2011 CTPG Final Study Plan

September 19, 2011

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1 Introduction

The California Transmission Planning Group (CTPG) is a forum for conducting joint transmission planning studies consistent with Federal Energy Regulatory Commission (FERC) Order 890 principles and for coordinating CTPG members' transmission planning activities. The CTPG members include both transmission owners and operators who are subject to North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) transmission planning standards. The primary objective of CTPG has been to provide a foundation for a statewide transmission plan that identifies the transmission infrastructure needed to reliably meet California's 33% Renewable Portfolio Standard (RPS) goal by the year 2020.

An important qualification is that CTPG is not a transmission or generation project decision making body. The CTPG members that are planning entities for their Balancing Authority Areas (BAA) will make such decisions. The statewide plan is intended to be conceptual rather than prescriptive, in keeping with CTPG's purpose. As such, the CTPG regularly requests and consolidates information on renewable projects from its members and state agencies to develop a likely snapshot of California's generation portfolio at some future time. This snapshot is then studied to identify regional transmission issues and propose potential transmission infrastructure additions that address those issues.

The CTPG, with the assistance of stakeholders in 2010, developed a California Transmission Plan (2010 Plan) for consideration by the state BAA's and other decision makers. For the 2011 Plan the CTPG will continue to review the appropriate categorization of the "high" and "medium" potential transmission upgrades identified in the 2010 Plan and determine if changes to this categorization are in order. The CTPG will determine if there are new renewable resource locations within or outside the state that have high development interest and whether to study different renewable resource development patterns. If new resource development patterns emerge, the CTPG will determine if these patterns give rise to potential reliability criteria violations and, to the extent not previously identified, select new transmission infrastructure additions that mitigate those violations. The CTPG may also consider whether new patterns of renewable resource development would make previously detected reliability criteria violations unlikely, thereby eliminating the need for the associated mitigation.

The 2011 Plan will be developed in three phases. Phase 1 will consist of developing detailed study assumptions used in the transmission planning studies. In Phase 2, transmission planning studies will be performed for the scenarios and assumptions documented in this study plan. The study results will be used to refine the determination of "high" and "medium" potential transmission upgrades. The 2011 Plan that emerges from Phase 3 will include updates from the different BAAs on their respective transmission plans, lessons learned in 2011 and a proposed work plan for 2012.

2 Scenarios

CTPG recognizes the inherent uncertainty in any renewable generation portfolio described for 2020. For this reason, the CTPG will develop its 2011 Plan from the nine different scenarios described herein. These scenarios investigate various means by which renewable resources will be made available to California load-serving entities for purposes of meeting their 33% RPS requirement. Table 1 summarizes each scenario providing the season, path flow and composition of the renewable resources to reach the renewable target. All scenarios will add 44.85 TWh of renewable resources to reach the 33% target; this energy amount is described throughout the study plan as the “Net Short”. The CPUC/POU Discounted Core, California’s Renewable Energy Transmission Initiative (RETI) Best California CREZ (Competitive Renewable Energy Zones) and renewable resources unique to the scenario is described in more detail in Section 6. The transmission path stress targets and flow on the major paths of California for each scenario prior to the addition and dispatch of the Net Short is provided in Section 3.7. The load modeled for each season is presented in Section 3.2.

The study plan refers to three types of cases: seed cases, foundation cases, stress cases. A seed case, oftentimes referred to as a base case, is a projected snapshot of the WECC power grid for a particular season-year. WECC posts these cases, created jointly by its members, to facilitate transmission planning within WECC. A foundation case is a seed case that has been validated and updated with new information, recognizing that some time has lapsed since WECC approved and made available its study case. Finally, a stress case modifies a foundation case by redirecting path flows to test specific power system limitations. Section 3 describes the three types of cases in greater detail.

Pacific Northwest Import

Two Pacific Northwest Import scenarios will show the impact of delivery of increased amounts of wind and hydroelectric generation from the Pacific Northwest into California. The emphasis on northern imports presents an alternative to the scenarios considering the majority of new renewable resources would come from Southern California and/or the Desert Southwest. The scenarios model approximately 2,500 MW of existing and planned wind capacity “shaped” by small hydroelectric resources for an overall wind capacity factor of approximately 50%. Spring run-offs increase the utilization of large hydroelectric resources; for this reason, close to 80% of installed capacity is assumed to be utilized. This scenario also includes a new discounted core and RETI Best CREZ resources located in California. Two scenarios will be examined with this import assumption, one will model stressed flows (north to south) on the California – Oregon Intertie (COI) and the other will utilize the foundation case. The foundation case is generally the WECC generation dispatch present in the WECC seed case; i.e., in the foundation cases selected paths are not “stressed” prior to adding the new renewable resources.

Northwest Nevada Import

Two Northwest Nevada Import scenarios focus on the delivery of new wind, geothermal, and solar resources located in Northwest Nevada and Northeastern California during summer peak load condition. With 750MW of geothermal generation from Northwest Nevada and 200MW of wind and 50MW of solar injected from Northeast California, these scenarios are another set of northern import alternatives. This scenario also includes a new discounted core and RETI Best CREZ resources located in California. Like the Pacific Northwest Import scenarios, one Northwest Nevada Import scenario will model a stressed southerly flow along COI and the other will be a foundation case utilizing the flows provided in WECC's summer case.

South to North Flow

This scenario will seek to identify any potential reliability criteria violations during a lightly loaded fall morning with high wind and morning solar generation in southern California. The scenario also includes a new discounted core and RETI Best CREZ renewable resources located in California. The South to North Flow scenario will be examined using the foundation case under fall conditions. Paths 15 and 26 in central California will flow south to north at typical historical fall morning values prior to the dispatch of the Net Short.

California Public Utilities Commission (CPUC) Public Policy Resource Portfolio

Incorporating updated assumptions for its 33% RPS Calculator model, the CPUC revised its "Cost Constrained" 33% RPS scenario from last year. The updated assumptions include an additional 1,384 MW of small-scale solar PV, and revisions to assumed transmission capabilities and costs in certain areas based largely on the California Independent System Operator (CAISO) Board-approved 2010/2011 Transmission Plan. The CPUC Public Policy Resource portfolio contains a total of 17,364 MW of newly installed renewable generating capacity. This includes 2,436 MW of distributed generation located within California and 4,337 MW of central station renewables located outside of California. The CPUC Public Policy Resource portfolio represents 54,269 GWh of new renewable energy sources. This portfolio will be scaled down to match the CEC staff's updated renewable net short of 46,974 GWh. The following table provides a list of resources which are considered anchor resources and are not scaled down. Also note that this scenario differs from the resource portfolio sent by the CPUC to the CAISO on June 6, 2011. The column title "June 6 Transmittal" shows the resource assumption provided to the CAISO.

CPUC Public Policy	June 6 Transmittal	Type & Location
230 MW	0 MW	solar PV in Fairmont CREZ
250 MW	62 MW	solar thermal in Kramer CREZ
500 MW	275 MW	solar thermal in Pisgah CREZ
642 MW	492 MW	solar thermal in Riverside East CREZ
82.5 MW	0 MW	wind in Santa Barbara CREZ
516 MW	450 MW	wind in Alberta
97 MW	103 MW	wind in Imperial CREZ
1247 MW	1273 MW	geothermal in Imperial CREZ
939 MW	1246 MW	distributed solar PV in SCE
1391 MW	1030 MW	distributed solar PV in PG&E
104 MW	160 MW	distributed solar PV in SDG&E

As a modeling convenience, the CTPG is treating its estimate of impacts from the CPUC-approved distribution-level small-scale solar PV additions as a reduction to the CEC staff's updated renewable net short. This modeling results in a CTPG renewable Net Short of 44,852

GWh which is used in all of CTPG's scenarios.[1] This scenario will be examined using the foundation case under summer peak conditions.

Central California

The Westlands CREZ and central California have large areas of disturbed land where renewable development is expected to have low adverse environmental impact and therefore a higher likelihood of development. This scenario will use the existing CAISO queue for proposed resources in central California. These resources will include 4,916MW of solar photovoltaic resources, 103MW of wind resources, and 8MW of Bio resources. These amounts are based upon the assumption that 50% of the proposed renewable energy projects in the CAISO queue are developed. For modeling purposes renewable power will be injected at the Panoche, Gates and Midway substations. This scenario will be examined using the foundation case under summer peak conditions.

West of River (WOR) Import

The WOR Import scenarios build upon work completed by CTPG in 2010. It assumes a relatively high level of new renewable resources developed outside of California resulting in a large increase of energy that is delivered to California from southern Nevada and western Arizona. These scenarios will test the import capability of the WOR transmission path during fall morning load conditions. Historically, flows on the WOR path peak during low load periods when lower cost energy is available for import into southern California. With low loads and high renewable imports, fossil-fired generation within California may be reduced relative to historical levels. WOR path flows will be set at the maximum level measured during 2010 with flows east to west prior to the addition of renewable resources. Two injection amounts will be examined; one scenario with injections at Eldorado (50%), Palo Verde (37.5%) and North Gila (12.5%) should stress the northern WOR system; the other scenario with injections at Palo Verde (50%), Eldorado (37.5%) and North Gila (12.5%) should stress the southern WOR system.

