	-	-	-	-	1,605	1,605	1,605
Shed DR	MW	-	222	222	222	222	222	222	222
Gas Capacity Not Retained	MW	-	-	-	-	-	-	*(2,046)*	(5,239)
In-State Renewables	MW	**2,000**	**4,034**	**8,924**	**10,924**	**11,811**	**12,495**	**17,274**	**85,470**
Out-Of-State Renewables	MW	**-**	**-**	**-**	**-**	**-**	**-**	**3,000**	**3,000**

38 MMT with 2019 IEPR

	Unit	2020	2021	2022	2023	2024	2026	2030	2045
Gas	MW	-	-	-	-	-	-	-	-
Biomass	MW	-	-	-	-	-	-	-	1,147
Geothermal	MW	-	-	-	-	-	-	-	2,308
Hydro (Small)	MW	-	-	-	-	-	-	-	-
Wind	MW	-	34	2,392	2,392	3,179	3,179	5,279	5,279
Wind OOS New Tx	MW	-	-	-	-	-	-	2,649	3,000
Offshore Wind	MW	-	-	-	-	-	-	-	-
Solar	MW	1,418	3,418	5,418	7,418	7,418	7,418	13,251	67,423
Customer Solar	MW	-	-	-	-	-	-	-	-
Battery Storage	MW	896	2,871	2,871	2,871	3,722	5,959	11,006	47,048
Pumped Storage	MW	-	-	-	-	-	1,700	1,700	1,700
Shed DR	MW	-	222	222	222	222	222	222	222
Gas Capacity Not Retained	MW	-	-	-	-	-	-	*(773)*	(5,239)
In-State Renewables	MW	**1,418**	**3,452**	**7,809**	**9,809**	**10,596**	**10,596**	**18,530**	**76,157**
Out-Of-State Renewables	MW	**-**	**-**	**-**	**-**	**-**	**-**	**2,649**	**3,000**

Figure 4 summarizes the resource build out in 2031, the resource planning year needed specifically for the 2021-2022 TPP. The GHG target modeled in 2031 was 36.4 MMT.[9]

[9] Extrapolated from a 38 MMT by 2030 target using the same assumptions that were used for incorporating post-2030 years into select modeling runs to reflect achievement of the Senate Bill (SB) 100 (DeLeón, 2018) 2045 goals in the development of the 2019 RSP.

Figure 4: Capacity Additions in 2031 (38 MMT with 2019 IEPR Portfolio)

38 MMT with 2019 IEPR (2031 Results)

	Unit	2031
Gas	MW	-
Biomass	MW	-
Geothermal	MW	28
Hydro (Small)	MW	-
Wind	MW	5,279
Wind OOS New Tx	MW	3,000
Offshore Wind	MW	-
Solar	MW	14,574
Customer Solar	MW	-
Battery Storage	MW	11,878
Pumped Storage	MW	1,700
Shed DR	MW	222
Gas Capacity Not Retained	MW	(2,070)
In-State Renewables	MW	**19,880**
Out-Of-State Renewables	MW	**3,000**

For the planning year 2031, the second sensitivity portfolio comprises 19,880 MW of new in-state renewable resources, 3,000 MW of OOS renewable resources, and 11,878 MW of battery storage, among other resources.

The portfolio does not include the latest baseline resources reported by LSEs in their IRP filings on 9/1/2020 as an updated input assumption. Rather, staff will identify such resources and reconcile them with the selected generic resources using the methodology described in "Modeling Assumptions: 2020-2021 TPP Report Release 1".[10] Accordingly, a small portion of the selected generic resources will be removed to avoid double-counting in TPP modeling.

Objective and Rationale:

The objective of the transmittal of this portfolio to the CAISO for the TPP as a policy-driven sensitivity is to better understand what the transmission implications would be under a 38 MMT resource planning future, to inform future CPUC decision-making to drive resource planning and development. The design of this portfolio best achieves this by closely reflecting the most recent 38 MMT portfolio included in D.20-03-028 but updated to the most recent load forecast. The TPP assessment results produced could be used to inform future IRP modeling inputs, assumptions, or scenarios.

[10] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

Furthermore, the CAISO could use this policy-driven sensitivity portfolio to determine which identified base case upgrades or alternatives are "least regrets" under a lower GHG target resource planning future.

The RESOLVE portfolio indicated the need for 1,599 MW of transmission upgrades in 2030 to accommodate the generation resources. Because RESOLVE is a system-level model with simplified transmission capability and cost assumptions, the CPUC will transmit this portfolio to the CAISO to conduct detailed transmission planning. CAISO TPP results will indicate whether any reliability or policy-driven transmission upgrades are found necessary. Because this is a sensitivity, the transmission upgrades would not be recommended for approval to the CAISO Board of Governors.

Policy-Driven Sensitivity #2

The "Offshore Wind Sensitivity Portfolio" will be developed and transmitted to the CAISO as a second policy-driven sensitivity.

Objective:

To obtain and refine transmission assumptions relevant to offshore wind resources to inform future IRP capacity expansion modeling.

