2010 CTPG Revised Phase 4 Study Plan

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1 Executive Summary

Since the California Transmission Planning Group (CTPG) initiated its study effort in early 2010, a primary objective of the Group has been to provide a foundation for a state-wide transmission plan that identifies the transmission infrastructure needed to reliably and efficiently meet the state's 33% Renewable Portfolio Standard (RPS) goal by the year 2020. Recognizing the complexity of the study effort, the CTPG has chosen to undertake a staged approach to achieve its objectives. This approach has provided the opportunity, in Phase 3, for CTPG to develop a methodology for identifying an initial set of proposed "high potential" and "medium potential" transmission elements to be considered in its state-wide plan. This approach involved ranking CREZs using publicly available measures of commercial interest and then evaluating the relative amounts of power from the highest ranked CREZs that can be expected to flow on each of the transmission infrastructure additions identified in CTPG's Phase 1, Phase 2 and Phase 3 studies. Those transmission infrastructure additions with the highest level of flow were deemed to be "high potential" transmission upgrades.

However, results from the Phase 3 analysis suggested a conclusion that the initial set of "high potential" transmission elements identified in the Phase 3 study effort would not provide sufficient additional capacity to avoid reliability criteria violations at the full 33% RPS goal in year 2020. The CTPG based its conclusion on the fact that the "high potential" transmission upgrades are a small subset of the transmission upgrades identified in the Phase 1, Phase 2 and Phase 3 studies. In addition, measures of commercial interest used by CTPG to identify high ranking CREZs excluded renewable development plans by non-CPUC jurisdictional load serving entities and the potential for development of out-of-state resources. A number of these non-jurisdictional load serving entities serve retail loads in northern California and it is not clear that these entities intend to meet their respective renewable resource goals through the renewable resource additions in southern California. In addition, CTPG stakeholders have expressed a common opinion that there are other viable high commercial interest CREZs in-state and out-of-state which if appropriately considered, would provide for diversity in renewable resource locations and technology. While the Phase 3 effort brought a large number of issues to closure, the CTPG concurs with general stakeholder sentiment that some additional analysis is needed to fully "inform" the CTPG's statewide transmission plan. To this end, the CTPG Phase 4 Study Plan has been prepared to describe the remaining work it considers necessary before a fully "informed" statewide transmission plan to meet the 2020 RPS goals can be completed.

In Phase 4, with input from stakeholders, the CTPG will continue to review the categorization of "high" and "medium" potential transmission upgrades documented in the final Phase 3 study report to ascertain whether additional transmission upgrades should be added to the current listing of "high" and "medium" potential transmission upgrades. This will include determining if there are other CREZs located within the state or renewable resource development areas outside the state, that have similar high interest as those identified in Phase 3 and whether a revised renewable resource development pattern is in order, and if so, would this pattern result

in potential reliability criteria violations and the identification of transmission infrastructure additions not previously identified by CTPG.

A significant amount of work has been performed this year towards developing the 2010 state-wide transmission plan to meet the state's RPS goals by the end of this decade. This work has relied heavily on significant input from stakeholders. CTPG looks forward to a continued and strong working relationship with all stakeholders as the work continues.

1.1 Introduction

The California Transmission Planning Group (CTPG) is a forum for conducting joint transmission planning studies and for coordinating CTPG members' transmission planning activities. The CTPG members include both transmission owners and transmission operators all of which are subject to North American Electric Reliability Corporation (NERC)/Western Electricity Coordinating Council (WECC) transmission planning standards. The purpose of the 2010 CTPG Study for 2020 is to develop a state-wide transmission plan that identifies the transmission infrastructure that could reliably and efficiently meet, by year 2020, the state's 33% Renewable Portfolio Standard (RPS) goal.

The CTPG has chosen to conduct its 2010 CTPG Study for 2020 in four phases with three phases completed to date. This Phase 4 Study Plan is designed to build on the work completed in Phases 1, Phase 2 and Phase 3 and is intended to reflect stakeholder input to date and to continue to receive additional input during the CTPG Phase 4 stakeholder process. Throughout the CTPG planning effort, CTPG has sought to be responsive to stakeholders and other entities with roles in the planning and implementation of transmission development, including the Renewable Energy Transmission Initiative (RETI), state energy agencies, and independent transmission and generation developers. The CTPG will continue this practice as it continues to develop its 2010 statewide plan.

1.2 Identification of Additional High Commercial Interest CREZs

In Phase 3, the CTPG identified high commercial interest CREZs by comparing the CREZs included in the "discounted core" portfolio assembled by the California Public Utilities Commission (CPUC) and the Generation Interconnection Queue portfolio assembled by the CTPG for the Phase 2 and Phase 3 studies. The "discounted core" consisted of CREZs determined by the CPUC to have signed power purchase agreements (PPAs) with California IOUs and a major permit filed and deemed data adequate by the permitting agency. The Generation Interconnection Queue portfolio consisted of projects mostly from the CAISO interconnection queue that either had signed or were in the process of signing their interconnection agreement or had posted financial securities. Specific CREZs that were found to be in both and within which there was an intersection of renewable generation technologies, were considered high commercial interest CREZs. These CREZs were used as a key input in the determination of the "high potential" and "medium potential" transmission elements. The Generation Interconnection Queue portfolio did include some Publicly Owned Utility (POU) resource projects, however the CPUC "discounted core" included only CREZs with power purchase agreements (PPAs) executed by IOUs. Therefore, CREZs that may have a comparable commercial interest status based on PPAs executed or being considered by municipal utilities were not identified in the Phase 3 analysis as high commercial interest CREZs.

The Phase 4 Study will review the commercial interest status of other in-state CREZs, including municipal utility renewable resource interests and out-of-state renewable resource development areas. If additional high commercial interest CREZs and renewable resource development areas are identified during the Phase 4 analysis, the CTPG will determine if additional power flow studies are necessary and whether the current list of "high potential" and "medium potential" transmission upgrades should be revised.

1.3 Northern California Alternative Analysis

The high commercial interest CREZs identified in the Phase 3 Study Report are mainly located in southern California. CTPG studies to date have suggested that transmission upgrades located between the southern California and northern California load centers would mitigate reliability criteria violations that could occur with increased transfers between southern and northern California. In addition, the CTPG has concluded that other transmission upgrades located between the California-Oregon border and northern California load areas and between the Northern California load areas and northern Nevada would provide the additional transmission capacity needed to import a proportionally larger amount of renewable resource from northern California, the Pacific Northwest and northwest Nevada than is assumed in other scenarios evaluated by the CTPG should California load serving entities choose to obtain a larger share of their renewable energy from renewable resources located in these areas. CTPG considered additional analysis in this area to be of significant importance to ensure the CTPG's statewide transmission plan provides for a northern import alternative which could be balanced against utilizing southern in-state renewable resources to meet California's RPS goals.