[1] The CPUC's net short estimate for year 2020 reflects renewable resource additions needed to meet California's 33% RPS requirement assuming (i) forecast retail loads included in the CEC's 2009 Integrated Energy Policy Report (IEPR), and (ii) renewable resources "existing" as of 2009. CTPG's Net Short estimate for year 2020 uses the CEC's staff's May 2011 load forecast update and renewable resources "existing" as of 12/31/2011.

Table 1: Scenarios

No.	Name	Description	Season Date Time	Path Flow	Net Short Renewable Resources
1	Pacific Northwest Import	Wind imports from Pacific Northwest combined with hydro runoff.	spring (early June, 5 PM)	stress COI (n-s)	CPUC/POU Discounted Core Out of State RETI Best CA CREZs
2				foundation[1]	
3	Northwest Nevada Import	Geothermal from Nevada & wind and solar from Northern California.	summer peak (July 4PM)	stress COI (n-s)	CPUC/POU Discounted Core Out of State RETI Best CA CREZs
4				foundation[1]	
5	South to North Flow	Determine transmission needs required during this time period generally characterized as light load with significant wind and morning solar generation. Paths 15 & 26 flows are south to north.	fall (Sep 9 AM)	foundation[1]	CPUC/POU Discounted Core RETI Best CA CREZs
6	CPUC Public Policy	Updates cost constrained scenario: includes Eldorado-Ivanpah, 1,384 MW of DG, 25% of 2020 RPS is out of state and projects from CAISO 2010/11 Transmission Plan.	summer peak (July 4PM)	foundation[1]	CPUC/POU Discounted Core CPUC Public Policy
7	Central California	Large development of disturbed land with low enviromental impact. Inject power at Panoche, Gates and Midway.	summer peak (July 4PM)	foundation[1]	CPUC/POU Discounted Core Central California gen queue RETI Best CA CREZs
8	West of River Import	High wind & solar imports from Wyoming, Utah, Nevada and Arizona to stress WOR. Inject power at Eldorado (50%), Palo Verde (37%) and N. Gila (13%).	fall (Sep 9 AM)	stress WOR (e-w)	CPUC/POU Discounted Core Out of State RETI Best CA CREZs
9		Same as above, except inject power at Eldorado (37%), Palo Verde (50%) and N. Gila (13%).			

Net Short of 44.85 TWh for all scenarios.

1. The foundation cases represent the generation dispatch pattern present in the WECC seed cases; i.e., in the foundation cases paths are not "stressed" prior to addition of the Net Short renewable resources.

3 Case Development

3.1 Overview

The CTPG obtained from WECC's case library the latest summer, spring and autumn cases to build the nine scenarios. These seed cases were selected as containing the most current detailed models of the entire WECC interconnected system with the appropriate seasons pertinent to this study. These cases are WECC full-loop representations and include the western United States, western Canada and the system of Comisión Federal de Electricidad (CFE) in Baja California, Mexico.

The following section provides the step-by-step verifications, updates and modifications of the WECC seed cases to create a scenario specific case for study. The creation of the seasonal, foundation and stressed path cases is the result of the completion of Step 0. The summer seed case is the basis for Scenarios 3, 4, 6 and 7. Scenarios 1 and 2 will be created from the spring seed case. The fall cases of Scenarios 5, 8 and 9 will be created from the autumn seed case. Step 1 will model the renewables (generation and associated transmission) as required for each scenario. The renewable generation will be modeled at zero output. Step 2 completes the scenarios by dispatching the renewables. At the end of each step, a contingency analysis will be performed to determine if reliability criteria has been met.

Step 0: Develop Foundation & Stress Path Cases

- Verify and update existing renewable generation
- Model implementation plans of Once-Through Cooling generation plants
- Verify and update all transmission projects which have Balancing Authority approvals
- Update to latest California Energy Commission 2020 load:
  - Summer peak
  - Spring
  - Fall
- Dispatch Paths:
  - Foundation - ensure all paths are within limits
  - Stress COI (n-s)
  - Stress WOR (e-w)
- Perform contingency analysis to confirm reliability criteria is met

Step 1: Add Renewable Projects

- Model renewable projects, generation and associated transmission such as gen-ties and collector systems, as required by scenario
- Renewable generation modeled at 0 MW output
- Perform contingency analysis to confirm reliability criteria is met

Step 2: Dispatch Renewables

- Dispatch renewable projects to anticipated output for each scenario
- Decrease fossil generation to balance renewable increase
- Perform contingency analysis to confirm reliability criteria is met
- Where reliability criteria violations are found, identify transmission infrastructure additions that mitigate the violations

3.2 Load Forecast

Table 2 shows the 2020 summer peak, spring and fall forecasts. The summer peak assumes a northern California 1-in-10 year peak demand coincident with a southern California 1-in-2 year peak demand. The spring and fall conditions are modeled at approximately 65% of summer peak. Starting with the CEC staff's May 2011 forecast peak demands CTPG elected to include 25% of the incremental energy efficiency, incremental Combined Heat and Power (CHP), and other incremental behind-the-load-meter distributed generation (e.g., rooftop solar PV additions) in reducing the peak demand. This forecast was then further reduced by:

- pump loads

- the projected impact of existing in-front-of-the-load-meter distributed generation (e.g., digester and landfill gas, small hydro, wholesale PV and other small capacity generation)[2]
- the assumed impact from the Investor Owned Utilities' CPUC approved in-front-of-the-load-meter solar PV programs
- forecast transmission losses (since the power flow program determines transmission losses based on the simulated power flows)

Table 2: 2020 Demand (MW) Based On CEC May 2011 Forecast

AREA		SUMMER PEAK (MW)				SPRING (MW)				FALL (MW)			
NO.	NAME	LOAD	PUMPS	LOSSES	TOTAL	LOAD	PUMPS	LOSSES	TOTAL	LOAD	PUMPS	LOSSES	TOTAL
30	PG&E*	31,238	256	1,194	32,688	19,256	394	790	20,440	18,719	537	518	19,774
24	SCE	24,978	191	396	25,565	16,176	1,069	315	17,560	16,236		278	16,514
22	SDG&E	4,812	-	88	4,900	3,392	-	48	3,440	3,128	940	55	4,123
26	LADWP	6,563	-	413	6,976	5,437	-	319	5,756	5,802		298	6,100
21	IID	1,261	-	63	1,323	974	-	37	1,011	531		25	556
Total		68,852	447	2,154	71,452	45,235	1,463	1,509	48,207	44,416	1,477	1,174	47,067

* Includes SMUD & TID

3.3 Planned Transmission Projects

All scenarios will include transmission projects that have been approved by their applicable Balancing Authority. A list of the significant transmission projects included in the nine scenarios is provided in Table 3.

Table 3: Balancing Authority Approved Transmission Projects

Project Name	Area:
COI 4800 Project	BPA
Little Goose Reinforcement Project	
West of McNary Reinforcement Project	
I-5 Corridor Reinforcement Project	
Imperial Valley-Dixieland 230 kV line	IID
Coachella Valley Substation to Mirage Substation (Path 42) double circuit 230 kV line reconductoring. (Path 42 Upgrade 1600 MW).	
El Centro Switching Station (ECSS) to Highline Station double circuit 230 kV transmission project.	
IV Sub to IID IV Sub and IID IV Sub to ECSS 230 kV transmission project.	
Path 42 upgrade to 800 MW	
Encina - Penasquitos 230 kV #2	SDG&E
Sunrise Powerlink	
HLSP1, HLSP2	LADWP
BCON18G	
SODMTGEN	
Barren Ridge - Haskell 230 kV (Barren Ridge Renewable Transmission Project Phase I)	
Barren Ridge - Rinaldi 230 kV upgrade (Barren Ridge Renewable Transmiission Project Phase II)	

[2] The impacts of behind-the-load-meter distributed generation are reflected in the forecast loads modeled in the power flow program.

