Transmission Capability Estimates for use in the CPUC's Resource Planning Process

White Paper

Revised

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Transmission Infrastructure Planning

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1 Introduction

As part of its Integrated Resource Planning (IRP) process, the California Public Utilities Commission (CPUC) develops resource plans to meet the state's renewable policy targets and resource adequacy requirements. The CPUC currently uses the RESOLVE resource optimization model for developing resource portfolios. RESOLVE co-optimizes investment and dispatch in order to identify least-cost resource portfolios that meet the policy and reliability targets. The portfolios are comprised of resources with Full Capacity Deliverability Status (FCDS), which count towards resource adequacy needs, and resources with Energy-Only Deliverability Status (EODS), which contribute to meeting renewable energy targets but do not count towards resource adequacy. The CPUC, in collaboration with the California Energy Commision (CEC) and the ISO, maps the geographically coarse RESOLVE resource selections to substations using a documented bus bar mapping process.

One of the key inputs to the resource optimization model and the busbar mapping process is transmission capability information supplied by the ISO. For this purpose, the ISO develops FCDS and EODS transmission capability estimates that limit the amount and deliverability status of candidate resources that can be selected by RESOLVE in transmission-constrained areas. The information includes previously identified conceptual transmission upgrades along with an estimate of the associated incremental increase in transmission capability.

The ISO uses the resource portfolios developed by the CPUC in its annual Transmission Planning Process (TPP). The CPUC typically transmits to the ISO a base portfolio and two sensitivity portfolios. The ISO utilizes the base portfolio in its reliability, policy-driven and economic assessments to identify the need for transmission development. The sensitivity portfolios are mainly used in policy-driven assessment for informational purposes.

The purpose of this white paper is to provide updated transmission capability estimate information for use by the CPUC in developing future resource portfolios. The paper describes the information, the methodology and key sources of information that are used to produce it and how the information may be implemented by the CPUC in its resource planning process. This white paper replaces the white paper the ISO released on May 20, 2019.[1]

As the name suggests, transmission capability estimates are just estimates. They are developed primarily based on the location, mix and size of resources in the ISO generation

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

interconnection queue and certain other assumptions described in this white paper. The accuracy of these estimates will be impacted depending, among other things, on the deviation of the resource portfolios selected from the commercial interest that these estimates are based on. The final determination of the transmission upgrades needed by the resources portfolios is made during the policy-driven assessment the ISO conducts as part of the TPP.

2 Previous transmission capability estimates

The previous version of the transmission capability estimates information was used by the CPUC to develop resource portfolios for the 2021-2022 TPP and prior planning cycles. For each transmission zone and sub-zone, the transmission capability estimate provided FCDS capability for the existing system, FCDS capability with conceptual transmission upgrades along with the capital cost of the transmission upgrades and estimated EODS capability of the existing system. The FCDS transmission capability estimates were developed based on the previous ISO deliverability methodology. EODS transmission capability was generally developed by adding to the FCDS estimate the amount of gas-fired generation and imports behind the constraint that were assumed to be displaced by the new renewable resources due to their higher marginal cost.[2]

Both the FCDS and EODS estimates were expressed based on installed capacity rather than based on the resource-type specific output assumptions used in deliverability studies. The estimates were implemented in RESOLVE as constants that did not differentiate the transmission capacity headroom that is taken up by different types of resources. This approach had to change particularly given the significant reduction in the output assumptions for solar used in the new deliverability assessment methodology.

3 Updated transmission capability estimates

Table 3-1 shows the updated transmission capability estimates information. At a high level, the transmission capability estimates information provided in this white paper includes to the extent possible:

- Estimates of the capability of the existing and approved transmission to accommodate resources with full capacity deliverability status (FCDS) and energy only deliverability status (EODS) that covers all areas where there is commercial interest even if deliverability constraints are not identified,

[2] As explained later in this document, the current EODS estimates utilize the results of off-peak deliverability studies performed in accordance with the new deliverability methodology.