CPUC Staff plan to improve the quality of the data used in modeling offshore wind resources in the CPUC IRP RESOLVE model. For future IRP modeling, staff plan to use the ongoing 2020 NREL California offshore wind study,[11] when completed, to update resource costs and generation profile data in RESOLVE. This updated information will pertain to five specific areas: Diablo Canyon, Morro Bay, Humboldt, Cape Mendocino, and Del Norte. Staff will also need to update inputs and assumptions on the cost of the bulk transmission system required to deliver resources from these areas to load. In the current CPUC IRP inputs and assumptions, transmission deliverability data is based on a CAISO whitepaper.[12] However, for three of the five resource areas – Humboldt, Cape Mendocino, and Del Norte – the CAISO whitepaper does not contain any transmission deliverability information. In order for CPUC Staff to use the RESOLVE model to consider offshore wind in all five areas in the future, the CPUC needs additional information about transmission upgrade costs. This TPP policy-driven sensitivity resource portfolio is designed with the objective of CAISO producing the required information that will be used to update RESOLVE inputs.

The aim is that the outputs produced will be long-lasting and can be used to study a wide range of futures, including 2045 cases with stringent GHG targets and high electrification futures. Staff strive to eliminate the need to include limits on the quantity of a resource type that can be selected in the optimization due to a lack of inputs.

[11] Relevant MAG webinar slides found here: ftp://ftp.cpuc.ca.gov/energy/modeling/2020-08-Offshore_Wind-MAG-Slides-Energy_Division.pdf; and here ftp://ftp.cpuc.ca.gov/energy/modeling/200827_MAG%20webinar_NREL.pdf

[12] http://www.caiso.com/Documents/WhitePaper-TransmissionCapabilityEstimates-InputtoCPUCIntegratedResourcePlanPortfolioDevelopment.pdf

Portfolio Development:

The offshore wind sensitivity portfolio was developed using the following assumptions in RESOLVE:

- Force in the following quantities of FCDS offshore wind in 2030 in each area based on resource potential limits: [13]
    - Humboldt: 1.6 GW
    - Diablo Canyon: 4.3 GW
    - Morro Bay: 2.4 GW
- Assume Diablo Canyon Nuclear Plant retirement with no retention of the deliverability by the generator, making that deliverability available for offshore wind
- Optimize the remainder of the portfolio using a 30 MMT target
- Maintain PRM and other RESOLVE constraints

To complete busbar mapping staff will:

- Use previously mapped portfolios, including the 30 MMT energy-only sensitivity portfolio transmitted for 2020-2021 TPP as a starting point for mapping non-offshore wind resources
- Use NREL's assumptions, updated with CAISO's guidance, to map offshore wind resources
    - Diablo Canyon offshore wind mapped to 500 kV busbar at Diablo Canyon substation
    - Morro Bay offshore wind mapped to 230 kV busbar at Morro Bay substation
    - Humboldt offshore wind would not be mapped to a substation. CAISO findings would point to required substation development.

Portfolio Description:

For the planning year 2031, the offshore wind sensitivity portfolio comprises 23,542 MW of new in-state renewables of which 8,351 MW are offshore wind resources, per the objective of the portfolio. Additionally, the portfolio comprises 3,000 MW of OOS renewable resources and 11,187 MW of battery storage among other resources. Figure 5 summarizes the resource build out in 2031.

[13] Inputs & Assumptions, 2019-2020 Integrated Resource Planning, November 2019 ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

Figure 5: Capacity Additions in 2031 (Sensitivity #2)

2021-2022 TPP Sensitivity #2 (2031 Results)		
	Unit	2031
Gas	*MW*	-
Biomass	*MW*	-
Geothermal	*MW*	-
Hydro (Small)	*MW*	-
Wind	*MW*	4,998
Wind OOS New Tx	*MW*	3,000
Offshore Wind	*MW*	8,351
Solar	*MW*	10,194
Customer Solar	*MW*	-
Battery Storage	*MW*	11,187
Pumped Storage	*MW*	1,076
Shed DR	*MW*	222
Gas Capacity Not Retained	*MW*	(2,441)
In-State Renewables	*MW*	**23,542**
Out-Of-State Renewables	*MW*	**3,000**

Assessment in 2021-2022 Transmission Planning Process

The CAISO will use the above 2031 resource portfolio to conduct the policy-driven sensitivity assessments including a power flow study, deliverability assessment, and production cost modeling of the sensitivity portfolio including 8.3 GW of offshore wind resources (Humboldt, Diablo Canyon and Morro Bay). In addition to the sensitivity assessment, the CAISO will conduct an "outlook" assessment focusing on a longer timeframe to accommodate the remaining offshore wind resource potential including 6.2 GW at Cape Mendocino and 6.6 GW at Del Norte, totaling 21.1 GW. This outlook assessment will aim to ensure that transmission development for early offshore wind resources is "least regrets". The objective is to identify how transmission development can be planned within the 2031 timeframe to accommodate further potential offshore wind development in the 2045 timeframe.

Load forecasts and generation beyond 2031, the tenth study year, are more uncertain and outside of the scope of the 2021-2022 TPP. For this reason, the outlook assessment will not include deliverability assessment or production cost modeling. In order to identify a "least regrets" transmission plan for offshore wind, it will be important to ensure that transmission development to accommodate early offshore wind resources is not undersized for future offshore wind development. Although the Central Coast will be included in the outlook analysis, the North Coast is expected to be the focus of this analysis due to the inability of the existing transmission system to deliver the significant offshore wind resources there to CAISO's main load centers.

The expected product is an updated transmission capability limits and upgrade cost estimate table, for use in RESOLVE, including:

- Updated transmission capability available in existing transmission zones.
- New transmission zones where appropriate and transmission capability estimates for the new transmission zones.
- The cost of upgrading transmission to accommodate the 8.3 GW in the sensitivity portfolio with the potential to increase to up to 21.1 GW offshore wind capacity as a part of the outlook assessment.

[END OF ATTACHMENT B]