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Project Name	Area:
Eldorado-Ivanpah Transmission Project (EITP)	SCE
Red Bluff Substation 500/230kV	
New Pisgah 500kV Sub, New Lugo-Pisgah 500kV T/L, Loop existing Eldorado-Lugo 500kV T/L	
Devers - Mirage 115 kV system Split	
Devers - Coachella valley 230 kV line loop	
San Joaquin Cross Loop	
Devers - Palo Verde 500 kV Transmission Line (DPV2)	
Rancho Vista 500/230 kV substation	
Mira Loma 500 kV shunt Capacitors	
Wildlife (formerly Jurupa) 230 kV substation	
Third A-Bank and rebuild of the 115 kV switch Rack at Victor Substation Phase 1	
Tehachapi Renewable Transmission Project	
Inland Empire Energy Center	
NRG El Segundo	
EME Walnut Creek	
Blythe Energy I Project	
T1058: San Benito Transmission Work (was San Justo Substation Interconnection)	PG&E
T1177: Natividad Substation Installation	
T970A: Crazy Horse Switching Station	
T1005: Sanger – Reedley 70 kV to 115 kV Conversion	
T854: Metcalf – Evergreen 115 kV	
T1173: Santa Cruz 115 kV Reinforcement	
T1003: Herndon 230/115 kV Transformer	
T1196: Morro Bay 230/115 kV Transformer Addition Project	
T1091: Tri-Valley Voltage Control	
T994: Lakeville – Ignacio #2 230 kV Line	
T258A: Gregg 230 kV Reactor	
T1120: Shepherd Substation Interconnection	
T759C: Atlantic – Lincoln Transmission	
T1042: Sanger – California Ave 70 kV to 115 kV Conversion	
T947: Hollister 115 kV Reconductoring	
T984: Pittsburg – Tesla 230 kV Reconductoring	
T1195: Ashlan-Gregg and Ashlan-Herndon 230 kV Line Reconductor	
T991: Contra Costa – Moraga 230 kV Line Reconductoring	
T1090: Midway – Renfro 115 kV Line Reconductor	
T1182: Mountain View/Whisman–Monta Vista 115 kV Reconductoring	
T982: Newark – Ravenswood 230 kV Line	
T197B: Ignacio – San Rafael and Ignacio – Las Gallinas 115 kV Reconductoring	
T986: Woodward 115 kV Reinforcement	
T444C: Missouri Flat – Gold Hill 115 kV Line	
T686A : Palermo – Rio Oso 115 kV Line Reconductoring	
T1040: Ravenswood – Cooley Landing 115 kV Reconductor	
T920A: South of San Mateo Capacity Increase	
T967: Tesla 115 kV Capacity Increase	
T249: Bay Meadows 115 kV Reconductoring	
T444D: Gold Hill - Horseshoe 115 kV Reinforcement	
T603B: Vaca Dixon-Lakeville 230 kV Reconductoring	
T1055: Stone Substation Capacity Increase	
T1127: Evergreen - Mabury 60 kV to 115 kV Conversion	
T1092: Occidental of Elk Hills 230 kV Interconnection	
T990: Moraga Transformer Capacity Increase	
T985B: Rio Oso 230/115 kV Transformer Upgrades	
T1214: Pit 3 - Pit 1 and Pit 3 - Round Mountain 230 kV Line Relays Replacement	
T1030: Table Mountain – Rio Oso 230 kV Reconductor and Tower Raises	

3.4 Existing Renewable Generation

The objective of this effort was to assure that the WECC seed cases used for the CTPG 2011 studies accurately modeled the types, amounts and locations of existing renewable energy resources located within California or directly interconnected with the California grid that were in-service as of December 31, 2010. A summary of such existing renewable generation in-service by resource type obtained from CEC draft QFER data as of early-April 2011 is provided in Table 4. With the assistance of the CTPG membership, the WECC seed cases were reviewed to identify which of the various units/plants were explicitly modeled in the seed cases and which were "load netted" and to determine if there were units/plants listed in the CEC data that needed to be added to the seed cases. The data obtained from this review was used to prepare change files to update the 2020 seed cases to include those units/plants that should be explicitly modeled.

Table 4: Existing In-State Renewable Generation as Of December 2010

Resource Type	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants
Interconnected With California Grid			
Biomass	1,025	5.65	121
Geothermal	2,687	13.11	68
Small Hydro	1,169	4.18	210
Solar	429	0.91	21
Wind [3]	3,019	4.80	96
Total	8,329	28.65	516
Interconnected With Other Systems			
Biomass	20	0.04	1
Small Hydro	65	0.25	5
Total	85	0.29	6
Total Existing Renewables			
Biomass	1,045	5.69	122
Geothermal	2,687	13.11	68
Small Hydro	1,234	4.43	215
Solar	429	0.91	21
Wind	3,019	4.80	96
Total	8,414	28.94	522

The data in Table 4 indicates that, on an annual basis, the capacity factor for the existing wind generation would be approximately 18% which would be expected if the entire amount of wind capacity was not in-service for the entire year. Review of the CEC QFER data indicates that approximately 840 MW of wind generation (approximately 28% of the total amount in service at the end of 2010) was added during the year. If it was assumed that the full 3,019 MW of wind

[3] CEC data did not include information as to the number of wind plants in service as of the end of 2010

capacity had been in-service for all of 2010 and that the annual capacity factor of the installed wind generation was 30%, the total wind generation during the year would have been approximately 7.9 GWH (an increase of about 3.1 GWH from the amount in Table 4). As a result, the total energy in Table 4 would increase to approximately 32 TWH.

In addition to the above existing in-state renewable generation, CEC reports indicate that in 2009 approximately 5.8 TWh of renewable generation utilized within California was located out-of-state. However, because no detail has been provided as to the location of these resources, the CTPG cannot, at this time, verify the existence of these facilities in the 2020 seed cases. Verifying that these facilities are modeled in the 2020 seed cases throughout the entire WECC would be a significant effort. The CTPG believes that, due to the accuracy of modeling of in-state resources, it is likely the out-of-state resources are also in the seed cases. Regardless, the CTPG 2011 Net Short accounted for these resources.

Also, in addition to the in-state and out-of-state renewable resources, the CEC identified approximately 4.6 TWh of renewable generation that is expected to be in-service by the end of 2011. The CTPG could not verify that all of these facilities were modeled in the base case. However, the CTPG believes that these facilities are also likely in the seed cases due to the accuracy of the modeled facilities prior to 2010. In the event the facilities expected to be completed this year are not currently modeled in the seed cases, it is expected these facilities will likely be inserted with the inclusion of the CPUC/POU discounted core since the core resources most accurately reflects the procurement plans of the state as of 2010.

Table 5 presents information regarding the capacity, annual energy, and number of units/plants by resource type which were identified as being explicitly modeled in the base cases (and interconnected with the California grid) or which were identified as being netted against the load at the pertinent high voltage busses.

Table 5 – Summary of Modeled and Load Netted Resources

Resource Type	Modeled Units			"Load Netted" Units		
	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants	Capacity (MW)	2010 Energy (TWH)	No. of Units/ Plants
Biomass	846	4.73	50	179	0.92	71
Small Hydro	906	3.28	122	263	0.90	88
Solar	406	0.89	10	23	0.02	11
Total	2,158	8.90	182	465	1.84	170

As shown in Table 5, the total number of explicitly modeled biomass, small hydro, and solar units interconnected with the California grid is only slightly larger than the number of facilities that are load-netted. However, approximately 82% of the total capacity associated with the biomass, small hydro, and solar plants/units that are interconnected with the California grid is explicitly modeled in the base cases.

Table 6 presents information regarding the number and associated installed capacity of units/plants that were added to the three WECC seed cases as a result of the effort discussed above.

Table 6 – Summary of Units Added to Seed Cases

Resource Type	Summer Case		Spring & Fall Cases	
	Number of Units Added	Capacity Added MW)	Number of Units Added	Capacity Added MW)
Biomass	0	0	0	0
Geothermal	0	0	0	0
Small Hydro [4]	5	13	5	13
Solar [5]	1	5	1	5
Wind [6]	0	0	5	103
Total	6	18	11	121

When the small hydro and solar units were added to the data sets their status was set to "1" such that they were modeled as being on-line. However, the status of the wind units was set to "0" so as to match the "off-line" status of a majority of the existing wind units in the data sets.

Table 7 – Comparison of CEC Data and "As Modeled" Data

Resource Type	Per CEC Data		In Data Sets	
	Capacity (MW)	N0. of Units/ Plants	Capacity (MW)	N0. of Units
"Modeled" Units				
Biomass	846	50	837	48
Geothermal	2,687	68	2,757	58
Small Hydro	906	122	952	105
Solar	406	10	390	10
Wind	3,019	96	3,024	96
Subtotal	7,864	346	7,960	317
"Load-Netted" Units				
Biomass	179	71		
Small Hydro	263	88		
Solar	23	11		
Subtotal	465	170		
Total	8,329	516		

[4] Units added to LADWP system in Owens Gorge area
[5] "Cal-Renew" unit added to PG&E system
[6] Hatchet Ridge project units added in spring case

Table 7 presents information comparing the capacity and number of units/plants by resource type interconnected to the California grid as presented in the CEC data to what was modeled in the seed cases after being modified to include the units shown in Table 6.

As shown in Table 7 there are some differences between the number of units/plants contained in the CEC list to the number of units explicitly modeled in the seed cases. These differences are due to how various units/plants were "aggregated" in the CEC data compared to how they are modeled in the powerflow data. In addition, as shown in Table 7, the installed capacity of the "modeled" units in the powerflow data sets is about 95 MW (1.2%) higher than the capacity values from the CEC data. It is the CTPG's opinion that the modeling of the existing renewables (both with respect to the number of units and installed capacity) in the modified seed cases accurately reflects the information in the CEC data.

Review of the three seed cases (modified to add the resources summarized in Table 6) also indicated that a number of the existing renewable units/plants were modeled as "off-line". Table 8 summarizes these findings for the three cases. Review of the information in Table 8 indicates that in the "final" seed cases, the status of a number of units (particularly wind) will need to be changed so that these units are on-line in subsequent studies. The capacity modeled for these units (plus those already on-line) will also need to be adjusted, as appropriate, to be reflective of the seasonal/time-of-day conditions modeled in each of the various Scenarios discussed above.

