Renewable Energy Transmission Initiative

RETI Coordinating Committee

PHASE 2A

FINAL REPORT

August 2009

California ISO

SCPPA

NCPA

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

RETI-1000-2009-001-F

Table of Contents

Appendices

List of Tables

List of Figures

1.0 Executive Summary

1.1 Introduction: About RETI and this Report

The Renewable Energy Transmission Initiative (RETI) is a California stakeholder process charged with developing a conceptual plan for expanding the state's electric transmission grid to provide access to renewable energy resource areas necessary to meet state energy goals. This plan is intended to help expedite development and approval of renewable energy infrastructure found to be required, in ways that minimize the economic cost, environmental impacts and number of new transmission facilities. The RETI conceptual plan assumes that California will also fully achieve its energy efficiency program targets and exceed its currently adopted goals to aggressively expand distributed photovoltaic generation.

RETI work is organized into three phases:

Phase 1: Identification, characterization and ranking of Competitive Renewable Energy Zones (CREZ) in California and neighboring regions;

Phase 2: Development of a statewide conceptual transmission plan to access priority CREZ, based on more detailed analysis of CREZ;

Phase 3: Development of detailed plans of service for priority components of the statewide transmission plan.

A Stakeholder Steering Committee (SSC) directs RETI work, which is performed largely by working groups composed of volunteers representing a wide range of interests and perspectives. RETI is committed to ensuring that its process is open and transparent, and that recommendations are based on the best publicly available information. Stakeholders focus as well on communicating RETI goals, process, results, and recommendations to a larger public audience.[1]

Phase 1 work is summarized in two reports available, along with all materials, maps and meeting records, on the RETI website.[2] RETI Phase 2 activities are guided by

[1] Background information about the purpose and formation of RETI, its Mission Statement, SSC member contact information and all RETI documents are available at www.energy.ca.gov/reti.
[2] Renewable Energy Transmission Initiative, Phase 1A Final Report, May 16, 2008; Renewable Energy Transmission Initiative, Phase 1B Final Report, January 2, 2009. See also, RETI Phase 1B Final Report Update, February 24, 2009.

mission statement, and by Executive Order S-14-08, issued by Governor Schwarzenegger on November 17, 2008.

RETI Phase 2 work focuses on two major tasks:

1. Expanded evaluation and re-ranking of CREZ preliminarily described in Phase 1;
2. Development of a statewide conceptual transmission expansion plan to access the CREZ.

This report presents the results of these activities and the processes used to obtain them. It is divided into chapters on each major task.

One of the primary functions of this report is to provide a recommendation as to which potential transmission projects should be considered priorities for future study, based upon information available today regarding the potential for renewable development. This report does not preclude study of other potential renewable development areas. It does not determine the need for any generation or transmission project, and it does not include in-depth assessment of the environmental impacts of such projects required by law. Consideration of the results presented in this report should take into account the uncertainties surrounding the potential cost and amount of renewable generation that will actually develop in specific CREZ. These assumptions, and the uncertainties surrounding them, are detailed in the RETI Phase 1B Report.

The Phase 2A conceptual transmission plan is designed to facilitate meeting the goal of obtaining 33% of the state's electricity from renewables by 2020. But large investments in transmission infrastructure will be needed between now and 2020, regardless of state energy-supply mix. Many elements of the RETI conceptual transmission plan would likely be required under non-renewables-based planning scenarios. The estimate of the aggregate cost of the conceptual transmission plan presented in this report thus cannot be attributed only to the state's renewable-energy programs.

The conceptual transmission plan presented here evaluates the relative usefulness of potential transmission lines for accessing and delivering renewable energy, under a limited set of assumptions. It does not provide information about the amount of energy that would flow in the line segments if they were in fact added to the system. It does not address congestion, reliability or other dynamics of transmission system operation. And it does not determine whether or to what extent the existing system could accommodate those flows if the line segments were *not* in place.

Within the acknowledged limitations of the preliminary conceptual plan, this report presents two noteworthy conclusions: stakeholder consensus recommendation of two sets of major lines likely to be required not only to deliver renewable energy, but that would provide important additional benefits to the grid; and development of a transparent and objective methodology for evaluating the usefulness of lines to carry renewables, in a process that supports active participation by a broad range of stakeholders.

1.2 Comments Received on the Phase 2A Draft Report

The Phase 2A Draft Report was posted for comment on June 3, 2009, and presented to the public in meetings in Victorville (June 18); Redding (June 23); and Sacramento (June 24). Comments on the Draft Report were accepted through July 10, 2009. A large volume of comments were received, from stakeholders representing: environmental organizations; local citizen groups and concerned individuals; counties; water districts; agricultural interests; utility companies; biomass, solar and wind generators; transmission owners and developers; Native American tribes; state agencies; and the military. As with other RETI reports, all comments received have been posted on the RETI website.

Comments received reflect a large amount of effort by many people to understand RETI planning, suggest improvements in both process and data, and request specific changes. The SSC reviewed comments received and directed revisions to the draft report which have been incorporated into this Phase 2A Final Report.

Some new information obtained since development of the Phase 2A Draft Report has not been able to be incorporated in this report. As a direct result of the state budget crisis and mandatory furlough days for state agencies, employees and contractors, and due to budgetary constraints, CREZ could not be re-ranked to fully incorporate the effects of, among other things, renewable energy tax credits approved by Congress earlier this year; changes in CREZ power output estimates caused by re-drawing boundaries of certain CREZ; or creation of a sub-CREZ for additional wind resources in Baja California. As noted throughout this report, these and other tasks have been deferred to later phases of RETI work, which are now under consideration by the SSC.

Economic re-ranking is likely to change the priority order of a few CREZ. This may affect the development priority of a few Renewable Collector lines, which may be analyzed more closely in potential future RETI work. It is highly unlikely to change the transmission line segments recommended in this report for immediate detailed study. The statewide conceptual transmission plan presented in this document can thus usefully be considered without waiting for economic re-ranking of CREZ.

Comments on the Phase 2A Draft Report note that the need for large-scale generation may not be as large as RETI estimated in Phase 1. RETI agrees that this estimate is subject to change. In its Update of the Phase 1B Report (February 2009) RETI both reduced its estimate of the total amount of electricity from renewable sources likely to be needed by 2020 and increased its assumption of how much distributed photovoltaic generation could be in place by that date. RETI notes further that small-scale geothermal and wind technologies can and should play a role in meeting our energy needs. Studies such as the High Distributed Generation scenario recently examined by the CPUC provide new information and perspective on this issue.[3] RETI will continue to update estimates of how much distributed energy is likely to be deployed as well as the amount of energy likely to be needed after existing resources are considered to comply with the state's Renewable Portfolio Standard. This amount of energy, called the "net short," is discussed in detail in Section 3.3.3.1 below.

RETI activities are based on the judgment that it is prudent to plan today for large-scale generation-transmission development, even if such facilities are later found not to be necessary and are never built. RETI estimates and assumptions regarding the amount of large scale energy California may need to meet its RPS on time have been developed publicly, using a transparent methodology, in order to account as prudently as possible for the large degree of uncertainty inherent in such an exercise.

1.3 Revised CREZ Descriptions

Phase 2 work has revised the descriptions and adjusted the boundaries of several CREZ initially identified in Phase 1. These changes incorporate new information from many sources, including on-the-ground evaluation of permitting and project developability issues. Revised CREZ provide a more accurate basis for estimating the electricity generation potential of biomass, geothermal, solar or wind projects sited in those areas. The timing and scale of actual generating projects that may be developed, however, remains uncertain.