Regardless of how future procurement strategies will develop, CTPG acknowledges that infrastructure additions into northern California, whether it is from southern California or the Pacific Northwest and northwest Nevada, will necessarily be based on the renewable resource development patterns and fossil-fired generation dispatch patterns described above. As such, a more complete understanding of load serving entities' procurement strategies is needed before a final transmission plan for southern or northern California can be developed. The CTPG does not intend to resolve these issues within the Phase 4 effort; rather it is intended to review the viability of northern California CREZs along with renewable resource development areas located in the Pacific Northwest and Northern Nevada. With this information along with the existing power flow studies completed in Phase 3, the CTPG will determine if there are additional "high potential" and/or "medium potential" transmission upgrades that should be considered, along with those presented by the CTPG in the Phase 3 Study Report, for inclusion in the 2010 state-wide transmission plan and further detailed study during the 2011 CTPG study effort.

1.4 Southern California Alternative Analysis

The CTPG stakeholders have strongly suggested that the CTPG perform additional studies on the potential delivery of much larger amounts of out-of-state renewable energy resources imported into California via southern Nevada and western Arizona. At the request of the CTPG, RETI has recently provided a proposed scenario that they have named the "West of the River Stress" scenario. The description of the proposed scenario provided by RETI is included in Section 4.3. This scenario includes a "discounted core" and an out-of-state component from the

southwest, with the remainder of the resources from the RETI's "Best CREZs". Table 1.1 shows the proposed resource contributions to the scenario.

Table 1.1: West of River Stress Scenario

Resource	GWh/year	% Total
Discounted Core[1]	20,905	40%
Additional Southwest Out-of-State Imports	21,106	40%
California RETI Best CREZs	10,753	20%
Totals	**52,764**	**100.0%**

The "discounted core" consists of projects identified by the CPUC as having power purchase agreements (PPAs) which have been approved by an appropriate regulatory entity *and* have filed an application for a permit to construct the project with appropriate permitting agencies. The "discounted core" provided by RETI is the most current information from the CPUC. The discounted core includes renewable resources located in Alberta, Oregon, Idaho, Montana, New Mexico, southern Nevada, and Arizona. The "additional southwest out-of-state import" category includes renewable resources located in New Mexico, southern Nevada, Arizona and Wyoming. As requested by RETI, CTPG intends to model the resources included in the "additional southwest out-of-state import" category as connected to existing buses at the Eldorado substation in southern Nevada, at the Palo Verde substation near Phoenix, Arizona and at the North Gila substation in southwest Arizona. RETI characterizes these substations as "portals." Table 1.2 shows the proposed injection amounts for the respective portals for the "additional southwest out-of-state import" category.

Table 1.2: Southwest Out-of-State Imports

Portal	GWh/yr	% Total
Eldorado	10,553	50%
Palo Verde	7,915	37.5%
North Gila	2,638	12.5%
Totals	**21,106**	**100%**

The sum of the renewable energy in the discounted core (20,907 gWh) and the "additional southwest out-of-state import" category (21,106 gWh) is less than the renewable net short requirement of (52,764 gWh). The remaining amount of renewable energy (10,751 gWh) for the "West of the River Stress" scenario consists of in-state energy resources evaluated by RETI in their Phase 2B Report as having the best estimated economic and environmental ranked scores.

[1] Includes resources located in the desert Southwest.

The final energy attributed to each resource is 17% of the total energy potential estimated for each renewable resource within the identified "best" CREZs.

Similar to the southwest scenario studies completed in Phase 2, the CTPG plans to perform two study cases in Phase 4 utilizing the RETI West of River Stress Scenario.

- Case A: 2020 Northern California adverse weather (1-in-10 Northern California peak coincident with an approximate Southern California 1-in-2 peak) case
- Case B: 2020 Southern California adverse weather (1-in-10 Southern California peak coincident with an approximate Northern California 1-in-2 peak) case

For the Phase 4 studies, the CTPG will also use the same Net Short provided by RETI for Phase 2 and Phase 3, 52,764 gWh. The methodology used in Phase 4 for decrementing of fossil fuel resource (re-dispatch) will also be similar to that used in Phase 2 and Phase 3. The CTPG will decrement fossil fuel generation with the highest heat rate units reduced first. For generation reductions in the local capacity areas of California, this method will limit reductions to levels above the local capacity requirement as identified by the applicable balancing authority. Generation units that are "must run units" located within the service territory of non-participating California ISO entities will also not be subject to re-dispatch. Also in Phase 4, the CTPG will continue to utilize the 70/30 in-state/out-of-state generation re-dispatch approach. All other analysis methods, grid configuration, and reliability criteria will be the same as those used in previous CTPG work.

1.5 Analysis of the Ability of High Potential Transmission Elements in Meeting the 33% RPS

The CTPG stakeholders have requested an analysis be done to determine the level of renewables that could potentially be delivered via the "high potential" transmission upgrades identified in the Phase 3 Study Report. In Phase 4, with input from stakeholders, the CTPG will perform power flow analysis to estimate the amount of renewable resources that can be dispatched without any contingency-based thermal overloads with the "high potential" transmission upgrades in place.

The CTPG will perform power flow analysis similar to those completed in Phase 1 through 3. Three stress cases will be utilized for the analysis:

- Case A: 2020 Northern California adverse weather (1-in-10 Northern California peak coincident with an approximate Southern California 1-in-2 peak) case
- Case B: 2020 Southern California adverse weather (1-in-10 Southern California peak coincident with an approximate Northern California 1-in-2 peak) case
- Case F: 2020 California Autumn morning, light load

Utilizing these stress cases, the CTPG will estimate the amount of renewable resources that can be dispatched without any contingency-based thermal overloads. The CTPG emphasizes that this analysis is designed only to evaluate the *capability* of the "high potential" transmission upgrades to accommodate increased levels of renewable resource development; it should not be interpreted as implying anything about the *likelihood* that the modeled pattern of renewable

resource development will in fact occur. Also, this analysis is limited to on-peak and off-peak "snapshots" of electric system performance and does not include deliverability analysis or economic determinations.

Note that because the CTPG's "high potential" and "medium potential" transmission upgrade identification methodology used the generator interconnection queue portfolio which only included generator interconnection queues for utilities with retail loads located exclusively in California as a filter for selecting CREZs with high commercial interest, there is, by definition, a limited number of out-of-state renewable generators included in the analysis. Note further that an interim CPUC "discounted core" renewable resource development portfolio was also used in the filtering process. This portfolio does not include any renewable generation that may be contracted to municipal utilities within the state of California.