Table 8 – Comparison of Total Units to "On-Line" Units

	Summer Case		Spring & Fall Cases	
	Total No. of Units	No. of On-line Units	Total No. of Units	No. of On-line Units
Biomass	48	44	48	43
Geothermal	58	56	58	54
Small Hydro	105	86	105	81
Solar	10	10	10	10
Wind	96	43	96	9
Total	317	239	317	197

3.5 Fossil Generation Updates

The WECC seed cases were updated to reflect current information regarding the status of fossil generation units. The following fossil plants were added to the seed cases to reflect recently awarded power purchase agreements (PPAs).

PG&E Area:
Marsh Landing, 774 MW by 2013
Oakley, 672 MW by 2016
Mariposa, 200 MW by 2013
GWF Tracy Expansion, 150 MW addition by 2012
Los Esteros Expansion, 120 MW addition by 2013

SDG&E Area:
Pio Pico (304.8 MW) (LMS100)
Escondido Energy Center (repower an old gas turbine) (45 MW) (LM6000)
Quail Brush ("Cogentrix") (99.8 MW) (gas-fired Wartsilla reciprocating engines)

3.6 Once-Through Cooling (OTC)

On May 4, 2010, the State Water Resources Control Board adopted a Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling under Resolution No. 2010-0020. Plant owners/operators were required to submit implementation plans on April 1, 2011 to the Statewide Advisory Committee on Cooling Water Intake Structures. Where possible the CTPG will use information from the public implementation plans. Three of the 17 OTC plants have shut down or re-powered. The remaining 14 plants submitted implementation plans. Diablo Canyon and San Onofre will be modeled as base loaded.

Compliance options:

1. Retirement by compliance deadline.
2. Track 1 – Units are re-powered or retrofitted with closed cycle wet or dry cooling to decrease water inflow rate.
3. Track 2 – Comparable reduction in impingement mortality and entrainment using operational or structural measures. Must demonstrate Track 1 is not feasible.

Immediate and interim requirements must also be addressed with large organism exclusion devices and cease water intake on non-power generating units unless need is demonstrated.

The CTPG will review the need for generation within local areas in order to meet applicable local capacity requirements such as CAISO's "2013-2015 Local Capacity Technical Analysis, Report and Study Results" and similar studies made available by other Balancing Authorities. CTPG will assume OTC units are either repowered with efficient combined cycle technology, or with the newer generation of gas turbines, to meet local reliability requirements. No uncommitted transmission projects will be included. Adequate system support should be provided by following the local capacity requirements.

Based on the review of the implementation plans submitted by generator owners, the CTPG will be using the following guidelines for modeling the OTC units within the CTPG base cases.

If the implementation plan specifies:

1. Retirement by 2020, the unit will be retired.
2. Track 2 Compliance by 2020, the unit will remain unchanged.
3. Track 1 Compliance by 2020 and only changing cooling system, the unit will remain unchanged.
4. Track 1 Compliance by 2020 with new generator type and size, the unit will be modeled as stated.
5. Track 1 Compliance with an unstated generator type, but size or minimum MW known, the unit(s) will be modeled according to the following table:

Generic Power Flow Assumptions

GE LM6000	Simple Cycle	50 MW	
GE LMS100	Simple Cycle	100 MW	
GE Frame 7	CC 2x1	500 MW	(140 MW, 140 MW, 220 MW)

*Start by assuming the largest generator and number of generators to reach target. If excess capacity is greater than 50 MW, reduce by 1 generator, proceed to next largest generator type, and repeat. Reduce the generation output pro-rata by the excess capacity amount

Ex. 946 MW:	2 x 500 MW	1000	54 MW > 50 MW
	1 x 500 MW	500	
	5 x 100 MW	1000	54 MW > 50 MW
	1 x 500 MW	500	
	4 X 100 MW	900	
	1 X 50 MW	950	4 MW < 50 MW

6. Track 1 or Track 2 compliance, Track 1 assumptions will be used.
7. Track 1 or Retirement, Retirement will be assumed.
8. Two or more capacity options, the lower of the two will be used. Excess capacity will be reduced on a pro-rata basis.

Pro-Rata Reduction	Max	Output	Approximate Representation
	500	497.89	497
	100	99.58	100
	100	99.58	100
	100	99.58	100
	100	99.58	100
	50	49.79	49
	950	946	946

GE machines will be used for generic power flow and dynamic response assumptions due to availability of models and information in the General Electric Positive Sequence Load Flow program (GE-PSLF). The capacity value assumptions were chosen for simplicity, consistency, and closeness to typical outputs of similar machines currently. Where specific machine information is made available, the CTPG will use that data instead of generic assumptions.

The following tables list the changes made to the OTC units by utility.

Table 9 - PG& E OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
Contra Costa Generating Station	6-7	690	Retirement	2013	12/31/2017	PG&E	Retired	0	0
Humboldt Bay Power Plant	1-10	166	n/a	Complete		PG&E	n/a		No Change
Morro Bay Power Plant	1-4	650	Track 2	By Dec 31, 2015	12/31/2015	PG&E	Repower 164 MW	164	164
Moss Landing Power Plant	1-2	1,020	Track 2	Compliance through 2032	12/31/2017	PG&E	No Change		No Change
	6-7	1,509	Track 2	By Dec 31, 2017	12/31/2017	PG&E	Repower 100 MW	100	100
Pittsburg Generating	5-6	660	Track 1	By Dec 31, 2017	12/31/2017	PG&E	No Change		No Change
	7	740	Retirement	2016	12/31/2017	PG&E	Retired	0	0
Potrero Generating Station	3	0	Retired	February 28, 2011		PG&E	Retired	0	0

Table 10 - LADWP OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
Harbor Generating Station	5	65	Track 1	2031	12/31/2015	LADWP	No Change; Transition Begins after 2020	65	No Change
Haynes Generating Station	5-6	535	Track 1	2013	12/31/2015	LADWP	No Change; 6 SC, 6x100 MW already modeled in 2020 HS case	600	No Change
	1-2	444	Track 1	2027	12/31/2015	LADWP	No Change; Transition Begins after 2020	444	No Change
	8	235	Track 1	2035	12/31/2015	LADWP	No Change; Transition Begins after 2020	250	No Change
Scattergood Generating Station	3	460	Track 1	2015	12/31/2020	LADWP	1 CC - 310 MW, 2 SC - 200 MW; Representation as specified by LADWP	510	510
	1-2	367	Track 1	2024	12/31/2020	LADWP	No Change; Transition Modeled in 2020 HS case	367	No Change

Table 11 - SDG&E OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
Encina Power Station	1	107	Track 1	2017	12/31/2017	SDG&E	1 CC, 558 MW	558	156
	2	104				SDG&E			156
	3	110				SDG&E			246
	4-5	630	Track 2	2017	12/31/2017	SDG&E	No Change	628	No Change
South Bay Power Plant	1-4	0	Retired	-	12/31/2012	SDG&E	Retired	0	0

Table 12 - SCE OTC Units

		2020 HS Case/ Plant Owners	Plant Owners		SWRB	CTPG Assumptions			
Generating Station	Units	Existing Capacity (MW)	Compliance Option	Implementation Timeline (Beyond Compliance Deadline)	Compliance Deadline	Area	Powerflow Model Changes	Modified Capacity (MW)	Units Modeled and Capacity
AES Alamitos Generating Station	1-6	2,010	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	2 CC (500), 4 SC (100), 1 LM6000 (50)	1417	98 98 98 98 489 489 47
AES Huntington Beach Generating Station	1-4	900	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	1 CC (500), 3 SC (100)	800	500 100 100 100
AES Redondo Beach Generating Station	5-8	1,356	Track 1	Some Units Beyond Dec 31, 2020	12/31/2020	SCE	1 CC (500), 4 SC (100), 1 LM6000 (50)	946	100 100 100 100 497 49
El Segundo Generating Station	1-2	0	Track 1	2013	12/31/2015	SCE	1 CC, 560 MW	560	157 157 246
	3	335	Retirement	2013	12/31/2015	SCE	Retired	0	0
	4	335	Track 1	Retired by 2017 if unable to repower	12/31/2015	SCE	Retired	0	0
Mandalay Generating Station	1-2	430	Track 2	Prior to Dec 31, 2020	12/31/2020	SCE	No Change	430	No Change
Ormond Beach Generating Station	1-2	1,520	Track 2	Prior to Dec 31, 2020	12/31/2020	SCE	No Change	1500	No Change

3.7 Transmission Path Flows

Tables 13 provide the target flows to stress particular paths for several scenarios. The left side of Table 13 lists the WECC path number, name and the megawatt (MW) ratings of the path. Several paths have two ratings, a north to south (n-s) and a south to north (s-n) rating. The WOR path is only rated in the east to west (e-w) direction. The right side of the table shows the path flow targets for the stress path cases. COI stressed will push Paths 66 and 65 to rated levels for Scenarios 1 & 3. WOR stressed will target a flow of 7,250 MW which was the maximum flow measured during 2010. The WOR stress will be modeled for Scenarios 8 & 9.