- Previously identified conceptual transmission upgrades that increase transmission capability along with cost estimates,
- The incremental FCDS and EODS capability provided by the conceptual transmission upgrades,
- Constraint boundary maps/diagrams showing BES substations inside each constraint zone (provided as Attachement A on the ISO Market Participant Portal), and
- Other information that may be helpful to the CPUC in implementing the estimates

The transmission capability estimates are developed using the current deliverability methodology. FCDS estimates are based on on-peak deliverability assessment methodology while the EODS estimates are based on the off-peak deliverability assessment methodology.

Table 3-1: Updated transmission capability estimates

Transmission Constraint	Affected Zones	Condition under which Constraint is Binding	Estimated FCDS Capability Based on On-peak Study Resource Output (MW)**		ADNU & Cost Estimate ($million)		Estimated EODS Capability Based on Off-peak Study Resource Output (MW)**		AOPNU & Cost Estimate ($million)		Wind/Solar Area Designation
			Existing System***	Incremental due to ADNU	ADNU (Time to Construct)	Cost (Escalated to COD)	Existing System***	Incremental due to AOPNU	AOPNU (Time to Construct)	Cost (Escalated to COD)	
SCE Northern Study Area Constraints											
South of Magunden Constraint	Non-CREZ – Big Creek	On-peak	670	840	Magunden 500kV upgrade (105 months)	$1,197	1,024*	N/A	N/A	N/A	Solar
Antelope – Vincent Constraint	Tehachapi, Non-CREZ – Big Creek	On-peak	4,040	2,700	Antelope - Vincent 500kV line rating increas	$15	5,171*	N/A	N/A	N/A	Solar
Windhub 500/230 kV Transformer Constraint	Tehachapi	On-peak, Off-peak	1,685	2,395	New 500/230kV substation connecting to Windhub 230kV and Vincent 500 kV (108 months)	$1,126	1,685	1,385	New 500/230kV substation connecting to Windhub 230kV and Vincent 500 kV (108 months)	$1,126	Solar
SCE Metro Study Area Constraints											
Laguna Bell – Mesa Constraint	Non-CREZ – Ventura	On-peak	0	3,178	Laguna Bell - Mesa line upgrade (27 months)	15	2,708*	N/A	N/A	N/A	Solar
SCE Metro Area	Non-CREZ – SCE Metro	None	4,083*	N/A	N/A	-	4,083*	N/A	N/A	N/A	N/A
SCE North of Lugo (NOL) Study Area Constraints											
Lugo 500/230 kV Transformer Constraint	Inyokern_North_Kramer, Victor, Pisgah	On-peak	1,576	980	New Lugo 500/230kV No. 3 transformer (42 months)	$70	1,619*	N/A	N/A	N/A	Solar
Victor-Lugo Constraint	Inyokern_North_Kramer Victor	On-peak	1,156	430	Reconductor Lugo - Victor 230kV lines (27 Months)	$226	1,311*	N/A	N/A	N/A	Solar
Kramer- Victor/Roadway -Victor Constraint	Inyokern_North_Kramer	On-peak, Off-peak	826	430	Loop in Kramer - Victor 115kV line into Roadway and reconductor Kramer to Lugo 230kV lines (81 months)	$108	1,237	480	Loop in Kramer - Victor 115kV line into Roadway and reconductor Kramer to Lugo 230kV lines (81 months)	$108	Solar
SCE Eastern Study Area Constraints											
Serrano – Alberhill – Valley 500 kV Constraint	Riverside_Palm_Springs, Arizona, Imperial	On-peak	5,700	3,648	Devers - Mira Loma - Mesa 500kV line (105 months)	$1,480	11,800*	N/A	N/A	N/A	Solar