1.6 2010 California State-Wide Transmission Plan

The CTPG is committed to developing a 2010 Statewide Transmission Plan that will facilitate the ability of the state to meet its 2020 RPS goal. The proposed plan will factor in the results, conclusions, and recommendations documented in the four phases of work performed by the CTPG during 2010. Like the preceding phases of the CTPG work, the proposed statewide transmission plan will include a stakeholder process to allow communication, coordination, and input from Stakeholders. A draft schedule for the Phase 4 process and development of the state-wide will be posted to the CTPG website. The proposed state-wide plan will also include a report on the status of the CTPG member's respective renewable energy transmission planning.

2 Phase 4 Study Plan Overview

2.1 Objectives

The CTPG is committed to developing a conceptual California state-wide transmission plan to meet, by year 2020, the state's 33% RPS goal. This transmission plan will seek to leverage a diverse portfolio of renewable energy generation technologies including wind, geothermal, small hydro, biomass and solar thermal and solar photovoltaic available to supply projected electricity demand in California from now to beyond 2020.

As reflected in this Phase 4 study plan, CTPG has sought to be responsive to stakeholders and other entities with roles in the planning and implementation of transmission development, including the Renewable Energy Transmission Initiative (RETI) and state energy agencies. An important further qualification of the CTPG process and the state-wide conceptual plan that is being developed is that CTPG is not a transmission or generation project decision-making body. Such decisions will be made by the relevant CTPG members that are planning entities for their Balancing Authority Areas in accordance with their own processes for such decisions. Thus the 2010 statewide plan is intended to be conceptual, not prescriptive, in line with the CTPG role as a forum for statewide collaboration on planning. As such, the CTPG regularly requests and utilizes information from its members and from other state agencies on renewable projects that represent a snapshot of their respective generation interconnection queue processes, and has sought to make assumptions on how to aggregate such projects into a portfolio that achieves a

state-wide 33% RPS. This snapshot is only being used to facilitate studies to determine potential state-wide transmission needs.

2.2 Study Scope

The identification of transmission system improvements that may be required by an expected change in generation resources or the grid configuration begins with snapshot analysis of grid performance under forecast system conditions. The North American Electric Reliability Corporation (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 center reliability. For the initial phase of the CTPG work, on- and off-peak studies were conducted to help frame system needs while accommodating increased renewable resource development. In evaluating the performance of the transmission system with increased levels of renewable resources, it is important to understand and prepare for what may happen under adverse system conditions, as well as during expected system conditions. Adverse conditions include high load hours when solar output will be at peak levels. Adverse conditions may also occur during lower load hours when wind generation is high but the amount of on-line dispatchable generation is relatively low. By testing a range of possible resource scenarios, in each phase across these same cases, the most accurate statewide transmission plan will be developed.

Phase 4 (like Phase 1 through Phase 3) includes variations of the following cases that represent forecasted adverse and normal conditions:

- Case A: 2020 Northern California adverse weather (1-in-10 Northern California peak coincident with an approximate Southern California 1-in-2 peak) case
- Case B: 2020 Southern California adverse weather (1-in-10 Southern California peak coincident with an approximate Northern California 1-in-2 peak) case

Phase 4 will also include the following additional study case in the analysis of the proposed High Potential Transmission elements:

- Case F: 2020 California Autumn morning, light load

Cases A, B, and F include those transmission additions that are in the WECC 2019 Heavy Summer seed case as well as certain transmission elements that will allow for the interconnection of new renewable resources. Case A, B, and F assume that major upgrades are built including Midpoint-Devers-Valley, Tehachapi Segments 1-11, the Barren Ridge/Haskell Canyon/Rinaldi upgrades, and upgrades in the Owens Valley.

The studies for the cases will be performed using the following general steps.

Step 0: Develop Benchmark Base Case

- WECC 2019 cases as seed for scenarios
- Reflect transmission system configuration expected in 2020
- Update California demand according to scenario
- Re-dispatch path flows according to scenario
- Perform detailed contingency analysis to confirm reliability criteria is met

Step 1: Add Renewable Projects

- Model renewable projects at 0 MW output – CAISO and POU queue projects
- Modify grid to provide CREZ connections – Gen-tie and collector lines
- Perform detailed contingency analysis to confirm reliability criteria is met
- Identify and review limiting constraints or violations

Step 2: Dispatch Renewable Projects

- Dispatch renewable projects to anticipated output for each scenario
- Decrease an equal amount of fossil fuel generation
- Perform detailed contingency analysis to meet reliability criteria
- Identify and review limiting constraints or violations
- Identify transmission additions that will mitigate identified reliability criteria violations. These additions may include elements of the RETI Phase 2A conceptual transmission plan.

The case nomenclature uses a letter designation for scenarios followed by a number representing the particular step. Case A0 for example would be Scenario A with the modeling required in Step 0.

Case A2 will assess additional transmission that will mitigate identified reliability criteria violations during a northern California 1-in-10 year peak coincident with a southern California 1-in-2 year peak assuming 33% RPS goals are met but without stressing path flows. Case B2 will assess additional transmission that will mitigate identified reliability criteria violations for a southern California 1-in-10 year peak coincident with a northern California 1-in-2 peak assuming 33% RPS goals are met but without stressing path flows. Case F will be use the CTPG member forecasted peak data for a typical September, 2020 day at 9:00 AM. Case F is intended to study system stress conditions that may be expected from a September morning which will include high wind generation output, morning solar generation output, and a light load.

Cases A, B, and F may identify certain Category B and C reliability criteria violations that require further study to identify suitable mitigation. Such mitigation can range from transmission infrastructure additions to operating procedures such as controlled load drop (for Category C) and/or generator tripping (Category B and C). However, the CTPG has decided it will not evaluate the feasibility of such operation measures (See Section 3.1 Reliability Criteria for this discussion.) It is important to note these cases do not assess the "deliverability" of renewable

resources as that term is used for resources connecting within the CAISO balancing authority area.

2.3 Grid configuration

As in previous phases, Phase 4 studies will be performed using the WECC's 2019 Heavy Summer case. This case is the latest available data for the WECC interconnected system for the 2020 time frame. A WECC full-loop representation will be used; and includes the Western United States, Western Canada and the system of Comisión Federal de Electricidad (CFE) in Baja California, Mexico.

As part of the study process some adjustments are anticipated between phases. For Phase 2 through Phase 4, the following adjustments were implemented:

- Removal of the proposed Green Path North project. LADWP has stated that this project will not be pursued.
- The addition of a recently approved third circuit to the Barren Ridge/Haskell Canyon/Renaldi planned upgrades.

Table 2.1 lists the major transmission upgrades in the seed 2019 WECC Base Case that were assumed in-service for all CTPG cases in this study and subsequent additions and subtractions.