Representative megawatt levels of the major paths in California for the three foundation cases are listed in Table 14. These path flows are approximate values prior to the addition of renewable generation. Ultimately, load levels and the final generation dispatch pattern will dictate path flows. CTPG will not attempt to move paths to any particular value to form the foundation cases. Table 14 simply provides a gauge of the flows in the WECC seed cases.

Table 13: Stress Path Target Flows (MW)

WECC Path						Stress Path Cases			
No.	Name	Rating				COI		WOR	
		MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.
66	California - Oregon Intertie (COI)	4,800	n-s	3,675	s-n	4,800	n-s	-	-
65	Pacific DC Intertie (PDCI)	3,100	n-s	3,100	s-n	3,100	n-s	-	-
46	West of Colorado River (WOR)	10,623	e-w	-	-	-	-	7,250	e-w

Table 14: Foundation Path Flows (MW) Pre-Renewables

WECC Path						Foundation Cases					
No.	Name	Rating				Fall		Summer		Spring	
		MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.	MW	Dir.
66	California - Oregon Intertie (COI)	4,800	n-s	3,675	s-n	1,750	s-n	3,700	n-s	3,750	n-s
15	Midway - Los Banos	3,265	n-s	5,400	s-n	3,650	s-n	1,800	s-n	1,800	n-s
26	Northern - Southern California	4,000	n-s	3,000	s-n	300	s-n	800	n-s	3,600	n-s
65	Pacific DC Intertie (PDCI)	3,100	n-s	3,100	s-n	1,850	s-n	2,600	n-s	2,600	n-s
27	Intermountain Power Project (IPP) DC Line	2,400	ne-sw	1,400	sw-ne	1,750	ne-sw	2,300	ne-sw	1,000	ne-sw
46	West of Colorado River (WOR)	10,623	e-w	-	-	5,100	e-w	3,000	e-w	5,500	e-w
49	East of Colorado River (EOR)	9,300	e-w	-	-	4,200	e-w	3,800	e-w	4,700	e-w
	Southern California Import Transmission (SCIT)	-	-	-	-	5,400		9,050		13,350	

4 Study Guideline and Reliability Criteria

The CTPG will conduct contingency-based power flow analysis for the scenarios described in Section 2. The GE-PSLF program will be used in conjunction with in-house Engineer Programming Control Language (EPCL) routines to analyze the study results. The study will use the following study methodology and criteria:

1. In the pre-contingency state and with all facilities in-service, the Bulk Electric System (BES) shall demonstrate transient, dynamic, and voltage stability. Facility ratings shall not be exceeded and uncontrolled separation shall not occur.
2. Starting with all facilities in-service and following single and double contingencies, the BES shall demonstrate transient, dynamic, and voltage stability. Facility ratings shall not be exceeded and uncontrolled separation shall not occur.
3. The single contingency analysis shall meet requirements R2.2 and R2.3 of NERC Reliability Standard FAC-010-2.1.
4. The double contingency analysis shall meet the requirements R2.5 and R2.6 and Regional Differences E.1 of FAC-010-2.1.

NERC Standard FAC-010-2.1 (E.1.2.5) and NERC Standard TPL-003-1a (B.R1) provide that for double contingencies, the controlled interruption of electric supply (load shedding), the planned removal of certain generators (generation dropping), and/or the curtailment of firm power transfers may be necessary to maintain the overall security of the interconnected transmission system. These system adjustments can be made either manually or automatically via protection control systems. Consistent with this standard, the CTPG may propose, and where feasible, evaluate the use of (i) existing special protection schemes and/or operating procedures, (ii) modifications of existing special protection schemes and/or operating procedures, and/or (iii) new special protection schemes and/or operating procedures to mitigate impacts caused by double contingencies. The CTPG recognizes that balancing authorities will make any final determination as to the feasibility of implementing such schemes or operating procedures within their areas based on their own assumptions, policies, and practices. It is further recognized that if the balancing authorities do not approve of the use of such schemes or operating procedures, facility upgrades would be required to mitigate impacts caused by double contingencies. As such, CTPG will, in most instances, also provide transmission facility upgrades for consideration as mitigation for identified reliability criteria violations. Consideration of other alternatives, such as special protection schemes and/or operating procedures, would presumably be undertaken as part of the regulatory process for determining the need for a proposed transmission upgrade.

Similarly, the CTPG will not be conducting a deliverability analysis to determine the necessary improvements and operating methodology for delivery of renewables to fulfill Resource Adequacy eligibility, and to provide integration capability for variable generation renewables, such as through pumped storage or other methods. This analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions.

All facilities must be operating within their applicable post-contingency thermal, frequency, and voltage limits. The only exceptions to remaining within applicable ratings are: 1) a common mode outage of two generating units connected to the same switchyard (FAC-010 E1.1.6) and 2) the loss of multiple bus sections as a result of bus-tie breaker failure or delayed clearing due to a single line to ground fault (FAC-010 E1.1.7).

For double contingency analysis, the CTPG will monitor all elements at 200 kV and higher, plus any additional critical lower voltage elements to determine potential reliability standards violations. Study results will document all elements that demonstrate a thermal loading of the facility applicable rating at 100% and above.

The NERC and WECC standards provide a framework from which computer simulation studies will be performed to model forecasted system conditions and evaluate system performance. The following standards will be used, along with FAC-010, for the reliability assessments and standards compliance:

1. NERC Reliability Standards
   - TPL-001: System Performance Under Normal Conditions
   - TPL-002: System Performance Following Loss of a Single BES Element
   - TPL-003: System Performance Following Loss of Two or More BES Elements
2. WECC
   - TPL–(001-004)–WECC–1–CR: System Performance Criteria
   - Voltage Stability Criteria, Under voltage Load Shedding Strategy, and Reactive Power Reserve Monitoring Methodology
3. Each member's and balancing authority's specific planning criteria

The NERC Standards TPL-001 through -003 requires that the transmission system be "planned such that the Network can be operated to supply projected customer demands and projected Firm (non-recallable reserved) Transmission Services, at all demand levels over the range of forecast system demands". The CTPG will address the potential violations of NERC/WECC reliability standards at the network level only. Potential violation at the local load center level will be reported in the study and addressed by the entity responsible for local load reliability.

CTPG will perform dynamic studies in 2011. Dynamic models for existing facilities will not be altered from the WECC seed case. Generic models will be used for the additional renewable resources required in 2020.

5 2020 Renewable Energy Planning Target (Net Short)

The CTPG updated the amount of renewable energy resource additions, "net short", that will be required between 2011 and 2020 to meet the 33% RPS requirement for the state of California. Net short updates are being considered in the development of the CEC's 2011 Integrated Energy Policy Report with energy efficiency, CHP and distributed photovoltaic as key variables. The CEC staff's May 2011 forecast update includes a range of forecasts ("Updated Low", "Updated Mid" and "Updated High") and, correspondingly, a range of renewable net shorts. As detailed in Table 5, CTPG will utilize the "High" Net Short estimate for all scenarios. In this final draft of the study plan an adjustment was made to the CTPG Net Short. The capacity factors associated with the "CPUC Approved Solar PV Program" for SCE, SDG&E and PG&E matches the factors used by the CPUC resulting in a decrease of 279 GWh in the CTPG Net Short.

Table 15: 2020 CTPG Net Short (CEC "Updated High")

GWH	
305,256	**2020 CEC Energy Demand Forecast (May 2011)**
	Energy not subject to RPS
3,320	Central Valley Project Pump Load
1,507	Metropolitan Water District Pump Load
8,729	Department of Water Resources Pump Load
15,200	Energy Efficiency
2,336	Private Photovaltaic
-	Combined Heat and Power
274,164	**Retail sales subject to RPS**
90,474	**Renewable Generation Requirement (33%)**
43,500	Existing Renewables
46,974	**CEC Staff Renewable Net Short**
	CPUC Approved Solar PV Program
1,008	SCE
105	SDG&E
1,008	PG&E
44,852	**CTPG Renewable Net Short**

6 Renewable Generation Dispatch

All scenarios will include the CPUC discounted core, currently being considered as part of the CPUC Long Term Procurement Plan. The criteria that staff proposes be used to determine inclusion in the discounted core is:

1.) A project must have a signed power purchase agreement (PPA) either under review or already approved by the Commission as of June 1, 2010; and

2.) The project must have its major permit (Application for Certification if under the jurisdiction of the Energy Commission; Conditional Use Permit in most other cases) filed with and deemed data adequate by the appropriate agency, as of March 1, 2010

The discounted core includes renewable resources located in Alberta, Oregon, Idaho, Montana, New Mexico, southern Nevada and Arizona. The CTPG has modified the CPUC discounted core with the following changes and will refer to it as the CPUC/POU discounted core:

- Removed Round Mountain CREZ 78MW. The proposed renewable resource project was completed this year and is modeled in the seed case
- Moved San Diego South CREZ 21MW to Non-CREZ. This proposed bio resource was incorrectly listed as a San Diego South CREZ resource.
- Added 128MW Wind to the Solano CREZ. This project is a POU project under construction.
- Added 8.5MW of solar PV in Tehachapi CREZ.
- Added 10MW of solar PV in Victorville CREZ.
- Added 25MW of Solar PV in the Los Angeles area.