Devers – Red Bluff 500 kV Constraint	Riverside_Palm_Springs, Arizona	On-peak, Off-peak	5,400	3,100	New Devers - Red Bluff 500kV No. 3 line (105 months)	$1,022	5,820	1,876	New Devers - Red Bluff 500kV No. 3 line (105 months)	$1,022	Solar
Colorado River 500/230 kV Transformer Constraint	Riverside_Palm_Springs: Colorado River Substation 230 kV	On-peak	1,490	1,000	New Colorado River 500/230kV No. 3 transformer (42 months)	$74	1,739*	1,000	New Colorado River 500/230kV No. 3 transformer (42 months)	$74	Solar
SCE/GLW East of Pisgah (EOP) Study Area Constraints											
Eldorado 500/230 kV Transformer #5 Constraint	Southern_Nevada, 'Eldorado/Mountain Pass (230kV)	On-peak	3,360	400	New Eldorado 500/230 transformer (42 months)	$70	3,360*	N/A	N/A	N/A	Solar
GLW-VEA Area Constraint	Southern_Nevada	On-peak, Off-peak	300	1,000	Pahrump - Sloan Canyon 230kV line rebuild and Innovation - Desert View 230kV line rebuild + other upgrades (60 months)	$175	269	1,110	Pahrump - Sloan Canyon 2nd 230kV line and Innovation - Northwest 2nd 230kV line + other upgrades (60 months)	$200	Solar
Mohave/Eldorado 500 kV	Southern_Nevada	On-peak	1,560*	N/A	N/A	-	1,560*	N/A	N/A	N/A	Solar
SDG&E Study Area Constraints											
East of Miguel Constraint	Arizona, Imperial, Baja, Riverside	On-peak, Off-peak	731	1,412	New Imperial Valley - Serrano 500 kV line (120 months)	$3,680	950	943	New Imperial Valley - Serrano 500 kV line (120 months)	$3,680	Solar
Encina-San Luis Rey Constraint	Arizona, Imperial, Baja, Non-CREZ within San Diego	On-peak	2,901	3,718	New Encina - San Luis Rey 230 kV line (120 months)	$102	3,035*	N/A	N/A	N/A	Solar
Imperial Valley transformer Constraint	Imperial	On-peak	1,959	400	Install a new Imperial Valley 500/230 kV Bank at new substation (105 months)	$214	1,959*	N/A	N/A	N/A	Solar
San Luis Rey-San Onofre Constraint	Arizona, Imperial, Non-CREZ within San Diego	On-peak	1,748	4,269	New San Luis Rey-San Onofre 230 kV line (120 months)	$237	3,281*	N/A	N/A	N/A	Solar
San Diego Internal Constraint	Imperial, Non-CREZ within San Diego	On-peak, Off-peak	968	2,067	Internal San Diego Area reconductoring (18 months)	$89	290	274	Internal San Diego Area reconductoring (18 months)	$89	Solar
Silvergate-Bay Boulevard Constraint	Imperial, Baja, Non-CREZ within San Diego	On-peak	1,202	2,119	Silvergate - Bay Blvd 230kV 3-ohm Series Reactor (72 months)	$31	2,163*	N/A	N/A	N/A	Wind
San Diego Oceanside Constraint	Non-CREZ within San Diego	On-peak	280	301	Oceanside ADNU (60 months)	$133	280*	N/A	N/A	N/A	Solar
Orange County Area	Non-CREZ within San Diego	None	450*	N/A	N/A	-	450*	N/A	N/A	N/A	N/A
PG&E North of Greater Bay Study Area Constraints											
Rio Oso-SPI-Lincoln 115 kV Line	Rio Oso area within Sacramento River	On-peak	42	54	Rio Oso (74 months)	$18	124*	N/A	N/A	N/A	WInd
Woodland-Davis 115 kV Lines	Davis Area within Sacramento River	On-peak	64	36	Q653-Davis (60 months)	$11	64*	N/A	N/A	N/A	WInd