1.3.1 CREZ Revision Working Group

Phase 1 CREZ descriptions were based on information available in mid-2008. In many cases, this information was preliminary or incomplete. In addition, reviewers of the

Phase 1B report raised a number of issues which could not be addressed in that report. One major Phase 2 task was to update and revise Phase 1 CREZ descriptions as appropriate.

The SSC formed a CREZ Revision Working Group (CRWG) to perform this task. It is chaired by the co-chairs of the Environmental Working Group (EWG), and meets regularly by web conference and frequently in person. CEC staff continues to provide invaluable support to the group.

1.3.2 Limitations of CREZ Environmental Screening

RETI CREZ maps identify areas in which biomass, geothermal, solar and wind generating projects can be most feasibly developed, considering resource quality, environmental concerns, proximity to existing transmission, distance to load centers, and capability of surrounding land uses to support this development. CREZ identification includes high-level environmental screening that: 1) excludes certain areas from consideration as development sites, based on statutory or policy restrictions; and 2) indicates areas where energy development may create fewer environmental concerns, based on the best information available to the Environmental Working Group (EWG).

EWG evaluation cannot, and is not intended to represent the magnitude of environmental concern or impacts of projects which may be developed within a CREZ. Numerical ratings are intended only to indicate relative levels of concern and have been used for the limited purpose of comparing CREZs. Because these values are gross indicators of potential environmental concern rather than of actual environmental impacts, they should not be used for any other purpose.[4] Given the limited focus of CREZ identification, it is possible that renewable energy development in any CREZ could result in significant environmental impacts under the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), or require permit limitations and mitigation conditions under either the California or federal Endangered Species Acts or other statutes.

[3] "33% Renewables Portfolio Standard Implementation Analysis: Preliminary Results," California Public Utilities Commission, June 2009.

[4] As reported in Phase 1B and in Section 2.4 below, consensus could not be reached on how wind project footprint, in particular, should be defined and applied in assessing environmental effects. The wind industry takes strong exception to the formulas applied in RETI environmental ranking, pointing to the lack of data and systematic study of such impacts, and stresses that they should not be considered to establish a precedent for evaluating wind project impacts.

1.3.3 Revised CREZ Descriptions and Re-Ranking

In addition to environmental considerations, Phase 1 CREZ descriptions were drawn to include both proposed commercial projects (referred to as "pre-identified projects") and "proxy" projects. As discussed in Section 2.1.1, pre-identified projects were defined as those having known commercial interest, as evidenced by a Power Purchase Agreement, a position in a transmission owner's interconnection queue, site control or a BLM lease application. Proxy projects, by contrast, had no identified commercial sponsor; they were identified only as sites that likely could be developed to take advantage of high quality renewable energy resources.

The viability or "developability" of proxy projects represented a major uncertainty associated with Phase 1 CREZ descriptions. The large majority of these were potential solar projects, many of which were located on private lands. During the Phase 1 process, no information was available on the degree of parcel and ownership fragmentation of the private land underlying these proxy projects. That data has now been accumulated and analyzed for all the CREZ in Southern California. At the recommendation of solar generators and other stakeholders, proxy solar projects in areas having more than 20 different owners per two-square mile area were deemed unlikely to be developed. Those projects were removed from CREZ, and new proxy projects were placed in feasible locations that met the ownership criteria. As a result, descriptions of some CREZ have changed significantly in Phase 2, especially in the Western Mojave area where large amounts of land remain extensively subdivided under abandoned land-use plans. Descriptions of some CREZ were also altered to eliminate proxy projects erroneously located in RETI Phase 1 on federal lands that had been procured from Catellus with funds from The Wildlands Conservancy, other donors and the federal government. In Phase 2, all proxy projects on these lands have been removed from RETI maps.

In addition, the list of generation projects in which commercial interest has been expressed ("pre-identified" projects) has been updated based on information from the Bureau of Land Management, the California Energy Commission, California ISO, and publicly-owned utilities (POUs). More precise locations and descriptions of many of these projects are now available and have been used in the CREZ adjustment process.

The CRWG developed a matrix of potential issues to serve as a checklist for identifying environmental issues of concern in each CREZ. This environmental issues matrix does not provide a single quantitative score for CREZ re-ranking. Rather, the matrix was designed to provide quantitative and qualitative information useful in estimating the difficulty and rate of generation project development in CREZ and thus the timing of future transmission needs. These matrices survey a broad spectrum of issues, but are not exhaustive. County concerns and detailed local information, for example, remain largely unavailable, and the CRWG could not incorporate these concerns into the Phase 2A CREZ re-ranking process.

After re-evaluating CREZ located in Southern California, the CRWG revised the descriptions of several of them to account for new information about permitting and developability. The revised CREZ descriptions have been used to re-rank the CREZ based on economic and environmental factors using the same process described in the Phase 1 B report.[5] A bubble chart showing the revised CREZ assessment in terms of the relative economic cost and environmental concerns per unit energy produced is presented in Section 2.4. Economic scores used in this chart do not reflect recent changes in the tax codes. Economic and environmental evaluation of revised CREZ remains subject to the same limitations noted in the Phase 1B Report, and CREZ economic scores remain subject to the same uncertainties as explained in that report and in Section 2.4 below.

CREZ maps are not yet final and in a few cases may indicate boundaries overlapping with areas in which development is prohibited. This unintentional overlap is in most cases due to very preliminary estimates of locations of potential power lines which could connect renewable projects in a CREZ to the existing grid. RETI stakeholders are continuing to correct mapping errors, and revised maps will be made publicly available as soon as possible.

1.3.4 Out of State Resources

RETI has focused primarily on in-state renewable resource potential. Evaluation of renewable resource regions located out of state in Phase 1 was limited by lack of comparable environmental data. Despite concerted efforts to obtain such information, data required to assess out of state areas on a basis comparable to that used for California CREZ remains unavailable.

Because of the need to evaluate potential imports of renewable generation from neighboring states in Phase 2 conceptual transmission planning, resources from British Columbia, Oregon, Nevada, and Baja California have been treated as CREZ. The relative economic scores of resources in these areas were computed on the same basis as California CREZ. In the absence of sufficient environmental data, Phase 2 work groups assigned the median environmental score for California CREZ to each of the out of state areas.

[5] The Executive Summary of the RETI Phase 1B Final Report describes CREZ ranking processes.

In Phase 1, Black & Veatch evaluated the economics of individual potential wind and solar *projects* in California, whereas for out of state regions they evaluated only the development potential of resource areas. (They evaluated biomass and geothermal resources on a project-level basis both in-state and out of state). For Baja California, they considered wind resources only in the border region; Rocky Mountain resources were not considered at all. Efforts to obtain a more detailed assessment of the economic potential of out of state resources, including Nevada geothermal, solar and wind; Baja California wind; and British Columbia geothermal, hydroelectric and wind resources are underway. The wind industry, for example, has already obtained wind speed data for additional areas of Baja California to augment Phase 1 resource estimates for that region. The SSC will consider using revised estimates of cost-competitive resources from out of state areas in future RETI work, if they can be documented well enough to provide a basis for supplanting those used to date.

1.3.5 Proposed Mojave Desert National Monument

The Mojave Desert National Monument contemplated by U.S. Senator Dianne Feinstein would affect at least a few CREZ, if it is created by legislation. Monument boundaries have not been established as of the writing of this report, but very roughly the area discussed extends from Needles, CA to the vicinity of the Pisgah Substation, and from north of the northeast boundary of Joshua Tree National Park to the southern border of Mojave National Preserve. Establishment of a monument including this general area could eliminate approximately 11,700 MW of potential solar and wind generation in the Pisgah, Iron Mountain, Baker and Needles CREZ.