The CPUC/POU discounted core includes 23,017 GWh of resources; the remaining energy needed by the studies to provide for the net short will consist of resources identified by the Renewable Energy Transmission Initiative in their Phase 2B report as RETI's Best California CREZs (Fairmont, Imperial North, Kramer, Round Mountain, San Diego-South, Solano, and Tehachapi). The CTPG has made the following modifications to the RETI Best California CREZ's:

- Moved all forecasted solar thermal to solar photovoltaic for Tehachapi and Fairmont.
- Split forecasted solar energy to 20% solar thermal and 80% solar photovoltaic for Kramer.

These changes reflect the status of projects currently proposed for these locations.

A summary of the renewable resources for each scenario is provided in Table 16. A breakdown by CREZ of the CPUC/POU discounted core is provided in Table 17 and Tables 18 through 24 details the renewable energy and dispatch by CREZ for each scenario.

CTPG will use generic factors to relate nameplate capacity to expected renewable energy production for the hour of study (e.g., peak hour, off-peak hour). These generic factors will be obtained from the monthly/hourly technology-specific energy output profiles prepared for each CREZ and renewable resource development area that correspond to the hour and month that will be simulated in the power flow program. The monthly/hourly technology-specific energy output profiles are based on actual hourly output data for similar technologies in similar locations or on studies of technical resource potential (e.g., solar insolation, wind speeds, subsurface steam availability, biomass fuel availability, terrain limitations, and land use limitations) in different areas of the WECC.[7] This energy spreadsheet was developed for the CPUC and requires a time adjustment from Greenwich Mean Time to Pacific Standard Time.

All renewable generators included in CTPG's studies will be modeled as must-run units; i.e., the output of renewable resources will not be reduced to mitigate any reliability criteria violations found in CTPG's studies (such as running out of fossil-fired generation that can be decremented to accommodate renewable resource output in the spring case – an over-generation condition). It should be noted that an evaluation of renewable integration requirements is outside the scope of CTPG's 2011 study work.

Table 16: Renewable Resources for each Scenario

Renewable Resource	Pacific Northwest Import		Northwest Nevada Import		South to North Flow		CPUC Public Policy		Central California		West of River Import	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
Discounted Core	23,017	51	23,017	51	23,017	51	23,017	51	23,017	51	23,017	51
Scenario Specific	10,950	24	6,345	14	0	-	21,835	49	11,826	26	18,318	41
RETI Best CA CREZs	10,885	24	15,490	35	21,835	49	0	-	10,009	22	3,516	8
Total	44,852		44,852		44,852		44,852		44,852		44,852	

[7]For a review of the production assumptions for each CREZ by renewable technology, see California ISO, "2020 Renewable Transmission Conceptual Plan Based on Inputs from the RETI Process Study Results," September 15, 2009, available at http://www.caiso.com/242a/242ae729af70.pdf .

Table 17: POU/CPUC Discounted Core

CREZ	Installed Capacity (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			1,742			1,742
Fairmont*			230			230			537			537
Imperial South*		300	49		40	389		701	125		302	1,128
Kramer*		250				250		584				584
Mountain Pass*		410				410		958				958
Palm Springs*	77					77	230					230
Pisgah*		500				500		1,169				1,169
Riverside East*		642	550			1,192		1,624	1,283			2,906
San Bernardino-Lucerne*	42					42	121					121
Santa Barbara*	83					83	236					236
Solano*	166					166	546					546
Techachapi*	1,912		9			1,920	5,388		19			5,407
Victorville*			10			10			22			22
Westlands*			50			50			117			117
Alberta*	516					516	1,410					1,410
Arizona*			290			290			737			737
Idaho*	90					90	229					229
Montana*	300					300	994					994
New Mexico*				32		32				238		238
Nevada S*		400	50			450		935	127			1,062
Non CREZ*			25	138		163			50	1,022		1,073
Oregon*	614					614	1,571					1,571
Total	**3,799**	**2,502**	**2,063**	**170**	**40**	**8,574**	**10,724**	**5,971**	**4,759**	**1,260**	**302**	**23,017**

Table 18: Pacific Northwest Scenario Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			263			263			1,742			1,742
Fairmont*			230			230			76			76			537			537
Fairmont**	118		300	23		440	80		98	21		199	329		659	168		1,156
Imperial North A**					227	227					204	204					1,709	1,709
Imperial South*		300	49		40	389		104	16		36	156		701	125		302	1,128
Kramer*		250				250		162				162		584				584
Kramer**	33	205	820		5	1,063	18	133	269		5	425	95	479	1,914		37	2,525
Mountain Pass*		410				410		235				235		958				958
Palm Springs*	77					77	49					49	230					230
Pisgah*		500				500		332				332		1,169				1,169
Riverside East*		642	550			1,192		336	181			516		1,624	1,283			2,906
Round Mountain**					63	63					57	57					477	477
San Bernardino-Lucerne*	42					42	22					22	121					121
San Diego-South**	112					112	58					58	314					314
Santa Barbara*	83					83	35					35	236					236
Solano*	166					166	123					123	546					546
Solano**	167					167	123					123	549					549
Tehachapi*	1,912		9			1,920	1,315		3			1,318	5,388		19			5,407
Tehachapi**	529		1,191	6		1,726	363		391	6		760	1,490		2,618	47		4,155
Victorville*			10			10			3			3			22			22
Westlands*			50			50			16			16			117			117
Alberta*	516					516	128					128	1,410					1,410
Arizona*			290			290			212			212			737			737
Idaho*	90					90	30					30	229					229
Montana*	300					300	97					97	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		253	16			269		935	127			1,062
Non CREZ*			25	138		163			8	124		132			50	1,022		1,073
Oregon*	614					614	390					390	1,571					1,571
Pacific Northwest***	2,500					2,500	1,588					1,588	10,950					10,950
Total	**7,258**	**2,707**	**4,373**	**199**	**335**	**14,871**	**4,418**	**1,555**	**1,552**	**178**	**301**	**8,005**	**24,452**	**6,450**	**9,950**	**1,476**	**2,524**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

Table 19: Northwest Nevada Scenario Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			479			479			1,742			1,742
Fairmont*			230			230			138			138			537			537
Fairmont**	166		422	32		619	99		252	29		380	464		927	237		1,628
Imperial North A**					319	319					287	287					2,406	2,406
Imperial South*		300	49		40	389		181	29		36	246		701	125		302	1,128
Kramer*		250				250		186				186		584				584
Kramer**	47	288	1,154		7	1,497	23	214	691		6	934	134	674	2,695		53	3,555
Lassen/NW Nevada***	200		50		750	1,000	46		30		675	751	563		127		5,655	6,345
Mountain Pass*		410				410		270				270		958				958
Palm Springs*	77					77	43					43	230					230
Pisgah*		500				500		373				373		1,169				1,169
Riverside East*		642	550			1,192		418	329			747		1,624	1,283			2,906
Round Mountain**					89	89					80	80					671	671
San Bernardino-Lucerne*	42					42	12					12	121					121
San Diego-South**	158					158	51					51	443					443
Santa Barbara*	83					83	28					28	236					236
Solano*	166					166	108					108	546					546
Solano**	286					286	186					186	938					938
Tehachapi*	1,912		9			1,920	1,156		5			1,161	5,388		19			5,407
Tehachapi**	744		1,676	9		2,429	450		1,003	8		1,461	2,098		3,685	67		5,849
Victorville*			10			10			6			6			22			22
Westlands*			50			50			30			30			117			117
Alberta*	516					516	123					123	1,410					1,410
Arizona*			290			290			216			216			737			737
Idaho*	90					90	13					13	229					229
Montana*	300					300	63					63	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		295	30			325		935	127			1,062
Non CREZ*			25	138		163			15	124		139			50	1,022		1,073
Oregon*	614					614	346					346	1,571					1,571
Total	**5,400**	**2,790**	**5,365**	**211**	**1,205**	**14,971**	**2,747**	**1,936**	**3,253**	**188**	**1,085**	**9,209**	**15,363**	**6,645**	**12,194**	**1,564**	**9,086**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

Table 20: South to North Flow Scenario Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			598			598			1,742			1,742
Fairmont*			230			230			172			172			537			537
Fairmont**	237		597	46		880	37		447	41		525	663		1,313	338		2,314
Imperial North A**					455	455					409	409					3,429	3,429
Imperial South*		300	49		40	389		237	37		36	309		701	125		302	1,128
Kramer*		250				250		225				225		584				584
Kramer**	67	411	1,643		10	2,131	8	370	1,228		9	1,616	191	960	3,835		75	5,061
Mountain Pass*		410				410		353				353		958				958
Palm Springs*	77					77	17					17	230					230
Pisgah*		500				500		439				439		1,169				1,169
Riverside East*		642	550			1,192		536	411			947		1,624	1,283			2,906
Round Mountain**					127	127					114	114					957	957
San Bernardino-Lucerne*	42					42	6					6	121					121
San Diego-South**	225					225	34					34	631					631
Santa Barbara*	83					83	6					6	236					236
Solano*	166					166	58					58	546					546
Solano**	335					335	117					117	1,101					1,101
Tehachapi*	1,912		9			1,920	304		6			310	5,388		19			5,407
Tehachapi**	1,061		2,389	13		3,463	169		1,786	12		1,966	2,990		5,258	95		8,342
Victorville*			10			10			8			8			22			22
Westlands*			50			50			37			37			117			117
Alberta*	516					516	45					45	1,410					1,410
Arizona*			290			290			212			212			737			737
Idaho*	90					90	26					26	229					229
Montana*	300					300	95					95	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		332	37			369		935	127			1,062
Non CREZ*			25	138		163			19	124		143			50	1,022		1,073
Oregon*	614					614	131					131	1,571					1,571
Total	**5,724**	**2,913**	**6,692**	**228**	**632**	**16,189**	**1,051**	**2,491**	**4,998**	**204**	**568**	**9,312**	**16,299**	**6,931**	**15,166**	**1,693**	**4,762**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