Cortina -Vaca-Dixon 230kV Line	Sacramento River& Round Mountain	On-peak	454	2,838	Delevan 500kV (144 months)	$3,531	795*	N/A	N/A	N/A	Wind
Humboldt-Trinity 115 kV Line	Humboldt	On-peak	21	57	Humboldt (98 months)	$158	63*	N/A	N/A	N/A	Wind
PG&E Greater Bay Study Area Constraints											
Vierra-Tracy-Kasson 115 kV Line	Kasson Area within Sacramento River	On-peak	149	125	Vierra-Tracy-Kasson 230 kV (62 months)	$15	247*	N/A	N/A	N/A	WInd
Melones-Tulloch 115 kV Line	Melones area within Sacramento River	On-peak	126	46	Melones-Tulloch 230 kV (64 months)	$18	239*	N/A	N/A	N/A	WInd
Contra Costa-Delta Switchyard 230kV Line	Solano & Round Mountain	On-peak	1,523	1,476	Bay Area (CC) (86 months)	$505	1,523*	N/A	N/A	N/A	Wind
PG&E South 500 kV Study Area Constraints											
Gates-Panoche #1 and #2 230kV Lines	Westlands and Carizzo	On-peak, Off-peak	10,830	378	Gates-Panoche #1 and #2 230kV lines (50 months)	$259	10,830*	N/A	Gates-Panoche #1 and #2 230kV lines (50 months)	$259	Solar
PG&E East Kern Study Area Constraints											
Midway – Gates 230kV Line	Kern and Greater Carrizo	On-peak, Off-peak	1,431	3,137	Gates - Arco - Midway 230 kV-Redraw boundary (98 months)	$142	2568*	N/A	Gates - Arco - Midway 230 kV-Redraw boundary (98 months)	$142	Solar
Kern–Lamont-Stockdale 115kV Line	Carrizo	Off-Peak	100*	N/A	N/A	N/A	125	30	Lamont-Stockdale 115kV (74 months)	$84	Solar
PG&E West Kern Study Area Constraints											
Morro Bay-Templeton 230kV Line	Westlands Kern and Carizzo	On-peak, Off-peak	1,708	739	Morro Bay 230 kV (98 months)	$1,248	1903*	N/A	Morro Bay 230 kV (98 months)	$1,248	Solar
PG&E Fresno Study Area Constraints											
Gates 500/230kV Bank #13 Constraint	Westlands, Carrizo and Kern	On-peak, Off-peak	3,151	4,453	Gates TB # 13 ADNU (48 months)	$40	3,279	964	Gates TB # 13 ADNU (48 months)	$40	Solar
Wilson-Storey-Borden #1 & #2 230 kV Lines	Within Westlands	On-peak	113	96	Wilson-Storey-Borden #1 and #2 230kV lines (50months)	$232	816*	N/A	N/A	N/A	Solar
Los Banos 500/230kV TB	Westlands	On-peak	1,127	446	Manining ADNU (72 months)	$370	2,534*	N/A	N/A	N/A	Solar
Tesla-Westley 230kV Line	Los Banos and Central Valley	On-peak	1,098	114	Reconductor Tesla-Westley 230 kV Line (50months)	$90	1,098*	N/A	N/A	N/A	Solar
Moss Landing 500kV	Unconstrained zone	On-peak	1,500*	N/A	None	N/A	1,500*	N/A	N/A	N/A	Solar
Warnerville-Wilson 230kV	Westlands	Off-Peak	272*	N/A	N/A	N/A	737	364	Warnerville-Wilson 230kV (86 months)	$36	Solar
Moss Landing-Las Aguilas 230kV	Los Banos and Central Valley	Off-Peak	316*	N/A	N/A	N/A	-	1,308	Moss Landing-Las Aguilas 230kV (98 month	$48	Solar
Las Aguillas-Panoche #1 and #2 230kV	Los Banos and Central Valley	Off-Peak	334*	N/A	N/A	N/A	516	939	Las Aguillas sw sta-Panoche #1 and #2 230k	$317	Solar
Moss Landing-Los Banos 230kV	Los Banos and Central Valley	Off-Peak	1,611*	N/A	N/A	N/A	3,102	1,822	Moss Landing-Los Banos 230kV (98 months)	$68	Solar
Los Bano-Gates #1 500kV line	Westlands/Los Banos	Off-Peak	1,265*	N/A	N/A	N/A	2,595	2,076	Los Banos-Gates #1 500kV line (98 months)	$640	Solar