Because of the uncertainty surrounding creation of the monument and its boundaries, RETI has not yet modified the energy and environmental scores of the potentially affected CREZ in its Phase 2 work. With the assistance of the EWG, however, some transmission line segments were eliminated or re-routed to avoid the area potentially affected by the monument. The remaining transmission line segments necessary to access generation in these CREZ were evaluated and rated by the environmental expert panel assembled for Phase 2A studies.

RETI will follow plans for creation of the monument closely and modify CREZ designations and supporting transmission facilities as appropriate.

1.4 Conceptual Transmission Plan

The initial conceptual transmission expansion plan presented in this report represents the consensus recommendation of a diverse set of stakeholders on two groups of major upgrades of the California grid, referred to here as Renewable Foundation lines and Renewable Delivery lines. These facilities increase the capacity of the grid, allowing energy to flow north or south as needed, and deliver energy to load centers. RETI has not evaluated the extent to which the existing grid can accommodate new sources of renewable generation. However, given the amount of renewable energy required to meet state goals in 2020, a number of these lines are likely to be required. Importantly, some are also are likely to be needed to meet growing energy demand regardless of generation source. Lines likely to be used no matter how the future unfolds—how population grows, energy efficiency savings accrue and generation develops—are referred to as least-regrets upgrades. They are so named because decision-makers who approve, and the customers who pay for, such infrastructure are unlikely to regret doing so. Identifying this set of least-regrets upgrades is a major outcome of RETI Phase 2 work.

In addition to Renewable Foundation lines and Renewable Delivery lines, the plan includes groups of Renewable Collector lines which provide access to geographically-adjacent CREZ. These groups, and the line segments of which they are comprised, are discussed in Section 3.5, and detailed in Appendices F and G.

This plan has been developed using a transparent and objective methodology for evaluating conceptual transmission connections that combines renewable energy access and environmental considerations. This methodology supports an unprecedented level of stakeholder involvement in conceptual planning designed specifically to evaluate transmission for renewable energy. It has the significant limitations explained in Section 3.4. But at a time when national and regional transmission planning is increasingly being tied to renewable energy development, stakeholder involvement in planning will help build public acceptance of the required infrastructure. Development of this ranking methodology is a second significant outcome of Phase 2.

1.4.1 Purpose and Limitations of Conceptual Transmission Planning

As population grows and Load-Serving Entity (LSE) energy supply portfolios change, new transmission facilities are likely to be needed to maintain system reliability and deliver electricity—including increasing amounts of renewable energy—to consumers. The purpose of conceptual planning is to identify such potential transmission facilities for detailed study. Power flow modeling and production cost simulations performed by the CAISO and POUs then determine which projects are needed and make economic sense, and how they must be configured electrically. A plan capable of being implemented can be developed only after such detailed study.

The RETI SSC recommends components of the plan presented here for such detailed study. These components are conceptual only. They represent potential network connections between substations.[6] Most of these line segments are located in existing transmission rights of way or designated corridors, or parallel existing transmission line rights of way. Precise geographic routings, however, cannot be determined at the conceptual planning stage.

1.4.1.1 An Objective Approach to Conceptual Planning

Conceptual planning is normally done by experts who have detailed knowledge of the operational characteristics of individual transmission systems. These experts use their judgment to identify potential upgrades or new facilities for detailed study. Because it relies on expert knowledge and is judgment-based, this process has rarely been transparent. Historically, the range of stakeholder perspective and involvement needed to build broad support for transmission expansion has been lacking at the conceptual planning stage.

A major goal of RETI, however, is precisely to involve stakeholders to identify conceptually how large amounts of renewable energy can best be delivered to consumers, in order to ensure that transmission expansion plans fully consider the interests of all those constituencies who may be affected by, and whose support will be needed to support the approval of new infrastructure.

To this end, RETI has developed a new, objective methodology for assessing the comparative usefulness of potential transmission facilities for the purpose of delivering economically competitive and environmentally preferred renewable energy. Planning began with the estimated renewable energy requirements of California LSEs in 2020 and was designed to ensure sufficient transmission capacity to satisfy those requirements. The methodology incorporates revised CREZ energy, economic and environmental information first assembled in Phase 1, approximately 200 potential network transmission elements including over 100 line segments, their estimated cost, electrical performance and environmental attributes.

The amount of quantitative detail considered in developing and assessing the RETI conceptual plan is unusually extensive. This conceptual plan will continue to evolve as information is updated and improved, analytical methods are refined, and the renewable energy industry grows. The RETI renewable transmission assessment

[6] Network connections, in which power may flow in both directions, are distinguished from radial lines, in which power flows in predominantly one direction. These concepts are explained more fully in Section 3.5.

methodology offers a model for other transmission planning efforts getting underway throughout the US.

1.4.2 Conceptual Plan Development and Assessment

1.4.2.1 Conceptual Transmission Planning Work Group

The SSC formed a Conceptual Planning Work Group (CPWG) to develop a statewide conceptual transmission expansion plan. Work Group members include representatives of all major transmission providers, Load-Serving Entities (LSEs), regulatory and permitting agencies, renewable energy generators, environmental organizations, and other stakeholders. The Work Group met bi-weekly beginning in October 2008; from January 2009 on, it then met weekly, in person and via web conference.

The SSC specified major assumptions the Work Group was to use in developing this plan in a Phase 2 Guidance Document. These directed that the plan should: 1) provide access for approximately 100,000 GWh/year of renewable energy (160% of the target for new renewable energy in 2020); 2) include some level of access to all CREZ; and 3) provide for import of approximately 15,000 GWh/year of renewable energy from out of state resources. The SSC also directed the CPWG to assume that only about 40% of the energy output potential of each CREZ would actually be developed by 2020.[7,8] To further limit the amount of new transmission facilities found necessary, CPWG planning also assumed that wind generation (much of which occurs during nights and evenings) and solar generation located in the same region could share much of the same transmission capacity.

1.4.2.2 Plan Development and Assessment

Using its collective judgment, the CPWG first assembled a comprehensive list of potential network line segments having sufficient capacity to provide access to all CREZ and cost-effective out of state resource areas, and to allow delivery of renewable energy to all LSEs adequate to meet their policy goals. The CPWG also identified existing and new substations at which energy from the CREZ could feasibly be injected into the network. These conceptual connections between substations were mapped to understand their proximity to areas having known land use restrictions or other environmental

[7] On-going work indicates that less than 40% of the output of each CREZ may be required to meet 160% of the state's 33% RPS goal, and this conceptual planning target may be revised downward, to 35% or less.
[8] Phase 2 planning assumes that 100% of the potential energy output of Tehachapi wind and Imperial Valley geothermal resources will be developed, along with 100% of the Out of State resource potential (Baja, Nevada, Oregon/Washington, British Columbia) found to be economic in Phase 1.

sensitivities. Segments found to be in conflict with these restrictions were reconfigured or eliminated from consideration.

Many of the line segments proposed are already in various stages of planning by various transmission owners. This prompted considerable debate over whether facilities in advanced stages of planning should automatically be included in the conceptual plan without further assessment of their renewable energy attributes. In order to identify the most effective ways to access renewable energy on a consistent basis across all transmission owner systems statewide, the SSC decided that the RETI conceptual plan should evaluate the renewable energy attributes of all proposed transmission facilities which have not yet received permission to be constructed.

To this end, the CPWG developed a methodology to evaluate the electrical function of each proposed line segment in relation to its value in: 1) providing access to renewable energy resources in California and neighboring states; 2) enabling energy transfers between major load centers; and 3) delivering energy to those loads. Standardized investment cost data was developed for all proposed facilities. In addition, the EWG developed a methodology, summarized below, for evaluating potential environmental concerns likely to be associated with construction of proposed facilities.