Table 2.1: Transmission Upgrades included in the 2019 "Heavy Summer" Seed Case and Transmission Additions/Subtractions made to the Seed Case

Upgrades with Key Regulatory Approvals and Environmental Permits	Upgrades without Key Regulatory Approvals and Environmental Permits	Upgrades Removed
-Tehachapi Segments 1-3 - Sunrise Powerlink project -Tehachapi Segments 4-11	- New Colorado River ("Midpoint") 500 kV substation looping in existing 500 kV Palo Verde-Devers #1 line. - 500 kV Colorado River-Devers #2 line - 500 kV Devers-Valley #2 line - Expand Barren Ridge 230 kV substation. Upgrade existing 230 kV Owens Gorge-Rinaldi line from Barren Ridge to Haskell Canyon with double circuit 230 kV towers. Add Barren Ridge-Haskell Canyon #2 line on open side of towers - Upgrade existing 230 kV Owens Gorge-Rinaldi line from Haskell Canyon to Rinaldi - Add 230 kV Castaic-Haskell Canyon #2 line on open side of towers - Loop existing 230 kV Coachella Valley-Devers line into Mirage substation creating 230 kV Mirage-Devers #2 line. - Reconductor 230 kV Mirage-Devers #2 line from 393 MVA to 494 MVA.	Green Path North

Upgrades with Key Regulatory Approvals and Environmental Permits	Upgrades without Key Regulatory Approvals and Environmental Permits	Upgrades Removed

3 General Guidelines and Criteria

The CTPG will conduct contingency-based power flow analysis for the cases described in the previous section. The General Electric Positive Sequence Load Flow program (GE-PSLF) will be used in conjunction with in-house Engineer Programming Control Language (EPCL) routines to help analyze the study results.

3.1 Reliability Criteria

Like the previous phases, the Phase 4 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-010-1.
4. The double contingency analysis shall meet the requirements R2.4 and R2.5 and Regional Differences E.1 of FAC-010-1.

NERC Standard FAC-010-1 (E.1 R.1.2.5) provides 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. The CTPG will not be performing an alternative analysis for mitigating the need for a new or upgraded transmission line with protection control systems in the 2010 study plan. This alternative analysis will be completed by the entity responsible for each particular proposed transmission improvement utilizing its own analysis assumptions and mitigation policies and practices. The CTPG may perform this type of analysis in future studies.

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. The CTPG may perform this type of analysis in future studies.

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 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.

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/WECC standards provide a framework from which computer simulation studies will be performed to model forecasted system conditions and evaluate the system performance. The following standards will be used for 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
    - Reliability Criteria For Transmission System Planning
    - 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

3.2 Power Flow Contingency Analysis Guidelines

Power flow contingency analysis will be performed for each scenario consistent with the standards referenced in the previous section to identify thermal overload conditions. Note that additional contingencies may be added based upon engineering judgment for particular runs.

4 Input Assumptions

This section describes the key input assumptions to the Phase 4 study plan, including the CTPG aggregate renewable energy planning target (net short), CTPG members' peak demands, and the new renewable generation scenarios and sensitivities to be studied.

4.1 Updates to the 2020 Renewable Energy Planning Target (Net Short)

In Phase 1, the CTPG identified the amount of renewable energy resource additions, "net short", that will be required between 2010 and 2020 to meet the 33% RPS goal for the state of California.[2] Further description of these assumptions is available in the CTPG Phase 1 study

[2]In Phase 1, CTPG used the 2020 energy forecast of the CEC's 2009 Integrated Energy Policy Report (IEPR), which resulted in an estimated 289,697 GWh of retail load in the state of California subject to the state's renewable goal. Under that assumption, assuming a 33% RPS goal in year 2020, load serving entities would be required to obtain a total of 95,600 GWh of renewable energy in order to meet the target, of which approximately 53,605 GWh would be acquired from resources over and above existing

plan and final report. In Phase 2, CTPG worked with RETI to update estimates of other miscellaneous renewable resource additions and clarifying other differences in assumptions to update the net short estimates that will be applied to the renewable resource portfolios modeled in Phase 2.

Table 4.1 compares CTPG's Phase 1 study estimated renewable energy production and net short with the 2009 RETI Phase 2A calculation which utilized a prior CEC demand forecast for 2020, and hence is higher than the more recent CEC forecast used for the Phase 2 RETI "Heavy In-State" and CTPG Generation Queue estimates. Note that the energy and peak load numbers provided below reflect the CEC's projection of the impact of the California Solar Initiative (CSI), and other behind-the-meter distributed generation, on retail loads. In Phase 4, the CTPG will utilize the same Net Short of 52,764GWhs. Like Phase 2 and Phase 3, to the extent any of CTPG's Phase 4 scenarios assume larger behind-the-meter impacts from distributed generation, or includes other in-front-of-the meter distributed generation, modeled loads in the power flow cases will be reduced accordingly.[3]

Table 4.1: CTPG 2020 RPS Planning Targets Including Net Short (GWh) with comparison to RETI Phase 2A

	CTPG Phase 1	RETI Phase 2A	CTPG Phase 2 RETI Heavy In State	CTPG Phase 2 Gen Queue
Forecast Retail Load subject to California's renewable goals:	289,697	301,974	285,734	285,734
Renewable Portfolio Standard (RPS) Goal:	33%	33%	33%	33%
Renewable Portfolio Standard (RPS) Energy Requirement:	95,600	99,651	94,293	94,293
Existing and New Renewables expected to be on line by end of 2009:	39,324	36,807	38,174	38,174
Miscellaneous renewable resource additions:	2,670	3,134	3,355	3,355
Total Existing and New Resource Additions	**41,994**	**39,941**	**41,529**	**41,529**
Net Short:	**53,605**	**59,710**	**52,764**	**52,764**

and new renewables and other miscellaneous additions – the Net Short. This net short requirement was modified in Phase 2, as described in this section and shown in the third and fourth column of Table 4.1.

[3] As noted elsewhere in this document, distributed generation poses modeling challenges that will eventually need to be addressed. For now, CTPG intends to simply model distributed generation by reducing loads.

Identified Renewable Resource Additions:	55,535	95,536*	52,764	52,764
Total Renewable Energy Production:	97,530	135,477*	94,293	94,293
Identified Renewable Energy as a Fraction of Retail Sales:	33.7%	44.9%*	33%	33%

*For purposes of developing a conceptual transmission plan that addresses uncertainties in the location of renewable resource development, RETI Phase 2A planned for renewable resource additions equal to approximately 1.6 times the RETI Phase 2A net short.

4.2 Peak Demand

In Phase 1, CTPG used peak demand forecasts for "1-in-2" and "1-in-10" summer weather conditions in 2020 provided by the individual members. In Phase 4, like Phase 2 and Phase 3, the scenario modeled will use the assignments to each area used in the CEC IEPR 2009 forecast for peak demands consistent with the assumptions of the CTPG renewable net short calculation.[4]

Table 4.2 provides the data from the CEC peak demand forecasts for year 2020 for the Northern California Peak and the Southern California Peak. The Northern California Peak Demand includes the Northern California 1-in-10 year peak demand coincident with the Southern California 1-in2 year peak demand. The Southern California Peak includes the Southern California 1-in-10 year peak demand coincident with the Northern California 1-in-2 year peak demand. The adjusted Northern and Southern California Peak Demands consists of the CEC Peak Demand Forecasts excluding: pump loads, forecasted distributed generation (Digester and Landfill Gas, Small Hydro, PV, and other small capacity generation) assumed by RETI, and transmission losses.