* Capability estimate reflects the amount of resources studied in the corresponding deliverability case as binding constraints are not identified

** The transmission capability estimates are based on the resource-type specific output assumptions that are used in deliverbility studies rather than the resources' installed capacity. The values can be translated into any combination of resource types by applying the applicable deliverability study resource output factors.

***The transmission capability estimates are over and above the baseline contracted future resource amounts the CPUC transmitted as part of its resource portfolios for use in the CAISO 2020-2021 TPP. The CPUC will need to adjust the estimates to account for additional resources that have been added to the baseline resource list since then. Retirements of Diablo Canyon and OTC generating units are accounted for in the estimates assuming the replacement resources are at the same or similar locations.

3.1 Sources of transmission capability information

The ISO relies on two key sources of information for developing transmission capability estimates:

1. <u>Generation interconnection process (GIP) studies</u>

   As part of the generation interconnection process, the ISO conducts on-peak and off-peak deliverability assessments of active generation in its interconnection queue. These assessments lead to the identification of deliverability constraints and transmission upgrades along with cost to mitigate the constraints identified.

   GIP studies lend themselves particularly well to development of transmission capability estimates because the amount of active generation in ISO's generation interconnection queue far exceeds the total generation resources that are typically selected as part of the resource portfolios transmitted by the CPUC. Thus, GIP studies reveal transmission constraints that would otherwise not be identified in TPP assessments of the CPUC's resource portfolios. For this reason, the ISO relies on GIP studies as the primary source of information for developing transmission capability estimates.

   The ISO has heavily leveraged deliverability assessments performed using the new deliverability assessment methodology as part of recent generation interconnection studies in producing the transmission capability estimate information. The information obtained from these studies includes the transmission constraints that limit resource development, the locational boundary of resources that contribute to each constraint, the maximum amount of new FCDS and OPDS resources that can be added behind each constraint without and with transmission upgrades along with the scope, cost, and lead time of the transmission upgrades.

2. <u>Transmission Planning Process (TPP) studies</u>

   In each TPP study cycle, the ISO conducts studies that assess whether transmission upgrades or other measures are needed to meet reliability, policy and economic criteria. As part of the policy-driven assessment in the TPP, the ISO assesses the transmission impacts of the base and sensitivity portfolios transmitted by the CPUC. These assessments provide insights into the reliability impact of the portfolios on the transmission system, constraints that would limit portfolio resource deliverability and renewable curtailment observed in production cost simulations. These insights are used as a supplementary source of information in the development of transmission capability estimates.

3.2 Elements of transmission capability estimate information

The information contained in the transmission capability estimates is described in more detail below.

1. <u>Transmission constraints</u>

The transmission capability estimate are primarily based on the on-peak and off-peak area deliverability constraints that are found in GIP studies to limit the deliverability of resources. The constraints are identified in accordance with the deliverability methodology. The transmission capability estimates associated with identified transmission constraints are referred in this paper as "actual" transmission capability estimates.

There are also parts of the system where the amount of resources in the generation interconnection queue was not found to be sufficient to cause on-peak, off-peak or either of the deliverability constraints. In the absence of actual transmission constraints, the amount of resources studied in the corresponding case are provided as "default" transmission capability estimates.

2. Affected zones

   The affected zone information is intended to provide a general idea as to the location of resources that contribute to and will be limited by the transmission constraint. In order to provide more detailed information regarding the parts of the system affected by each constraint, the 100 kV and above point of interconnection (POI) substations that are located inside the boundary of each constraint are identified using substation-line diagrams or lists. The substation-line diagrams and lists are provided as Appendix A in the version of this paper that is posted on the ISO Market Participant Portal (MPP). As can be seen from the diagrams, the resource zones affected by the transmission constraints can be isolated, nested or overlapping.

3. Condition under which constraint is binding

   This information indicates whether the constraint was identified in the on-peak scenario, off-peak scenario, both scenarios or neither scenario. The information determines whether the associated FCDS and EODS transmission capability estimates are actual or default as explained above.