A complete set of renewable energy, cost, and environmental data was prepared for each proposed line segment. Individual segments were then combined into functional groups, and the line segment information was combined to provide information for each group. The complete assessment methodology is shown schematically in the flow chart in Figure 1-1.

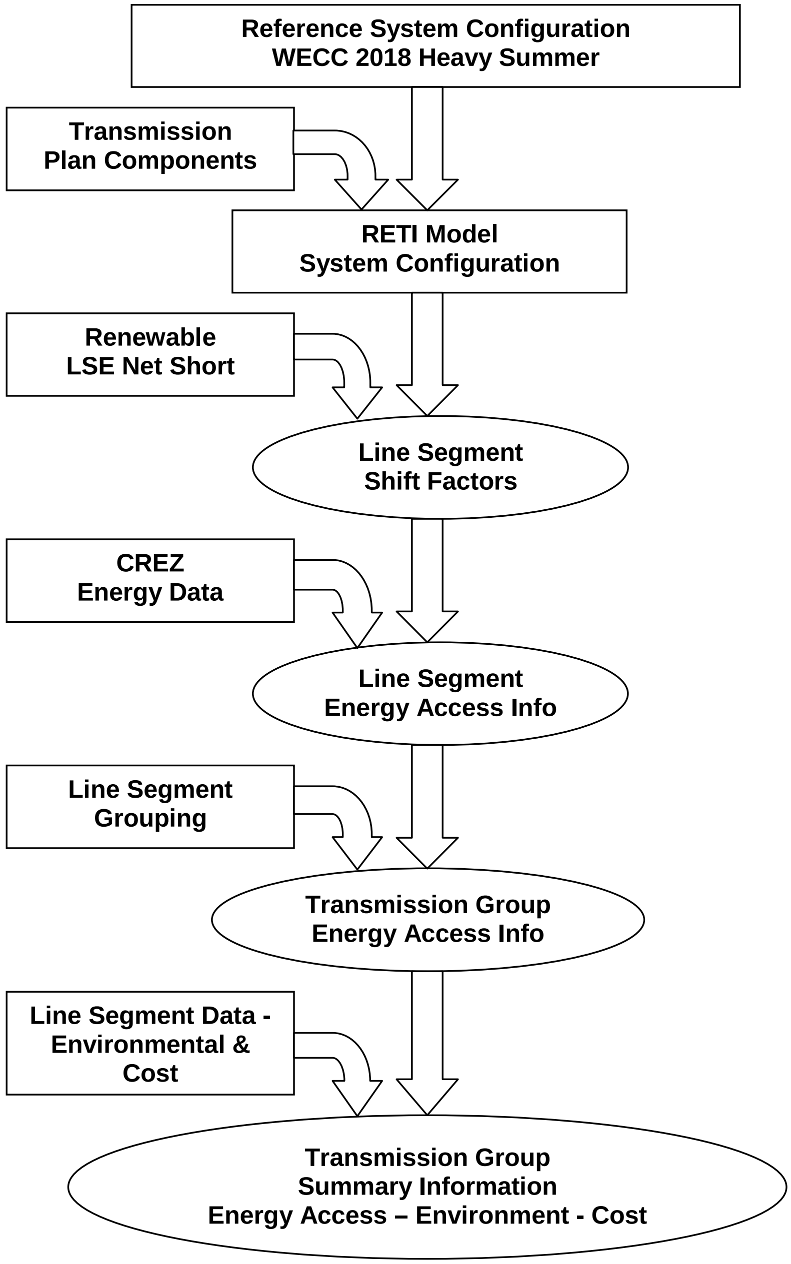


Figure 1-1. Conceptual Plan Assessment Flow Chart.

The conceptual plan assessment methodology follows a five-step process:

1. Transmission system modeling – In the first step, all of the proposed new network transmission elements in the plan were added to the western regional transmission system expected by the Western Electricity Coordinating Council (WECC) to be in place for the year 2018.

2. Shift Factor Calculations – This transmission system configuration, with the proposed new network facilities added, was analyzed for RETI by San Diego Gas & Electric Company using the ABB GridView computer program. The program injects a small amount of energy from each RETI CREZ, one at a time, and withdraws this energy at LSE load centers, in proportion to each LSE's net short estimates. The program calculates the fraction of these small energy injections which would flow in every segment of the WECC grid, including the proposed RETI line segments. These fractions are known as "power distribution factors" or "shift factors." They provide the basic information on the energy from each CREZ which flows in each line segment of the conceptual plan.
3. The shift factors were then combined with four different sets of energy information associated with each CREZ to provide a renewable energy rating for each line segment. The four rating criteria employed capture the economic and environmental score of each CREZ, as revised in Phase 2; the energy output of each CREZ; and commercial interest, represented by the amount of energy able to be provided by projects having Power Purchase Agreements and/or queue positions in each CREZ.
4. The line segments were then combined into functional groups, with line segment information combined to provide overall results for each group.
5. Environmental ratings and investment cost for each line segment were also compiled for each group, alongside group energy ratings. This information is summarized for comparison purposes on Table 1-1 below.

1.4.2.3 Environmental Framework of the Conceptual Plan

Conceptual planning usually considers only potential electrical connections between substations, without regard to geographic factors. The first steps in the RETI planning approach, in contrast, are to exclude even potential transmission facilities (referred to as "conceptual" facilities) from being considered on lands where development is prohibited by law or policy, and to avoid environmentally sensitive lands. RETI Phase 1 work referred to these as Category 1 (Black) and Category 2 (Yellow) lands, respectively.

As emphasized in the discussion of CREZ revision work, RETI review of environmental concerns associated with generation and transmission projects is necessarily limited to high-level screening. Nevertheless, the SSC believes that even preliminary assessments of environmental concerns associated with new transmission facilities can help evaluate the developability of line segments. This includes identifying those unlikely to be able to be permitted.

The CPWG, CRWG and EWG, working together, modified the configuration of several of the transmission components initially proposed for the statewide plan, to avoid sensitive areas and to make maximum use of existing and approved corridors. Interested stakeholders frequently attended collaborative working sessions.

In addition to this initial environmental screening process, the CPWG and CRWG developed a methodology to quantify the level of environmental concern associated with every line segment. This considers the amount and type of new rights of way required and the extent of disturbance associated with construction of new facilities. In addition to these objective considerations, the CRWG convened panels of environmental experts, for Northern California and Southern California, to provide their collective professional opinion on environmental concerns and the extent to which these concerns could be mitigated. Line segment environmental data, the issues matrix used by the expert panels and panel members can be found online at http://www.energy.ca.gov/reti.

1.4.2.4 Updating the Conceptual Plan

The conceptual plan described in this Report is a work in progress. It identifies conceptual connections capable of delivering much more renewable energy than the RETI planning target of 160% of the estimated renewable net short. Future RETI work will prioritize and narrow down the number of line segments. The current plan includes line segments likely to be redundant, so some will be reconsidered; others may be added. CREZ data continues to be updated as more information becomes available on out of state resources, land use managers amend their plans, and renewable development patterns change. Assessment results will continue to be updated so that mid-course corrections can be made in the future.

Despite the limitations inherent in CREZ and transmission element data and assessment methodology, the current plan provides a stakeholder-vetted basis for detailed planning by the CAISO and POUs. This detailed planning includes the contingency-based power flow modeling and economic grid simulations necessary to confirm the need for and cost-effectiveness of projects in the RETI conceptual transmission plan.