Table 4.2: CTPG Phase 2 Year 2020 Peak Demand (MW) based on CEC 2009 forecast

Area	CEC Northern California Peak Demand	Adjusted Northern California Peak Demand	CEC Southern California Peak Demand	Adjusted Southern California Peak Demand
PG&E	26,423	24,606	24,626	22,924
TID BA	829	802	776	749
SMUD BA	5,679	5,450	5,196	4,972
SCE	26,875	25,127	29,359	27,604
SDG&E	5,157	4,937	5,673	5,435
LADWP BA	6,912	6,335	7,501	6,917

[4] Available at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/CEC-200-2009-012-SF-REV.PDF

IID BA	1,256	1,253	1,354	1,349
Total	73,132	68,511	74,485	69,951

4.3 Renewable Generation Scenarios

CTPG recognizes that there remains uncertainty about the renewable generation portfolios that will be realized in 2020 under the State's RPS. To address this uncertainty, CTPG is evaluating several alternative renewable generation portfolios as a basis for determining the impact of those alternatives on the state-wide conceptual transmission plan. This section reviews the portfolios used in Phases 1 through 3 and then describes the additional scenarios that will be examined in Phase 4. Additional information on the portfolios used in the prior phases can be found in the study plans and reports for each phase available on the CTPG website.

Review of CTPG Phases 1, 2, and 3 Renewable Generation Portfolios

Phase 1 - California Load-Serving Entity (LSE) procurement plan portfolio. This portfolio was developed to reflect the initial preferences of the load serving entities supplying the majority of California retail loads. These entities have provided renewable procurement portfolios that reflect anticipated plans, installed capacity, and in some cases the expected renewable dispatch at the time of peak[5]. In other cases CTPG used generic factors to relate nameplate capacity to expected renewable dispatch for the hour of study (e.g., peak hour, off-peak hour). These generic factors were taken from energy output profiles prepared for each of RETI's CREZs by technology for the specific hour and month. These hourly and monthly output profiles were also used to determine the forecasted annual energy generation estimate in the year 2020 by CREZ and technology. Rooftop PV and other distribution-level generation were considered as a reduction to load. The CTPG members jointly identified the amount of renewable energy resource additions, the "net short", that will be required between 2010 and 2020 to meet the 33% RPS. Finally, as is evident from the data collected by the CTPG, California load serving entities' plans included adding renewable resources located in Idaho and Montana.

Phase 2 - Generation Interconnection Queue-based Portfolio. This portfolio utilized the renewable generation interconnection queues of CTPG members. The selection criteria used for the CAISO queue was to include projects in the following stages in their interconnection process: (1) For Serial interconnection studies (LGIP and SGIP) – All renewable projects with all interconnection studies completed and that have either signed or are in process of signing their interconnection agreement; (2) all remaining renewable projects in the ISO Transition Cluster (after posting of financial securities). The portfolio also added the proposed renewable generation projects and associated transmission for renewable energy projects considered to be the most advanced in their respective approval processes from the other CTPG planning entities

[5] Not all entities serving retail loads in California that are subject to California's renewable resource goals supplied renewable procurement plans to CTPG. CTPG's Phase 1 report lists those load serving entities that supplied renewable procurement plans to CTPG, and those that did not.

(IID, LADWP, SMUD, TANC, and TID). For the CAISO queue, approximately 15,000 MW of resources were selected; the other CTPG planning entities selected approximately 3000 MW of resources.

The total annual renewable energy generation requiring transmission access used in this portfolio was set equal to a "net short" calculated by RETI, a value of 52,764 GWh.[6] The aggregate of the CAISO queue projects and the other state planning agency projects that met the selection criteria resulted in a 35% RPS. Therefore the CTPG scaled down all queue projects equally so that the aggregate of all proposed projects equaled 33%. The CTPG recognized that this scenario contained only approximately 8% of energy generated out-of-state. However, other scenarios studied in Phases 1 and 2 evaluated larger import levels and the associated impacts.

Phase 2 - RETI "Heavy In-State" Portfolio. This portfolio was developed by RETI with contributions by the CPUC. Like the generation queue portfolio, the case was scaled to achieve the RETI net short. Renewable generation included in the scenario was identified from three categories: (a) a "discounted core" consisting of projects having power purchase agreements (PPAs) which have been approved by an appropriate regulatory entity and have filed an application for a permit to construct the project with appropriate permitting agencies; (b) Competitive Renewable Energy Zones (CREZ) in California having estimated economic and environmental ranking scores better than median California scores; and (c) out of state CREZ having economic scores better than the median out-of-state economic score (RETI has not attempted to compare environmental attributes of out-of-state areas). Finally, the energy needed in addition to the discounted core to satisfy the net short was (a) Divided 70/30 between in- and out-of-state areas; and (b) computed on a pro rata basis from CREZ included based on total estimated CREZ energy potential.

Phase 2 - "Northern" and "Desert Southwest" Scenarios. The Generation Interconnection Queue Portfolio was used as the basis for two further portfolios with additional out-of-state resources: a "Northern" scenario and a "Desert Southwest" scenario. The Northern scenario assumed that renewable resources modeled in Northern California or north of California and committed to California load serving entities in Phase 1 were to change from 18% of total required renewable resources to about 42%. The Desert Southwest portfolio assumed that out-of-state renewable resources modeled in that region and committed to California load serving entities were to change from 2% of total renewable resources to about 15% of total renewable resources. In both scenarios, the renewable resources from the Generation Interconnection Queue Portfolio in Southern California were decremented on a pro-rata basis so that the aggregate of all proposed projects equaled 33%.

Phase 2 - Owens Valley Development Scenario. The Generation Interconnection Queue Portfolio was also used as the basis for a scenario in which 5000MW of installed capacity of Solar Photovoltaic at Owens Valley was substituted for other renewable resources in Southern California. The other Southern California renewable resources were decremented on a pro-rata basis so that the aggregate of all proposed projects equaled 33%.

[6] See http://www.energy.ca.gov/reti/steering/2010-01-19_meeting/documents/04-Net%20Short%20Draft%202010-01-18.pdf.