4. Estimated existing system FCDS capability

   The existing system FCDS capability estimates associated with actual on-peak deliverability constraints represent the transmission plan deliverability (TPD) calculated for the constraint in accordance with the on-peak deliverability methodology. ISO-approved transmission upgrades are modeled in the assessment. The amount of resources studied in the on-peak deliverability case are provided as default limits for each off-peak deliverability constraint that is not found to be binding in the on-peak deliverability assessment and for areas in which no deliverability constraint is identified. Default FCDS capability estimates are marked with an asterisk. The FCDS capability estimates are over and above the baseline contracted future resource amounts the CPUC transmitted as part of its resource portfolios for use in the ISO 2020-2021 TPP. Retirements of Diablo Canyon and OTC generating units are accounted for in the estimates assuming the replacement resources are at the same or similar locations.

   Estimated existing system FCDS capability is expressed based on the resource-type specific resource output assumptions used in on-peak deliverability assessment rather than based on installed capacity or Interconnection Service Capacity (ISC). As a result, the FCDS capability estimates are resource-type neutral and can be translated into any combination of resource types by applying the applicable resource output factors. The resource output assumptions used in the on-peak deliverability methodology[3] reflect the transmission capacity various resource types are assumed to take up during the on-peak deliverability assessment hours.

The resource output factors applied for intermittent resources like solar and wind in the Highest System Need (HSN) and Secondary System Need (SSN) scenarios are a fraction of their installed capacity. For new non-intermittent resources, the resource output applied is 100% of the resource's ISC. For energy storage resources, the 4-hour discharging capacity is modeled as the resource's output. The resource output factors currently applied in on-peak deliverability assessments are shown in Table 3.1-1.

Table 3.1-1: Resource output factors used in FCDS capability estimates

Resource type	HSN			SSN		
	SDG&E	SCE	PG&E	SDG&E	SCE	PG&E
Solar	3.00%	10.60%	10.00%	40.20%	42.70%	55.60%
Wind	33.70%	55.70%	66.50%	11.20%	20.80%	16.30%
Non-Intermittent resources	100%					
Energy storage	100% if duration is ≥ 4-hour or 100% if duration is ≥ 4-hour or 4-hour equivalent if duration is < 4-hour					
Hybrid	The lesser of 100% of combined ISC or The lesser of 100% of combined ISC or [(Study amount of storage plus study amount of paired resource)/ISC]					

5. <u>Estimated incremental FCDS capability due to ADNU</u>

GIP cluster study area reports are the primary source of the information for the estimated incremental FCDS capability. The reports include conceptual Area Delivery Network Upgrades (ADNUs) that are needed to mitigate area deliverability constraints identified in the study along with an estimate of the incremental deliverable capacity provided by each ADNU. The incremental FCDS estimate reflects the incremental amount of additional queued generation behind the constraint that could be made deliverable by the identified ADNU. Incremental FCDS capability is not provided for areas with default existing system FCDS limits where on-peak deliverability constraints are not identified.

Like existing system FCDS capability, incremental FCDS capability is expressed based on the resource output assumptions used in on-peak deliverability assessment shown in Table 3.1-1 above.

6. <u>Description of ADNU</u>

A description of the ADNU, which is the basis for the incremental FCDS capability, is included as part of the transmission capability estimate information to enable the CPUC to identify ADNUs that are also identified to increase EODS capability and thereby avoid the possibility of double counting

[3] http://www.caiso.com/Documents/On-PeakDeliverabilityAssessmentMethodology.pdf

transmission upgrade cost. The information also includes time to construct for each ADNU that can be used to determine when the associated incremental capacity can become available.

7. ADNU cost estimate

   The ADNU cost information along with the incremental FCDS capability will allow the CPUC to co-optimize resource and transmission by enabling it to evaluate the trade-off between limiting the amount of FCDS resources to within the existing system capability versus selecting resources beyond the existing system capability and triggering the additional transmission cost. The costs estimates are escalated to the year of commercial operation.