Table 21: CPUC Public Policy Scenario Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy Production (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo South*			800			800			521			521			1,742			1,742
Carrizo South**			71			71									154			154
Fairmont*			230			230			138			138			537			537
Imperial*		300	49		40	389	21	181	30		803	1,035		701	125		302	1,128
Imperial**	69	0	0		852	921							194	0	0		6,426	6,620
Kramer*		250				250		186				186		584				584
Mountain Pass*		410				410	14	270				284		958				958
Mountain Pass**	80	0				80							216	0				216
Palm Springs*	77					77	84					84	230					230
Palm Springs**	71					71							213					213
Pisgah*		500				500		373				373		1,169				1,169
Riverside East*		642	550			1,192		418	329			747		1,623	1,283			2,906
Round Mountain*	0					0					14	14	0					0
Round Mountain**	0				15	15							0				108	108
San Bernardino-Lucerne*	42					42	58					58	121					121
San Bernardino-Lucerne**	155					155							446					446
San Diego South**	479					479	156					156	1,369					1,369
Santa Barbara*	83					83	28					28	236					236
Solano*	166					166	278					278	545					545
Solano**	261					261							856					856
Tehachapi*	1,912		9			1,921	1,813		5	24		1,842	5,388		19			5,407
Tehachapi**	1,087		0	26		1,113							3,066		0	195		3,260
Victorville*			10			10			6			6			22			22
Westlands*			50			50			30			30			117			117
NonCREZ & distribution-level PV*			1,077	138		1,215	177		906	163		1,246			2,172	1,022		3,194
NonCREZ & distribution-level PV**	297		977	46		1,320							879		2,008	339		3,227
less CPUC-approved distribution-level PV in CTPG net short*			-1,052			-1,052			-467			-467			-2,122			-2,122
Alberta*	516					516	75					75	1,410					1,410
Arizona*			290			290			216			216			737			737
British Columbia**				35		35				32		32				263		263
Colorado**	297					297	47					47	825					825
Idaho*	90					90	13			14	85	112	229					229
Idaho**	0			24	95	119							0			154	685	839
Montana*	300					300	63					63	994					994
Nevada-S*		400	50			450		295	30			325		935	127			1,062
New Mexico*				32		32	74			27	13	114				238		238
New Mexico**	632			0	14	646							1,789			0	110	1,899
Oregon*	614					614	346			62		408	1,571					1,571
Oregon**	0			69		69							0			510		510
Wyoming**	324			1		325	37			1		38	1,020			11		1,031
Total	7,551	2,502	3,111	371	1,017	14,552	3,283	1,722	1,743	322	915	7,985	21,597	5,971	6,922	2,733	7,631	44,852

Table 22: Central California Scenario Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			479			479			1,742			1,742
Fairmont*			230			230			138			138			537			537
Fairmont**	108		274	21		403	65		164	19		248	304		602	155		1,060
Imperial North A**					208	208					188	188					1,571	1,571
Imperial South*		300	49		40	389		181	29		36	246		701	125		302	1,128
Kramer*		250				250		186				186		584				584
Kramer**	31	188	752		5	976	15	140	450		4	609	87	440	1,758		34	2,320
Mountain Pass*		410				410		270				270		958				958
Palm Springs*	77					77	43					43	230					230
Pisgah*		500				500		373				373		1,169				1,169
Riverside East*		642	550			1,192		418	329			747		1,624	1,283			2,906
Round Mountain**					58	58					52	52					438	438
San Bernardino-Lucerne*	42					42	12					12	121					121
San Diego-South**	103					103	34					34	289					289
Santa Barbara*	83					83	28					28	236					236
Solano*	166					166	108					108	546					546
Solano**	153					153	100					100	504					504
Tehachapi*	1,912		9			1,920	1,156		5			1,161	5,391		19			5,409
Tehachapi**	487		1,096	6		1,589	294		656	5		955	1,372		2,409	44		3,825
Victorville*			10			10			6			6			22			22
Westlands*			50			50			30			30			117			117
Alberta*	516					516	124					124	1,410					1,410
Arizona*			290			290			216			216			737			737
Idaho*	90					90	13					13	229					229
Montana*	300					300	63					63	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		295	30			325		935	127			1,062
Non CREZ*			25	138		163			15	124		139			50	1,022		1,073
Oregon*	614					614	346					346	1,571					1,571
Gates***	103		3,102			3,205	25		1,856			1,856	288		7,242			7,530
Midway***			1,348	8		1,356			807	7		814			3,147	59		3,206
Panoche***			466			466			279			279			1,088			1,088
Total	**4,785**	**2,690**	**9,100**	**205**	**311**	**17,091**	**2,425**	**1,862**	**5,489**	**183**	**280**	**10,238**	**13,572**	**6,411**	**21,006**	**1,518**	**2,345**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

Table 23: West of River Import Scenario with 50% Eldorado Injection Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			598			598			1,742			1,742
Fairmont*			230			230			172			172			537			537
Fairmont**	38		100	7		145	6		75	7		87	106		220	54		380
Imperial North A**					73	73					66	66					549	549
Imperial South*		300	49		40	389		237	37		36	309		701	125		302	1,128
Kramer*		250				250		225				225		584				584
Kramer**	11	67	263		2	343	1	61	197		1	260	31	157	615		12	814
Mountain Pass*		410				410		353				353		958				958
Palm Springs*	77					77	17					17	230					230
Pisgah*		500				500		439				439		1,169				1,169
Riverside East*		642	550			1,192		536	411			947		1,624	1,283			2,906
Round Mountain**					20	20					18	18					153	153
San Bernardino-Lucerne*	42					42	6					6	121					121
San Diego-South**	36					36	5					5	101					101
Santa Barbara*	83					83	6					6	236					236
Solano*	166					166	58					58	546					546
Solano**	54					54	19					19	176					176
Tehachapi*	1,912		9			1,920	304		7			311	5,388		19			5,407
Tehachapi**	172		384	2		557	27		288	2		317	483	0	844	15		1,342
Victorville*			10			10			8			8			22			22
Westlands*			50			50			37			37			117			117
Alberta*	516					516	78					78	1,410					1,410
Arizona*			290			290			212			212			737			737
Idaho*	90					90	26					26	229					229
Montana*	300					300	95					95	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		295	37			332		935	127			1,062
Non CREZ*			25	138		163			15	124		139			50	1,022		1,073
Oregon*	614					614	131					131	1,571					1,571
Eldorado (50%)***	1,521	1,100	1,000			3,621	218	913	748			1,879	4,259	2,567	2,335			9,161
Palo Verde(37.5%)***	1,544	510	580			2,634	207	426	434			1,066	4,323	1,190	1,354			6,868
North Gila (12.5%)***		436	545			981		344	407			751		1,018	1,272			2,290
Total	**7,174**	**4,615**	**4,935**	**179**	**135**	**17,038**	**1,203**	**3,826**	**3,683**	**160**	**121**	**8,993**	**20,204**	**10,904**	**11,399**	**1,329**	**1,016**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

Table 24: West of River Import Scenario with 50% Palo Verde Injection Renewable Dispatch