Phase 3 – RETI "Best CREZ" Portfolio. In Phase 3, the CTPG continued its engagement with RETI and modeled an additional RETI scenario. The RETI scenario consisted of the "Best CREZs" as ranked by RETI and selected to supply 33% renewable energy. RETI CREZ ranking was refined over several phases of RETI work and consists of evaluating a broad set of economic and environmental criteria, which resulted in an economic "supply curve" and an environmental "supply curve" for the in-state and a few out-of-state CREZs. The best CREZs were those with the best economic and environmental scores. A difference between this RETI portfolio and the one modeled in CTPG Phase 2 is that this portfolio did not specifically require inclusion of the "discounted core" projects included in the Phase 2 RETI scenario. That is, some identified projects may overlap with the discounted core but the full set of the core projects is not carried over into this portfolio.

Phase 3 – Generation Interconnection Queue-based Portfolio with Additional Sensitivities on Northern Scenario. In Phase 3, the CTPG continued studying the "Northern" scenario building on the efforts of Phase 2. The Phase 2 report noted that the study results for this scenario exhibited significant unanticipated power flow results measured at the California-Oregon Border and recommended that additional studies for this scenario be conducted.

Phase 4 – RETI West of River Stress Scenario. In Phase 4, in response to stakeholder's suggestions, the CTPG will perform additional studies on the potential delivery of much larger amounts of out-of-state renewable energy resources imported into California at southern Nevada and western Arizona. At the request of the CTPG, RETI has recently provided CTPG with a proposed scenario that they have named the "West of the River Stress" scenario. The description of the proposed scenario provided by RETI is included in Appendix A. This scenario includes a "discounted core" and an out-of-state component from the southwest, with the remainder of the resources from RETI's "Best CREZs". Table 4.3 below shows the proposed resource contributions to the scenario.

Table 4.3: West of River Stress Scenario

Resource	GWh/year	% Total
Discounted Core[7]	20,905	40%
Additional Southwest Out-of-State Imports	21,106	40%
California RETI Best CREZs	10,753	20%
Totals	**52,764**	**100.0%**

The "discounted core" consists of projects identified by the CPUC as having power purchase agreements (PPAs) which have been approved by an appropriate regulatory entity *and* have filed an application for a permit to construct the project with appropriate permitting agencies. The "discounted core" provided by RETI is the most current information from the CPUC.

[7] Includes resources located in the desert Southwest.

The southwest out-of-state imports include the injection of renewable energy resources at the Eldorado, Palo Verde, and North Gila portals. Table 4.4 below shows the proposed amount of energy resources that will be injected at these portals.

Table 4.4: Southwest Out-of-State Imports

Portal	GWh/yr	% Total
Eldorado	10,553	50%
Palo Verde	7,915	37.5%
North Gila	2,638	12.5%
Totals	**21,106**	**100%**

The remainder of the scenario consists of in-state energy resources evaluated by RETI as having the best estimated economic and environmental ranked scores. Table 4.5 below shows the annual energy production for the renewable resources included in the West of River Stress scenario. Table 4.6 below compares the renewable resource generation scenarios for each of the CTPG study phases.

Table 4.5: West of River Stress Scenario

CREZ / Renewable Resource Location	Biomass/ Biogas (gWh)	Geothermal (gWh)	Solar PV (gWh)	Solar Thermal (gWh)	Wind (gWh)	Total (gWh)
Barstow						0
Carrizo North						0
Carrizo South			1859			1859
Cuyama						0
Fairmont	170		504	703	347	1724
Imperial East						0
Imperial North-A		1759				1759
Imperial North-B						0
Imperial South		298	109	657		1064
Inyokern						0
Iron Mountain				329		329
Kramer		28		3018	78	3124
Lassen North						0
Lassen South						0
Mountain Pass				898		898
Needles						0
Owens Valley						0
Palm Springs					202	202
Pisgah-A				1095		1095
Riverside East			1205	1077		2282
Round Mountain-A		445				445
Round Mountain-B					207	207
San Bernardino-Baker						0
San Bernaridno-Lucerne					110	110
San Diego North Central						0
San Diego South					319	319
Santa Barbara					216	216
Solano					100	100
Tehachapi	46			2804	6605	9455
Twentynine Palms						0

CREZ / Renewable Resource Location	Biomass/ Biogas (gWh)	Geothermal (gWh)	Solar PV (gWh)	Solar Thermal (gWh)	Wind (gWh)	Total (gWh)
Victorville						0
Westlands			110			110
San Diego (Border substation)	92					92
Sylmar	44					44
Stockton	197					197
McFarland	193					193
Petaluma	22					22
Hanford	9					9
Blue Lake	48					48
Alberta					1356	1356
Arizona			3273	2638	3958	9869
Idaho					237	237
Montana					788	788
Nevada-Central						0
Nevada-South			2748	3515	1319	7582
New Mexico	140				2639	2779
Oregon					1614	1614
Wyoming					2639	2639
					TOTAL	**52764**

Table 4.6: Comparison of Renewable Generation Scenarios for CTPG Phase 1, RETI Phase 2A, CTPG Phase 2-Generation Queue and RETI Heavy In-State, CTPG Phase 3 RETI Best CREZ, and CTPG Phase 4 RETI West of River Stress Scenarios

	CTPG Phase 1 Portfolio		RETI Phase 2A Portfolio*		CTPG Phase 2 Portfolio				CTPG Phase 3 Portfolio		CTPG Phase 4 Portfolio
CREZ	LSE Commercial Interest Installed Capacity (MW)	LSE Commercial Interest Annual Renewable Energy Production (GWh)	RETI Projected Installed Capacity (MW)	RETI Projected Energy Production (GWh)	Generation Queue Installed Capacity (MW)	Generation Queue Annual Renewable Energy Production (GWh)	RETI Heavy In-State Installed Capacity (MW)	RETI Heavy In-State Annual Renewable Energy Production (GWh)	RETI Phase 3 Scenario Installed Capacity (MW)	RETI Phase 3 Annual Renewable Energy Production (GWh)	RETI Phase 4 Annual Renewable Energy Production (GWh)
Barstow	850	1985	617	1546	0	0	0	0	0	0	0
Carrizo North	0	0	422	896	718	1532	0	0	0	0	0
Carrizo South	1545	3429	1024	2197	228	510	760	1616	0	0	1859
Cuyama	0	0	211	471	37	78	0	0	0	0	0
Fairmont	345	862	929	2734	0	0	1126	2974	1346	3555	1724
Humbolt	11	82	0	0	0	0	0	0	0	0	0
Imperial East	15	43	429	1045	0	0	0	0	0	0	0
Imperial North-A	352	2775	1370	10626	546	4305	631	4456	696	5126	1759
Imperial North-B	386	1843	483	1190	418	901	0	0	0	0	0
Imperial South	466	1091	981	2420	2101	4990	300	648	0	0	1064
Inyokern	242	467	642	1669	483	2552	0	0	0	0	0
Iron Mountain	0	0	1297	3065	0	0	0	0	0	0	329
Kramer	344	988	1693	4370	41	326	2724	6280	3256	7507	3124
Lassen North	873	2262	387	999	463	3652	0	0	0	0	0
Lassen South	0	0	108	292	0	0	0	0	0	0	0
Mountain Pass	768	1777	438	1145	656	1475	310	800	0	0	898
Needles	0	0	122	313	0	0	0	0	0	0	0
Owens Valley	0	0	370	954	184	399	0	0	0	0	0
Palm Springs	147	500	203	685	183	624	37	118	0	0	202