1.4.3 Initial Conceptual Transmission Plan

To develop this initial plan, the Conceptual Planning Work Group started with the revised CREZ, including those representing Out of State resources. It considered alternative network connections for accessing them, and compiled a comprehensive list of conceptual line segments for this purpose. Using the evaluation methodology described below, it then grouped the line segments into three categories of facilities: Renewable Foundation lines; Renewable Delivery lines; and Renewable Collector lines. Some lines serve two or three of these functions.

1. **Renewable Foundation** lines increase the capacity of the California transmission network between Palm Springs and Sacramento, allowing energy to flow north or south as needed. There are 14 key line segments in the Foundation Group. The capacity these lines provide is likely to be essential to be able to deliver renewable energy from any CREZ to consumers in all major load centers. The usefulness of the Foundation Group is not limited to renewable energy. The increased capacity these lines provide is likely to be needed to meet growing energy demand regardless of generation source.

2. **Renewable Delivery** lines move energy from Foundation lines to major load centers. The increased capacity provided by the lines of this group is likely to be needed to meet growing energy demand regardless of generation source. There are 13 major line segments in the Renewable Delivery Group.

3. **Renewable Collector** lines carry power from CREZ to Foundation and Delivery lines. These line segments are grouped geographically into projects capable of accessing adjacent CREZ. There are 12 groupings of collector lines. Several of these lines form portions of or connect to major inter-tie lines connecting California to the western regional grid, and therefore provide access to out of state resources.

The table below sorts these groups of network line segments by the amount of renewable energy they carry; their environmental ratings; and rough estimates of their capital cost. The process used to evaluate line segments and sort them into groups is detailed in Section 3.3.

Please note these important qualifications of the information on Table 1-1:

a. **No Benefit/Cost Analysis**. Both the benefits and the costs of transmission projects must be evaluated over their 50^{+}year lives. The RETI plan, however, looks only to the year 2020. RETI has produced no estimate at all of the benefits that the lines identified might provide in reducing congestion, providing access to lower-cost generation or improving grid reliability; and it provides only a rough estimate of the initial capital cost of each group of projects. RETI cannot and does not make any judgment about the overall benefits and costs of any specific transmission line proposal.

b. **Limited Value of Renewable Energy Rating**. The RETI methodology is geared mainly to evaluate the *relative* usefulness of line segments, and groups of lines, in carrying renewable energy. Foundation lines carry renewable energy from many CREZ; because larger amounts of renewable energy flow on those lines, they have a higher rating. Collector lines generally carry major amounts of renewable energy from only one or a few electrically-adjacent CREZ.

Lower CREZ energy ratings for transmission line groups, however, mean only that lines in a group carry smaller amounts of renewable energy. Groups of lines carrying smaller amounts of renewable energy may be useful and cost-effective projects. The Carrizo Group, for example, is shown on Table 1-1 to carry the smallest amount of renewable energy of any Group of lines in the plan. But it also has the lowest estimated cost and the lowest (best) environmental score; market or customer factors may make it a cost-effective project. The state's 33% renewable energy goal in 2020 notwithstanding, there may be no reason to relegate such a project to a later phase of development, in favor of ones that provide nearer-term access to larger amounts of renewables.

Explanation of information on Table 1-1.

Group Combined CREZ Energy: The CREZ Energy column refers to the amount of renewable energy, in Gigawatt-hours (millions of kilowatt-hours), flowing on the lines in the group. Each of the 14 line segments in the Foundation line group carries renewable energy from several CREZ. As a group, when the flows on each of these lines are added together, they carry a very large amount of renewable energy. Because of this, Foundation lines and Delivery lines are not directly comparable to Collector lines, and have been shown separately on Table 1-1.

Collector lines, such as in the Carrizo group, carry major amounts of renewable energy only from one or a few CREZ. It is important to note that, because the same renewable energy may flow on multiple line segments, the energy in this column does not represent the amount of such energy delivered to consumers.

Group Environmental Rating: In this column, lower numbers represent less environmental concern. Environmental rating of transmission line segments is explained in Section 3.7 of Chapter 3.

Table 1-1. Transmission Groups Sorted by Energy, Environmental Rating and Cost.

Foundation & Delivery Lines			
	Group Combined CREZ Energy (GWh)	Group Enviro Score	Group Cost ($Million)
Foundation	82,739	1,700	$5,144
Delivery	8,767	739	$788

Collector Lines

Group	Group Combined CREZ Energy (GWh)	Group	Group Enviro Score	Group	Group Cost ($Million)
Imperial	22,377	Carrizo	20	Carrizo	$78
Tehachapi	18,167	Tehachapi	77	LEAPS	$162
IronMt	7,282	BarrenRidge	77	BarrenRidge	$208
MtPass	6,939	Inyo	88	Tehachapi	$531
NorthEast	4,849	Riverside	123	Riverside	$608
BarrenRidge	4,738	IronMt	131	Inyo	$656
Riverside	4,687	LEAPS	246	NorthEast	$735
LEAPS	4,472	MtPass	252	MtPass	$798
Inyo	4,217	North	401	IronMt	$832
North	3,295	NorthEast	600	Imperial	$1,311
Carrizo	2,491	Imperial	837	North	$3,898
Median	**4,738**	**Median**	**131**	**Median**	**$656**

Foundation lines, Renewable Delivery lines and Renewable Collector lines are shown on the map in Figure 1-2.