8. Estimated existing system EODS capability

   The EODS constraints and the associated existing system EODS capability estimates are determined based on the off-peak deliverability methodology[4]. The off-peak deliverability methodology was developed to ensure some minimal level of protection for renewable generation from otherwise potentially unlimited curtailment. By definition, off-peak deliverability constraints and the associated transmission capability limits derived using the off-peak deliverability methodology represent the limits on the amount of renewable resources beyond which curtailment would become excessive and potentially trigger transmission upgrades. As such, off-peak deliverability limits are used as the basis for EODS capability estimates.

   Actual existing system EODS capability estimates are calculated for the off-peak constraints identified in GIP reports using data and results from the study. ISO-approved transmission upgrades are modeled in the assessment. For on-peak deliverability constraints that are not found to be binding in the off-peak deliverability assessment and for areas where no deliverability constraint is identified, the amount of resources studied in the off-peak deliverability assessment are provided as default EODS capability estimates. Default EODS capability estimates are marked with an asterisk. While an actual EODS capability estimate for a constraint is allowed to be less than the FCDS capability estimate for the constraint, default EODS estimates are adjusted to equal the FCDS capability estimate to prevent default EODS estimates from unduly restricting the amount of FCDS resources that can be selected. Actual EODS capability can be less than the corresponding FCDS capability when there is a large amount of baseline renewable generation or load and no thermal and hydro generators behind the constraint. Default EODS capability can also be less than the corresponding FCDS capability when there is a large amount of queued energy storage behind the constraint.

   Like the FCDS capability estimates, the EODS capability estimates are over and above the baseline contracted future resource amounts the CPUC transmitted as part of its resource portfolios for use in the ISO 2020-2021 TPP. Energy storage increases EODS capability as it is dispatched in charging mode to address off-peak deliverability constraints. In order to avoid overestimating EODS capability, only existing and contracted energy storage resources are used in the assessment of EODS capability.

[4] http://www.caiso.com/Documents/Off-PeakDeliverabilityAssessmentMethodology.pdf

The existing system EODS capability estimates are expressed based on the resource output assumptions used in off-peak deliverability assessments rather than based on installed capacity or ISC. Table 3.1-2 provides resource output factors currently applied in off-peak deliverability assessments. The solar and wind resource output factors vary depending on whether the resources in the study area are predominantly wind or solar resources.

Table 3.1-2: Resource output factors used in EODS capability estimates

Resource type	Wind Area			Solar Area		
	SDG&E	SCE	PG&E	SDG&E	SCE	PG&E
Solar	68%			79%	77%	79%
Wind	69%	64%	63%	44%		
Hydro	30%					
Thermal	0%[5]					
Energy storage	100% in charging mode if duration is ≥ 4-hour or 4-hour equivalent if duration is less than 4-hour[6]					

9. Estimated incremental EODS capability due to AOPNU

GIP cluster study area reports are the primary source of the information for the estimated incremental EODS capability. The reports include conceptual Area Off-Peak Network Upgrades (AOPNUs) that are needed to mitigate area off-peak deliverability constraints identified in the study, which can be the same as the ADNUs that are identified to mitigate on-peak constraints. The incremental EODS capability estimate reflects the incremental amount of queued generation behind the constraint that can be accommodated by the identified AOPNU. The actual incremental EODS capability may be higher. Incremental EODS capability is not provided for areas with default existing system EODS limits where off-peak deliverability constraints are not identified.

Like existing system EODS capability, incremental EODS capability is expressed based on the resource output assumptions used in off-peak deliverability assessment as shown in Table 3.1-2.

10. Description of AOPNU

A description of the AOPNU, which is the basis for the incremental EODS capability provided, is included as part of the transmission capability estimate information to enable the CPUC to identify AOPNUs that also increase FCDS capability and thereby avoid the possibility of double counting transmission upgrade cost. The information also includes the estimated time to construct for each AOPNU that can be used to determine when the associated incremental capacity can become available.

11. AOPNU cost estimate

[5] Thermal resources are initially dispatched at 15% in off-peak deliverability assessments but can be reduced to 0% to mitigate constraints

[6] Energy storage is initially initially swiched off in off-peak deliverability assessments but can be dispatched incharging mode at 100% of its capacity if duration is ≥ 4-hour or 4-hour equivalent capacity if duration is less than 4-hour to mitigate constraints.