	CTPG Phase 1 Portfolio		RETI Phase 2A Portfolio*		CTPG Phase 2 Portfolio				CTPG Phase 3 Portfolio		CTPG Phase 4 Portfolio
CREZ	LSE Commercial Interest Installed Capacity (MW)	LSE Commercial Interest Annual Renewable Energy Production (GWh)	RETI Projected Installed Capacity (MW)	RETI Projected Energy Production (GWh)	Generation Queue Installed Capacity (MW)	Generation Queue Annual Renewable Energy Production (GWh)	RETI Heavy In-State Installed Capacity (MW)	RETI Heavy In-State Annual Renewable Energy Production (GWh)	RETI Phase 3 Scenario Installed Capacity (MW)	RETI Phase 3 Annual Renewable Energy Production (GWh)	RETI Phase 4 Annual Renewable Energy Production (GWh)
Pisgah	3248	7763	673	1658	781	1867	500	1047	0	0	1095
Riverside East	1562	3471	2785	6725	2527	5615	0	0	0	0	2282
Round Mountain-A	0	0	101	710	94	253	163	1086	195	1298	445
Round Mountain-B	78	319	49	196	0	0	103	303	0	0	207
San Bernardino - Baker	825	1870	969	2299	0	0	0	0	0	0	0
San Bernardino - Lucerne	174	560	800	2150	0	0	42	96	0	0	110
San Diego	23	171	0	0	0	0	0	0	0	0	0
San Diego North Central	0	0	74	195	24	51	0	0	0	0	0
San Diego South	0	0	179	508	332	939	308	935	344	929	319
Santa Barbara	92	249	114	312	110	299	83	280	0	0	216
Solano	408	1248	236	756	587	1953	2	5	454	1382	100
Tehachapi	3868	10189	5514	15716	5633	15397	6026	15804	5294	12914	9455
Twentynine Palms	0	0	477	1219	0	0	0	0	0	0	0
Victorville	0	0	432	1128	312	768	0	0	0	0	0
Westlands	0	0	0	0	0	0	0	0	2539	4223	110
Arizona	333	740	0	0	0	0	2048	5240	564	1376	9869
Baja	0	0	5000	16966	1029	2704	0	0	0	0	0
British Columbia	0	0	340	1849	0	0	0	0	0	0	1356
Idaho	130	350	0	0	0	0	668	2352	351	1327	237
Montana	413	1111	0	0	0	0	0	0	0	0	788

	CTPG Phase 1 Portfolio		RETI Phase 2A Portfolio*		CTPG Phase 2 Portfolio				CTPG Phase 3 Portfolio		CTPG Phase 4 Portfolio
CREZ	LSE Commercial Interest Installed Capacity (MW)	LSE Commercial Interest Annual Renewable Energy Production (GWh)	RETI Projected Installed Capacity (MW)	RETI Projected Energy Production (GWh)	Generation Queue Installed Capacity (MW)	Generation Queue Annual Renewable Energy Production (GWh)	RETI Heavy In-State Installed Capacity (MW)	RETI Heavy In-State Annual Renewable Energy Production (GWh)	RETI Phase 3 Scenario Installed Capacity (MW)	RETI Phase 3 Annual Renewable Energy Production (GWh)	RETI Phase 4 Annual Renewable Energy Production (GWh)
New Mexico	0	0	0	0	544	0	0	0		0	2779
Nevada	456	2388	466	3446	0	1574	727	2476	187	1259	7582
Oregon	1637	4408	392	3062	0	0	1349	3921	560	2035	1614
Utah	0	0	0	0	0	0	255	905	322	1140	0
Washington	963	2594	0	0	0	0	447	1422	563	1793	0
Wyoming	0	0	0	0	0	0	0	0	2230	6899	2639
Non CREZs											602
Total	**20554**	**55535**	**30327**	**95536**	**18031**	**52764**	**18609**	**52764**	**18900**	**52764**	**52764**

* For purposes of developing a conceptual transmission plan that addresses uncertainties in the location of renewable resource development, RETI planned for renewable resource additions equal to 1.6 times the RETI net short.

4.4 Renewable Generation Production Profiles

As noted above in Phase 1 through Phase 3, CTPG used a combination of sources to establish production profiles for renewable resources. Based on the location of each CREZ, and the mix of renewable resources within each CREZ, CTPG members have developed estimates of the expected energy output of each CREZ for the specific study conditions assumed for the power flow cases. These estimates are based on actual hourly output data for similar technologies in similar locations.[8] In Phase 2, this information was updated by Black and Veatch to match the energy production profiles currently used by RETI. For study purposes, the CTPG utilizes the expected average capacity factor for that resource type within that CREZ location. In contrast, RETI's West of River Stress scenario utilizes (i) the capacity factors for a specific discounted core project within each CREZ, and (ii) approximate capacity factors for generic resources in the "best" CREZs for inclusion in their scenario(s). This difference in approach, depending on location, will result in differences between RETI's annual energy output calculations and those that would be produced were the location-specific renewable output profiles used. For purposes of the West of River Stress scenario, CTPG will use the capacity factors provided by RETI.

Wind and solar generation modeled in the studies are represented as fixed production profiles. There is no consideration given in the analysis to dispatch control of renewable resource output (i.e., generation re-dispatch as discussed for fossil units in Section 6.1.), as may ultimately be needed to mitigate over-generation and congestion or ramp constraints on the rest of the generation fleet caused by variable renewable generation. Evaluation of renewable integration requirements will be completed separately by each planning entity.

5 Generation Re-Dispatch

5.1 Reduction Priority

As renewable generation production is increased, an equal amount of fossil fueled generation is required to be turned down (or decremented). 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. The least efficient fossil units will be the most likely to shut down by 2020. In Phase 1 through Phase 3, the CTPG used several methods as the basis for reduction priority including using heat rate as a measure of the cost to generate and carbon as a potential indicator of future costs. In Phase 4, heat rate will be used again to determine which units will be backed down first. Generally, a high heat rate translates into higher cost to produce electricity.

Because of their location, some fossil generation because of their location may provide local benefits which can override economic considerations (i.e. must run or local capacity requirements). Renewable integration during real time operations may also require more fossil

[8]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 .

generation to remain on-line to address intermittency issues. Fossil generation developed as peakers may also remain in the generation fleet though they typically have higher heat rates.