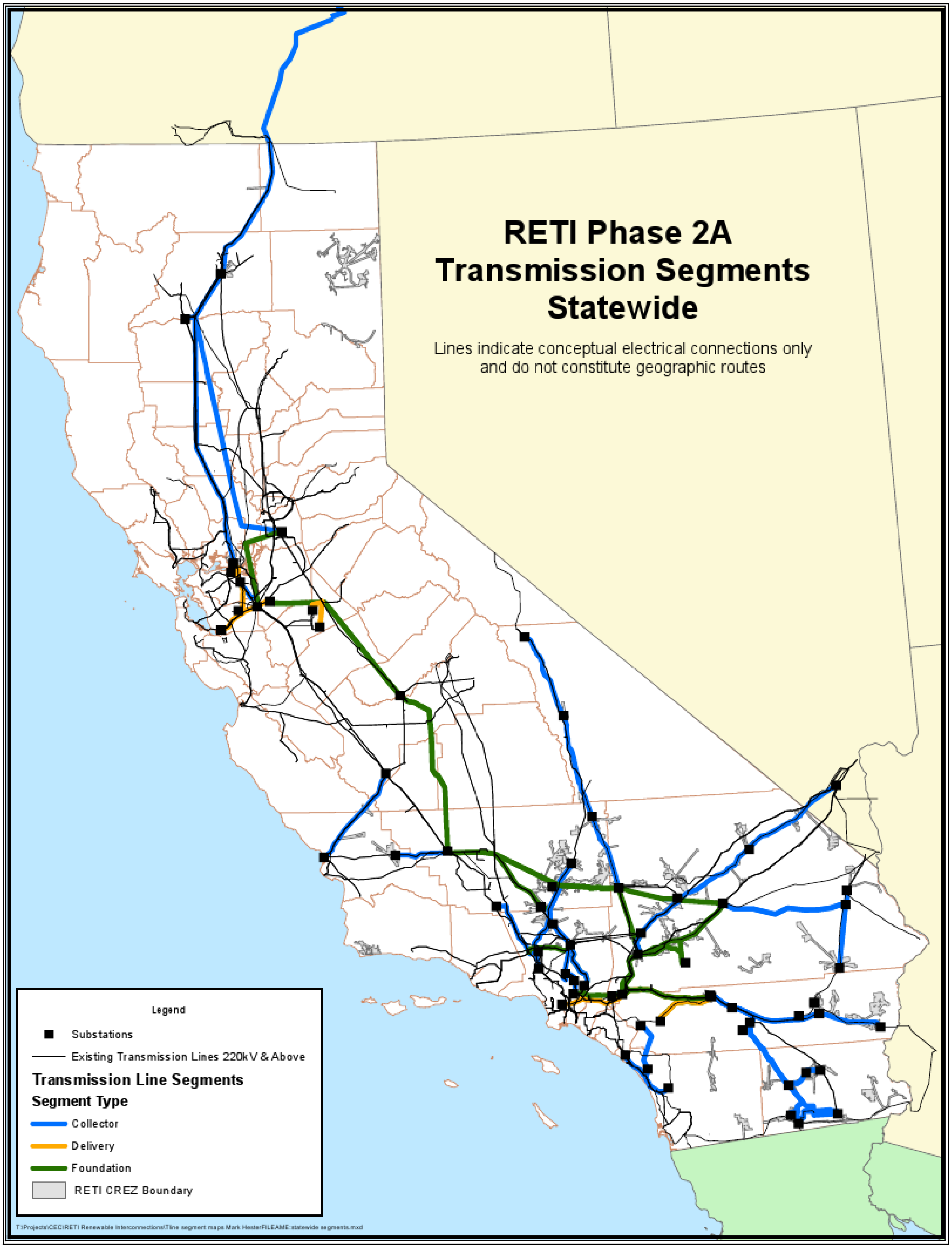


Figure 1-2. Foundation Lines, Delivery Lines and Renewable Collector Lines.

1.4.3.1 Least-Regrets Upgrades

Given inherent uncertainties about how much new generation will be needed, where and when it will develop and where load growth will be concentrated, prudent transmission planning emphasizes facilities that are likely to be heavily used under a wide range of planning scenarios. These are referred to as "no-regrets" or least-regrets facilities. Foundation lines and Renewable Delivery lines serving multiple purposes meet this requirement. Some Renewable Collector lines, such as those in the Tehachapi Group, to name only one example, have also been identified as least-regrets facilities. Development of Renewable Collector lines will be phased to accommodate generation, thus minimizing the possibility that these lines would go underutilized. This combination of attributes builds flexibility into the RETI preliminary conceptual plan.

RETI Phase 2A Conceptual Transmission Plan at a Glance

The RETI Conceptual Transmission Plan:

- Identifies additional transmission capacity to access and deliver renewable energy to meet state goals in 2020.
- Evaluates relative usefulness of potential lines for accessing and delivering renewable energy.
- Identifies potential transmission network lines for further detailed study by CAISO or POUs.
- Locates most conceptual lines in existing rights of way and/or designated utility corridors.
- Builds in environmental considerations from the first; includes high-level screening of conceptual transmission lines.
- Incorporates a wide range of stakeholder perspective.

The Conceptual Plan Does Not:

- Include precise routing of lines.
- Preclude study of other areas with renewable potential.
- Provide a determination of need, or information about power flows, congestion, or reliability.
- Determine ability of existing system to accommodate flows of new renewable generation.
- Provide the project-level environmental impact assessments required for specific project approvals.

1.4.3.2 Transmission Cost

The conceptual and very rough cost estimates presented in Table 1-1 were prepared using standardized cost factors, to enable comparison of segments on a consistent basis. Preparation of transmission cost estimates is discussed in Section 3.6.

The 14 segments in the Foundation Group, four of which are double-circuit 500 kV facilities, were estimated to have an aggregate cost of $5.6 billion. Because the segments in this group provide major system benefits and are likely to be needed to meet load growth regardless of generation source, it is not appropriate to attribute all of their cost to the cost of meeting renewable energy or climate change goals. For the same reason, the aggregate cost of the 13 Delivery lines, $3.4 billion, and the cost of those Collector lines which provide interstate transfer capacity, should not be attributed solely or primarily to renewable energy development.

The groups of lines on Table 1-1 provide transmission capacity well in excess of that required to meet the 33% renewable energy goal in 2020. Power flow and economic grid simulation studies to be performed by the CAISO, IOUs and POUs will determine which lines are needed and when they should be placed in service. Until such studies are completed, there is little basis for estimating the aggregate cost of the new transmission necessary to meet the 33% goal. Lines will not be approved unless they are found to be economic and needed by permitting authorities.

The crucial point for policymakers and the public is that transmission development leverages much larger investments in new generating resources. Transmission typically accounts for only a small percentage of the cost of the generation built to deliver energy over those lines. And the value of the energy delivered can repay the cost of the transmission investment quickly.[9] In addition, transmission lines approved for the primary purpose of delivering renewable generation to the grid will provide other benefits to consumers such as increased reliability, decreased congestion, and greater system efficiency. This report does not attempt to calculate these benefits.

1.4.3.3 Phased Development

The many line segments identified in the preliminary conceptual plan are in different stages of development. Some, like Tehachapi and Imperial Irrigation District (IID) segments, have been studied and approved by the CAISO and IID Board of Directors. Some are in advanced permitting, some are in early stages of development, and others have not yet been proposed as parts of commercial transmission projects.

With these factors in mind, the CPWG identified the earliest feasible in-service dates for each segment. Some IID lines are expected to be in service in 2011; Tehachapi

[9] ERCOT 2006. *Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas*. http://www.ercot.com/news/presentations/2006/ATTCH_A_CREZ_Analysis_Report.pdf; ERCOT 2008. *Competitive Renewable Energy Zone Transmission Optimization Study*. http://www.ercot.com/news/press_releases/2008/nr04-02-08. Quoted in US Department of Energy, *20% Wind Energy by 2030*, July 2008, p. 97: http://www.nrel.gov/docs/fy08osti/41869.pdf.

segments, in 2013. Lines in the Foundation Group were estimated to be able to be placed in service in the 2014-2016 period. Several larger projects are not expected to be built until 2020. Maps showing lines that may be able to be placed in service in these development phases (<2013; 2015; 2020) are presented in Chapter 3. Achieving these in-service dates depends heavily on avoiding permitting and litigation delays. Doing so is a major goal of RETI involvement in early-stage project conceptualization.

1.5 Results and Recommendations

Sorting line segments into functional groups and applying the rating methodology summarized below produces the quantitative results shown on Table 1-1. Energy access scores, environmental scores, investment costs and detailed recommendations for each group of transmission projects are discussed in Section 3. In addition to this technical assessment of proposed new transmission facilities, the recommendations below propose measures that may help minimize the costs and environmental impacts, and facilitate approval and public acceptance of expanding transmission capacity to access renewable resources.

New transmission lines are understandably controversial, especially those which require new rights of way. CEQA and NEPA require that the public be given the opportunity to comment on proposed transmission lines and alternatives to them. Early and active involvement by interested parties in the selection and assessment of alternate routes prior to the formal approval process increases the possibility of public support for the final selection, even though it is perhaps impossible to avoid all opposition to new lines. The CEC has developed an interactive Web-based application known as Planning Alternative Corridors for Transmission lines (PACT) to support more useful and informed stakeholder involvement in corridor identification and selection.

RETI's planning horizon extends to 2020 and planning on even longer time scales is beginning in other agencies. Many years may elapse before planned transmission lines are constructed. In the meantime, population growth and land development may encroach on transmission corridors in which these transmission lines are expected to be constructed. The CEC was given authority to designate transmission corridors under Public Resources Code §25331. After going through a public process to prepare a programmatic Environmental Impact Report, a designated corridor can become part of local general plans and thereby provide assurances that the corridor will be available for new transmission facilities when needed.