The estimated AOPNU cost provided along with the incremental EODS capability will allow the CPUC to co-optimize resource and transmission by enabling it to evaluate the trade-off between limiting the amount of EODS resources to within the existing system capability versus selecting resources beyond the existing system capability and triggering the additional transmission cost. The costs estimates are escalated to the year of commercial operation.

12. Designation as Wind Area or Solar Area

The transmission capability estimate information includes the designation of constrained areas as Wind Area or Solar Area in accordance with the off-peak deliverability methodology. The information indicates which wind and solar resource output factors from Table 3.1-2 are applied in the existing system and incremental EODS capability estimates. The same factors should be applied to implement the EODS capability estimates in RESOLVE.

4 Implementation of transmission capability estimates in IRP

This section provides the ISO's thinking, which has been discussed with the CPUC, as to how the transmission capability limits provided in this paper may be implemented in RESOLVE, the busbar mapping process and when making any desired manual adjustments to the resulting resource portfolios.

The CPUC may adjust the implementation approach proposed in this white paper due to practical limitations or other reasons in consultation with the ISO.

4.1 Representation of constraints as linear expressions

As explained in the previous sections, all of the transmission capability estimates provided in this white paper are expressed based on the applicable resource-type specific output assumptions used in deliverability assessments as described in Table 3.1-1 and Table 3.1-2 rather than on the basis of installed capacity or ISC. As a result, the transmission capability estimates are resource-type neutral and can be translated into any combination of resource types by applying the respective deliverability study resource output factors. On the other hand, implementing the transmission capability estimates based on installed capacity allows different resource types with the same installed capacity to take up the same transmission headroom during resource optimization, despite resource-type specific deliverability capacity factors being applied in deliverability studies that are used to develop the transmission capability estimates.

In order to align the implementation of transmission capability estimates with the deliverability assessment methodology, the FCDS and EODS transmission capability estimates provided can be implemented using three linear expressions for each constraint. In the linear expressions, the capacities of the various resource types selected by RESOLVE are the variables and the applicable resource output factors are the coefficients as described further below.

1. Implementation of FCDS capability estimates

In order to ensure FCDS resources selected in IRP portfolios do not exceed on-peak deliverability constraints both in the HSN and SSN scenarios, each FCDS capability estimate can be implemented using the two linear expression shown below.

HSN Scenario

*FCDS capability estimate ≥ Sum of the capacity of each resource type selected * respective resource output factor for the HSN scenario*

SSN Scenario

*FCDS capability estimate ≥ Sum of the capacity of each resource type selected * respective resource output factor for the SSN scenario*

Where FCDS capability estimate is the existing system FCDS capability estimate or the existing system FCDS capability plus the incremental FCDS capability due to ADNU.

2. Implementation of EODS capability estimates

Each EODS capability estimate can be implemented using the linear expression below.

*EODS capability estimate ≥ Sum of the capacity of each non-storage resource type selected * respective resource output factor for EODS estimates – Storage capacity selected (or 4-hour equivalent if duration is less than 4-hours)*

Where EODS capability estimate is the existing system EODS capability estimate or the existing system EODS capability plus the incremental EODS capability due to ADNU or AOPNU and the resource output factors for wind and solar are consistent with the designation of the constrained area as Solar Area or Wind Area.

Energy storage selected is subtracted from the right hand side of the expression because it increases EODS capability since it is dispatched in charging mode to address off-peak deliverability constraints.

4.2 Baseline reconciliation

As noted earlier, the transmission capability estimates are over and above the baseline contracted future resource amounts the CPUC transmitted as part of its resource portfolios for use in the ISO 2020-2021 TPP. The CPUC will need to adjust the estimates to account for additional resources that have been added to the baseline resource list since then. The respective resource output factors should be applied when adjusting the FCDS and EODS capability estimates.

Appendix A

Constraint Boundary Definitions

Confidential – Subject to Transmission Planning NDA
Document available on ISO Market Participant Portal[7]

[7] Market Participant Portal>Transmission Capability>2021