5.2 In State/Out of State

Phase 1 through Phase 3 employed a 70/30 constraint in the reduction of fossil generation. Seventy percent of the decremented generation is located within California with thirty percent located outside the state. Phase 2 continued with this assumption for both the heat rate and fuel type methods. Phase 3 utilized both the 70/30 constraint method and a fuel type method with no constraints on in state/out of state. In Phase 4, the CTPG will use the 70/30 constraint methodology.

5.3 Re-Dispatch Method

The Heat Rate decrements fossil generation in a merit-order fashion (least economic reduced first). 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. A 70/30 (in/out of state) constraint is imposed for this method.

Table 6.1 shows an example of the fossil generation decremented to offset the first block of renewable generation. This particular block is split 70/30 between units in California and those outside the state. Units in the block are decremented equally until all units in the block are turned off. Decrements below minimum output level are not allowed; i.e., the unit is turned off. Units that are in the next block are then reduced in the same fashion. Nuclear and hydro units are not decremented in the summer peak cases but could be reduced for the off peak cases.

Table 6.1: Fossil Generation Decrement Example - First Block

Internal (In California)			
Name	Unit	Nameplate (MW)	FL H.R. (mmBtu/MWh)
Mandalay	3	130	16.065
Ellwood	1	54	15.125
Olive	1	44	13.953
Long Beach	1	65	13.106
Long Beach	2	65	13.106
Long Beach	3	65	13.106
Long Beach	4	65	13.106
RAMCO OY	1	42	13.009
Grayson	8b	70	13.009
Goose	2	48	13.009
Lambie	1	48	13.009
	Total	**696 MW**	

External (Out of State)

Name	Unit	Nameplate (MW)	FL H.R. (mmBtu/MWh)
Ocotillo GT1	1	56	14
Ocotillo GT2	1	56	14
Yucca CT1	1	19	14
Yucca CT2	1	19	14
WPhx GT1	1	56	14
WPhx GT2	1	56	14
Reeves	1	40	13.613
	Total	**302 MW**	

For generation reductions in the ten local capacity areas of California, this method limits reductions to levels above the 2014 local capacity requirement as identified by the California ISO. The California ISO report is available at:

http://www.caiso.com/2495/2495c63b23450.pdf

The following generation units located within the service territory of Los Angeles Department of Water & Power and the Sacramento Municipal Utility District BAA(s) will be considered must run units and will not be re-dispatch.

Table 6: LADWP and SMUD BAA Must Run Units

BUS NO.	GENERATOR NAME	ID
LADWP		
26143	HARBCT10	10
26144	HARBCT11	11
26145	HARBCT12	12
26146	HARBCT13	13
26147	HARBCT14	14
26026	HAYNES1G	1
26027	HAYNES2G	2
26151	HAYNES8G	8
26152	HAYNES9G	9
26153	HAYNS10G	10

BUS NO.	GENERATOR NAME	ID
26112	SCATT1G	1
26067	SCATT3G	3
26148	VALLEY6G	6
26149	VALLEY7G	7
26150	VALLEY8G	8
SMUD		
37320	UCDMC	1
37321	COSUMNE1	1
37322	COSUMNE2	1
37323	COSUMNE3	1
37303	CAMPBEL1	1
37304	CAMPBEL2	1
37310	PROCTER1	1
37311	PROCTER2	1
37312	PROCTER3	1
37315	SRWTPA	1
37315	SRWTPA	2
TID		
38570	WEC1-CT	1
38574	WEC2-CT	1
38572	WEC3-ST	1
38550	DONPDR01	1
38552	DONPDR02	1
38554	DONPDR04	1
38564	ALMONDCT	1
38560	LA GRNGE	1

BUS NO.	GENERATOR NAME	ID
38562	DAWSON	1

6 Methodology comparison to RETI

As noted above, transmission planning generally consists of three main elements: an estimate of the load that is expected in the planning horizon; modeling of the supply resources that are, or will be, interconnected to the transmission grid; and identification of alternative transmission facilities (upgraded or new transmission lines, substations, and so on) that can meet reliability, economic and policy objectives, such as RPS. The planning methodologies used to model future power system requirements can also vary.

At the request of stakeholders, this section compares the planning assumptions and methodologies used in the CTPG Phases 1 through 4 with those used by RETI in their Phase 2A report. As noted in the prior CTPG study plans and reports, there are both similarities and differences between the CTPG and the RETI Phase 2A assumptions and methodology. This CTPG Phase 4 study plan reflects a further convergence in CTPG and RETI approaches, in that RETI has provided the estimates of future net load and renewable resource scenarios as inputs, while CTPG is conducting the transmission modeling.

6.1 Transmission System Analysis

One basic difference between the RETI Phase 2A transmission analysis and the CTPG approach is the level of transmission modeling used. RETI Phase 2A used input from RETI participants, including CTPG members, to identify potential transmission upgrades. However, this input did not have the benefit of power flow and transient analysis. RETI performed a "generation shift factor" analysis as an input for developing an economic ranking of transmission elements included in the RETI Phase 2A conceptual transmission plan. In contrast, the CTPG is performing power flow and transient analysis to measure electric system performance and for determining transmission system needs.

There was some overlap between the transmission additions included in the RETI Phase 2A conceptual transmission plan and those identified in CTPG's Phase 1 conceptual transmission plan (see the 2010 Phase 1 CTPG 2020 Study Report for a comparison table of RETI Phase 2A and CTPG Phase 1 transmission elements).[9] This results in a smaller set of transmission elements than identified by RETI. CTPG studies will continue to provide those comparisons.

6.2 Net Short and Input Assumptions

When comparing CTPG Phase 1 to the RETI Phase 2A, both studies utilized CEC sources for the forecast of retail energy sales for the state. CTPG and RETI differed slightly in the estimates of expected renewable resources additions by the end of 2009. RETI Phase 2A also assumed that 160% of the renewable energy needed to achieve the 33% RPS should be modeled to account for potential uncertainties. The CTPG has instead identified sufficient renewable resources to

[9] Available at http://www.ctpg.us/public/images/stories/pdfs/2010_phase_1_ctpg_2020_study_report_011310.pdf .

achieve 33% RPS and then identified transmission elements that would mitigate identified reliability criteria violations with this amount of installed renewable generating capacity.

In terms of resources modeled, RETI Phase 2A developed its estimates based on economically feasible renewable development potential, rather than an actual commercial interest in that potential. In addition RETI considered out-of-state renewable resource development potential in British Columbia, Washington, Oregon, Nevada, Arizona and Baja. As is evident from the data collected by the CTPG in its Phase 1, California load serving entities' plans include adding renewable resources located in Idaho and Montana.

In CTPG Phase 2 through Phase 4, as discussed above, CTPG and RETI have converged in that they have agreed to use a common "net short" estimate. Also CTPG will continue modeling updated RETI renewable generation portfolios that, unlike Phase 2A, will be restricted to megawatts of installed renewable capacity needed to achieve a 33% renewable energy target.