To support expedited approval and development of the infrastructure required to enable California to meet its policy goals while minimizing environmental and economic costs, the RETI SSC recommends that:

1. The CAISO, IOUs and POUs perform detailed, contingency-based technical analysis of Renewable Foundation lines and Renewable Delivery lines as soon as possible to determine which are needed, and how construction should be phased to ensure that sufficient transmission is placed in service to meet state goals by 2020.[10]
2. In order to avoid duplicative or redundant facilities, California transmission-planning authorities work closely with one another to identify, propose, study and approve joint IOU-POU projects, and eliminate barriers to joint use of such facilities.
3. The California Energy Commission, working with the California Public Utilities Commission, CAISO, IOUs, and POUs, conduct a study to determine the extent to which multiple transmission charges present barriers to achieving state renewable energy and greenhouse gas reduction goals, and recommend measures to eliminate or mitigate these barriers while ensuring that transmission owners recover their costs.
4. The California Department of Conservation expand and expedite its efforts to define, identify and map vacant and disturbed lands throughout California, focusing first on counties RETI has identified as having large renewable energy and transmission development potential, and make this information available as soon as possible.
5. The California Energy Commission, in conjunction with other state and federal agencies, local governments and renewable energy stakeholders, identify an action plan to address land ownership consolidation of disturbed or degraded private lands for renewable energy development on an expedited basis.
6. Entities planning new transmission lines engage local governments, environmentalists, and other interested parties in a collaborative process to identify and assess potential alternatives, including other transmission alternatives, non-transmission alternatives, as well as alternative routes for the proposed line, early in their planning processes. The California Natural

[10] Renewable Foundation lines and Renewable Delivery lines form the core of the RETI conceptual plan. Renewable Collector lines, defined in Section 1.4.3 and described in Section 3.5, will be analyzed in more detail and prioritized in future RETI work.

Resources Agency should provide participants with pertinent data and information in GIS format together with assistance in using the Web-based PACT assessment application.

7. The California Energy Commission, as authorized by Public Resources Code §25331, should begin immediately to consider the RETI transmission line segments to determine which are the best candidates for corridor designation. The Energy Commission should immediately initiate public outreach to agencies and stakeholders that would participate in a corridor designation proceeding. Corridors considered for designation should be beyond those already established by federal agencies or utilities' rights of way and should reserve and protect transmission access to areas where renewable energy development is likely to occur. Designated corridors should include likely routes for Renewable Foundation lines, Renewable Delivery lines, Renewable Collector lines, and potential expansion of existing rights-of-way. Corridor designation must be coordinated among local, state and federal agencies and tribal governments and support access to, for example, BLM Solar Energy Zones, and Desert Renewable Energy Conservation Plan (DRECP) generation development areas, as well as to CREZ most likely to be developed.

In addition, specific recommendations regarding development of the Renewable Collector line groups shown on Table 1-1 are presented in Section 3.9.

1.6 Next RETI Activities

1.6.1 Coordination with Activities to Implement the Governor's Executive Order; BLM Solar Energy Study Areas

Executive Order S-14-08 directs the Department of Fish and Game and the Energy Commission, in cooperation with the federal Bureau of Land Management and the U.S. Fish and Wildlife Service, to produce a Desert Renewable Energy Conservation Plan (DRECP) by the end of 2010. This plan is to be based on a Natural Communities Conservation Plan (NCCP) for the desert regions of California most affected by potential renewable energy and transmission development. The DRECP will then be subject to CEQA and NEPA review before permits to site generating projects under the DRECP can be issued.

The permitting agencies are expected to build on CREZ identified by RETI in designating areas where renewable energy generation project permitting can be expedited, subject to compliance with the NCCP. Components of the statewide conceptual transmission plan may be adjusted as a result of development of the DRECP.

On June 29, 2009, US Department of Interior Secretary Salazar identified 351,000 acres of the Mojave Desert (and a similar amount of land in AZ, CO, NM, NV and UT) for consideration as Solar Energy Study Areas. Environmental studies of these lands over the next two years will determine where BLM Solar Energy Zones should be designated, under a Solar Programmatic Environmental Impact Statement (PEIS). The intent is to accelerate permitting for solar generating projects located in such BLM Solar Energy Zones. Solar Energy Study Areas in California contain several of the CREZ located in the Mojave region. As with the DRECP, CREZ boundaries and components of the statewide conceptual transmission plan may be adjusted as a result of final designation of BLM Solar Energy Zones.

1.6.2 Next Phases of RETI Work

The economic ranking of CREZ in this report is unchanged from that in the Phase 2A Draft Report. Economic re-ranking in later RETI work will take account of changes in federal tax credits now available for renewable energy generating projects; changes in CREZ power output estimates as a result of the CREZ revision work described in this report; and the creation of a Baja California sub-CREZ. This economic re-ranking will be published as an update to the Phase 2A Final Report later in 2009. This re-ranking may change the priority of some CREZ, and thus the development priority of associated Renewable Collector lines, but it is not expected to change core elements of the conceptual transmission plan presented in this document.

The RETI Stakeholder Steering Committee will decide the scope of Phase 2B work after publication of the Phase 2A Final Report. This work may address three major tasks, to: 1) reduce the number of and prioritize lines in the Phase 2A preliminary conceptual transmission plan; 2) re-evaluate the MW amounts and cost-competitiveness of Out of State resources, including resources across state borders that should be considered as contributing to adjacent CREZ, and determine the amount of Out of State renewable energy imports the conceptual plan should accommodate; and 3) identify short-term measures that may make it possible for some renewable energy generating projects to be built and connect to the grid in the next few years, before major transmission projects can be approved and constructed.

Re-evaluation of Out of State resources will consider the resource assessment undertaken for the western US, British Columbia, Alberta and Baja California by the Western Renewable Energy Zone (WREZ) initiative of the Western Governors Association. It will also consider how best to coordinate RETI planning with the transmission for export alternatives identified in Nevada's Renewable Energy Transmission Access Advisory Committee (RETAAC) June 2009 report. Interim interconnection measures, the third component of a Phase 2B report, will necessarily be developed cooperatively by transmission operators, generators, regulators and other stakeholders. They may include transformer upgrades in certain locations, loop-in of existing transmission lines, Remedial Action Schemes, in conjunction with generation curtailment agreements, and other such measures. If this work is taken on by the SSC, results of these three tasks will be collected into a RETI Phase 2B Report in early 2010.

RETI will support development of detailed electrical plans for the first projects recommended for study at the CAISO and Publicly Owned Utilities, including study coordinated by the California Transmission Planning Group (CTPG) now being formed. The many interests represented on the SSC are in position to help support consideration and approval of newly proposed projects. Stakeholder support for development of the Tehachapi Renewable Transmission Project plan of service, for example, assisted the CAISO in preparing that project for approval by the CAISO board in 2007.

RETI may also engage stakeholders in support of transmission corridor designation work at the Energy Commission. RETI work to date has collected a large amount of information about access to resource areas. This information, and the broad range of stakeholder perspective included on the SSC, will assist the Energy Commission in identifying corridors, not already established by federal agencies or utilities, which minimize costs and impacts and represent the best candidates for formal designation as areas to be reserved for future transmission development.

Future RETI work may also include updates of its statewide conceptual transmission plan, on roughly a two-year cycle, if agencies and other stakeholders deem such updates necessary to support applications for and approvals of transmission projects essential to renewable energy development. The next update, in mid-2011, would take account of generation siting areas designated by the DRECP and Solar Energy Zones designated by BLM; generating project proposals that emerge over the next 24 months; and new ecosystem data that becomes available and can be used to guide the location and reduce the impacts of generation-transmission development. Updates will be geared to inform on-going transmission planning by CAISO, POUs and the CTPG.