CREZ	Installed Capacity (MW)						Dispatched (MW)						Annual Energy (GWh)					
	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total	Wind	Solar Thermal	Solar PV	Bio	Geo	Total
Carrizo North/South*			800			800			598			598			1,742			1,742
Fairmont*			230			230			172			172			537			537
Fairmont**	38		100	7		145	6		75	7		87	106		220	54		380
Imperial North A**					73	73					66	66					549	549
Imperial South*		300	49		40	389		237	37		36	309		701	125		302	1,128
Kramer*		250				250		225				225		584				584
Kramer**	11	67	263		2	343	1	61	197		1	260	31	157	615		12	814
Mountain Pass*		410				410		353				353		958				958
Palm Springs*	77					77	17					17	230					230
Pisgah*		500				500		439				439		1,169				1,169
Riverside East*		642	550			1,192		536	411			947		1,624	1,283			2,906
Round Mountain**					20	20					18	18					153	153
San Bernardino-Lucerne*	42					42	6					6	121					121
San Diego-South**	36					36	5					5	101					101
Santa Barbara*	83					83	6					6	236					236
Solano*	166					166	58					58	546					546
Solano**	54					54	19					19	176					176
Tehachapi*	1,912		9			1,920	304		7			311	5,388		19			5,407
Tehachapi**	172		384	2		557	27		288	2		317	483	0	844	15		1,342
Victorville*			10			10			8			8			22			22
Westlands*			50			50			37			37			117			117
Alberta*	516					516	78					78	1,410					1,410
Arizona*			290			290			212			212			737			737
Idaho*	90					90	26					26	229					229
Montana*	300					300	95					95	994					994
New Mexico*				32		32				27		27				238		238
Nevada S*		400	50			450		295	37			332		935	127			1,062
Non CREZ*			25	138		163			15	124		139			50	1,022		1,073
Oregon*	614					614	131					131	1,571					1,571
Eldorado (37.5%)***	1,544	510	580			2,634	218	423	434			1,075	4,323	1,190	1,354			6,868
Palo Verde(50%)***	1,521	1,100	1,000			3,621	204	918	747			1,869	4,259	2,567	2,335			9,161
North Gila (12.5%)***		436	545			981		344	407			751		1,018	1,272			2,290
Total	**7,174**	**4,615**	**4,935**	**179**	**135**	**17,038**	**1,200**	**3,829**	**3,682**	**160**	**121**	**8,993**	**20,204**	**10,904**	**11,399**	**1,329**	**1,016**	**44,852**

*From CPUC/POU Discounted Core CREZs

**From RETI Best CA CREZs

*** Scenario Specific Resources

7 Generation Re-Dispatch

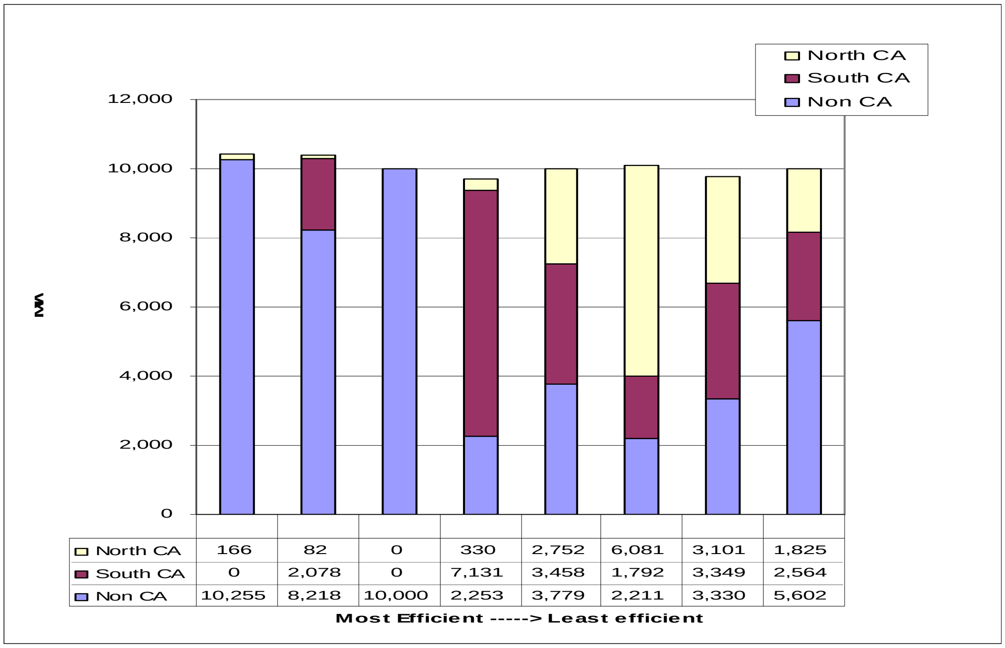
When renewable resources are added to the pre-renewable power flow cases and dispatched at the output level corresponding to the applicable technology and the month/hour being simulated, an equal amount of fossil-fueled generation must be turned down (or decremented) in order to maintain a generation-load balance in the power flow program. Fossil generation was selected for reduction because of economics. With renewable generation mandated to occupy 33% of the electricity market in California, fossil generation must compete to remain in the market. It is anticipated that the least efficient units, in the absence of overriding reliability and/or operational requirements, will be the most likely to shut down by 2020. Fossil generation will be decreased in a merit-order fashion (least economic reduced first) across the WECC. This merit order is established through the use of heat rate data obtained from the WECC Transmission Expansion Planning & Policy Committee's (TEPPC's) 2017 economic database. Fossil units are decremented equally in blocks until all units in the block are turned off. Decrements below minimum output level are not allowed; i.e., the unit is turned off. Nuclear, qualifying facilities/cogeneration, and hydro units are not decremented in the summer peak cases.

Because of their location, some fossil generation may be required to operate for local reliability reasons even though their variable operating costs are relatively high and application of a strict merit-order economic dispatch would suggest they should not run. CTPG will limit generation decrements to levels above known local capacity requirements as identified by the applicable balancing authority or as suggested by an examination of a WECC economic grid simulation case conducted by the CAISO in connection with the CAISO's 2010/2011 transmission planning process.

The CTPG has issued a survey to transmission planning entities throughout WECC to identify dispatchable generators, obtain minimum output of dispatchable units and descriptions of constraints requiring specific dispatchable units to be on line for specific system conditions. While not all WECC entities responded to the survey, the majority did and those responses have been incorporated into the economic merit-order list of WECC generators that may be decremented in the power flow program. The responses however did not provide significant information regarding minimum generation requirements and the conditions in which reliability considerations will supersede economic merit-order. The economic merit-order list of dispatchable gas-fired generators is provided on a spreadsheet that will be available on the CTPG web site.

Figure 1 provides a summary of the fossil units in WECC ranked by efficiency in the horizontal axis. Each column represents approximately 10,000 MW with the most efficient on the left and the least efficient on the right. The figure reflects both the CTPG assumptions regarding OTC units and the WECC survey results for dispatchable generation. The colors distinguish resources located in Northern California, Southern California and outside California.

Figure 1: WECC Install Capacity
Dispatchable Gas-Fired Generation



North CA	166	82	0	330	2,752	6,081	3,101	1,825
South CA	0	2,078	0	7,131	3,458	1,792	3,349	2,564
Non CA	10,255	8,218	10,000	2,253	3,779	2,211	3,330	5,602

While the economic merit-order list of dispatchable gas-fired generators excludes any generators that WECC entities identified as must-run, it does not indicate the minimum amount of generation that must be on-line in specific load pockets for the system conditions that will be evaluated in CTPG's studies. Other documents will be used to determine these minimum amounts. [8]

The CAISO has published a December 30, 2010 document entitled *2013-2015 Local Capacity Technical Analysis, Report and Study Results* which sets forth the minimum amount of dependable generating capacity that must be available in the following load pockets within the CAISO BAA: Humboldt, North Coast/North Bay (northeast of San Francisco), Sierra, Stockton, Greater Bay (east of San Francisco), Greater Fresno, Kern, Los Angeles Basin, Big Creek/Ventura and San Diego. This document is available at *http://www.caiso.com/287c/287ca3cc28a80.pdf*.

Minimum generation requirements in the San Diego area are governed by San Diego Area Unit Commitment Requirements for Voltage Stability and by the Local San Diego Area 25% Minimum Generation Requirement. These minimum generation requirements are described in the document named "*San Diego Area Generation Constraints*" which is available on the CTPG web site. The Los Angeles basin area served by SCE is subject to a similar minimum generation requirement.

[8] The WECC survey provided some information on minimum generation requirements, particularly for certain areas of California. The WECC survey yielded limited information on minimum generation requirements in areas outside of California; it is not known whether this is because there are few limits or because the WECC entities have simply not provided it. CTPG anticipates an ongoing effort to collect and refine information regarding minimum generation requirements throughout the WECC.

Within the SMUD BAA, there are two minimum generation requirements. One ties the minimum amount of generation that must be committed within a defined SMUD load area to load levels within the SMUD load area. The other ties the minimum amount of generation which must be committed from among a specific set of generators to load levels within a defined Sacramento load area. A document setting forth these requirements will be posted on the CTPG website.

MID has minimum on-line generation requirements tied to the MID distribution service area's daily peak loads. A document setting forth these requirements will be posted on the CTPG website.

TID has minimum on-line generation requirements tied to the TID distribution service area's daily peak loads. A document setting forth these requirements will be posted on the CTPG website.

Associated with Path 15 is a remedial action scheme (RAS) which drops specific generators south of Midway substation as well as load north of Los Banos Substation. If this generation is decremented, the RAS become less effective and Path 15 must be de-rated in the south to north direction. To prevent this de-rate in the study, the decision was made to not decrement the associated generators.

Given the robust information regarding minimum generation levels in California versus the limited information received from the WECC survey, CTPG will bypass economic merit-order dispatch in areas outside of California for the following reasons:

1) When decrementing specific units or blocks of units in an area produce local reliability issues.

2) Unable to achieve stress path flow targets as specified in a CTPG scenario. Bypassing economic merit-order dispatch shifts the analysis to a more traditional transmission planning approach by examining the impact of a single specific transmission assumption; high import path flows into California and the resulting impact.

Deviations from economic merit-order dispatch will be document in the study report.