2.0 CREZ Revision

Phase 2 work has revised the descriptions and adjusted the boundaries of several CREZ initially identified in Phase 1. These changes incorporate new information from many sources, including on-the-ground evaluation of permitting and project developability issues. Revised CREZ provide a more accurate basis for estimating the electricity generation potential of biomass, geothermal, solar or wind projects sited in those areas.

2.1 Introduction

Phase 1 CREZ descriptions were based on information available in mid-2008. In many cases, this information was preliminary or incomplete. Commercial interest in renewable generation projects changes in response to market and other factors. Estimates of the viability of potential projects in which no commercial interest has been identified (referred to as “proxy” projects in Phase 1) changes as more information becomes available. Accordingly, one major Phase 2 task was to update and revise Phase 1 CREZ descriptions as appropriate.

The SSC formed a CREZ Revision Working Group (CRWG) to perform this task. It is chaired by the co-chairs of the Environmental Working Group (EWG), and meets regularly by web conference and frequently in person. CEC staff continues to provide invaluable support to the group.

The CRWG evaluated boundaries of some CREZ to avoid sensitive lands, based on more recent information not available in Phase 1. These include BLM lands, such as Desert Wildlife Management Areas (DWMAs), subject to a 1% cap on all forms of development. The CRWG also obtained information about previously disturbed land in the vicinity of some CREZ, and attempted to redraw CREZ boundaries to make use of such lands.

Proxy solar projects identified in Phase 1 were located in areas of high insolation with suitable slopes and distance from known structures. At the time, no information was available about the underlying land ownership patterns. Highly fragmented ownership makes energy development unlikely, so a major Phase 2 task was to ensure that proxy projects were located in areas with only a few different owners, as described below.

Phase 1 CREZ were further revised by updating the list of generation projects in which commercial interest has been expressed (“pre-identified” projects) based on new information from the Bureau of Land Management, the California Energy Commission, the California ISO, and publicly-owned utilities (POUs). More precise locations and descriptions of many of these projects are now available and have been used in Phase 2 CREZ descriptions.

The CRWG re-assessed the revised CREZ using the process described in the Phase 1B Report, and calculated new economic and environmental ranking scores. These revised CREZ ranking scores are used to prioritize components of a preliminary statewide conceptual transmission plan.

2.1.1 Pre-Identified and Proxy Projects

Comments on the Phase 2A Draft Report indicate that the role of both pre-identified and proxy projects in RETI planning requires more explanation.

RETI refers to generating projects now under development by renewable energy companies as “pre-identified” because most of these projects appearing on RETI maps were proposed before RETI began work. The money invested by these companies expresses commercial interest in and some degree of commitment to building projects at specific locations. The RETI evaluation methodology takes account of key milestones of project development. These include obtaining site control; obtaining a position in an interconnection queue; obtaining a Power Purchase Agreement, under which a Load-Serving Entity agrees to buy the power to be generated by the project; and obtaining an Interconnection Agreement, which establishes the terms under which the project will connect to the grid and take transmission service. The RETI methodology gives more weight to those pre-identified projects that have achieved several of these milestones. Because such projects are the most likely actually to be built, there is more certainty that CREZ containing pre-identified projects will be developed. As a result, there is also more certainty that transmission built to CREZ containing a number of pre-identified projects will be fully utilized.

Federal (FERC) policy requires transmission providers, such as the CAISO, to plan transmission to any generator that applies to connect to its system. The CAISO or POUs therefore must plan transmission to pre-identified projects, regardless of what RETI does or does not do. The RETI CREZ-based conceptual transmission plan is intended to avoid such one-project-at-a time connection of generating projects, in order to minimize the amount of new transmission needed to meet state policy goals.

In Phase 1, RETI identified and mapped Category 1 lands, where development is prohibited by law or policy; and Category 2 lands, which include environmentally sensitive areas where development would be difficult and controversial. RETI stakeholders agreed that no proxy projects would be located on Category 2 lands for purposes of CREZ identification or conceptual transmission planning. However, a few pre-identified projects, which were under development before RETI was conceived, are located on Category 2 lands. The RETI Environmental Working Group has helped developers of these projects to better understand the challenges they face in getting their projects permitted. But RETI has no authority to relocate such projects, or to order developers to abandon or move their projects. If RETI ignores such projects, transmission providers will plan transmission to access them, under federal law. For these reasons, RETI has not removed the few pre-identified projects on Category 2 lands.

Proxy projects, in contrast, represent generation that could be developed to take advantage of the most cost-effective biomass, geothermal, solar or wind resources. They have no development sponsor and are only hypothetical. They nevertheless play an essential role in energy and transmission planning. There are no proxy projects on Category 2 lands.

Transmission facilities have useful lives of more than 50 years. Planning investments in 50-year assets to accommodate only those generating projects that can now be identified as commercial poses the serious risk that such transmission facilities will go underutilized. Transmission planning thus must account for substantial uncertainty surrounding when and where future unknown generation will develop.

Commercial or pre-identified projects now under development are generally geared to be built in the next two-five years. These projects can help meet our renewable energy needs to the middle of the next decade. But the state will need additional renewable energy to meet its 33% goal in 2020, on top of accelerated energy efficiency savings and distributed photovoltaic generation. Because no commercial projects are yet proposed to supply this renewable generation, transmission planning has to rely on forecasts of generation development. Proxy projects help provide a basis for such forecasts.

At proxy project sites, where both resource quality (e.g., solar insolation, wind capacity factor) and project development costs can be estimated with reasonable certainty, the cost of electricity generated there can also be estimated with some degree of confidence. Proxy project sites shown to be capable of generating cost-competitive electricity are likely to attract development.

Many CREZ do not contain enough near-term, commercial projects to justify building transmission to access them. But additional commercial projects will not be proposed in CREZ until developers know that projects there will have transmission access. Aggregations of proxy projects in a CREZ provide a reasonable basis for planning transmission to access renewable resources there in advance of actual generation interconnection requests.

2.2 CREZ Revision

2.2.1 Land Ownership Fragmentation Issues

Initial CREZ revision work was divided into four subtasks:

- Acquisition of parcel maps and ownership lists for Southern California counties;
- Preparation of maps overlaying parcel information with Phase 1 CREZ and generation project data;
- Identification of problem proxy projects with underlying parcels having more than 20 different owners per two square miles;
- Eliminating, moving, or reshaping problem proxy projects.

The location of major commercially viable renewable energy resources in California is well known. Nearly all of the renewable generation projects proposed by commercial developers were grouped into 29 CREZ in Phase 1. However, the potential for commercial energy development in these zones is greater than may be indicated by "pre-identified" generation projects alone. This is especially true for solar energy development, given the huge, high-quality resource available and the rapid advancement of solar technologies as a source of large-scale electric generation.

In order to estimate the cost and environmental concerns associated with the total potential solar development in a CREZ, RETI placed "proxy" solar projects on CREZ maps, primarily in the Mojave Desert region where solar radiation makes their output most cost effective, and included these projects in CREZ for purposes of its analysis. RETI assumed that these proxy solar projects would utilize conventional solar trough technology, which requires relatively flat land having a slope of no more than 1%. In addition, RETI assumed that commercially viable solar projects using this technology must be at least 200 megawatts (MW) in size, requiring 2 square miles of area.

Using maps available on Google Earth and other data, locations were identified which appeared suitable for solar thermal development, having relatively flat land, no structures, good insolation, and other such factors. A proxy solar project was represented on RETI maps as a square area containing 1280 acres (2 square miles). These are shown as the orange squares in Figure 2-1 below. In preparing the Phase 1 report, RETI work groups recognized that such high-level identification of apparently suitable sites could include areas which might not prove to be suitable due to land ownership complications.

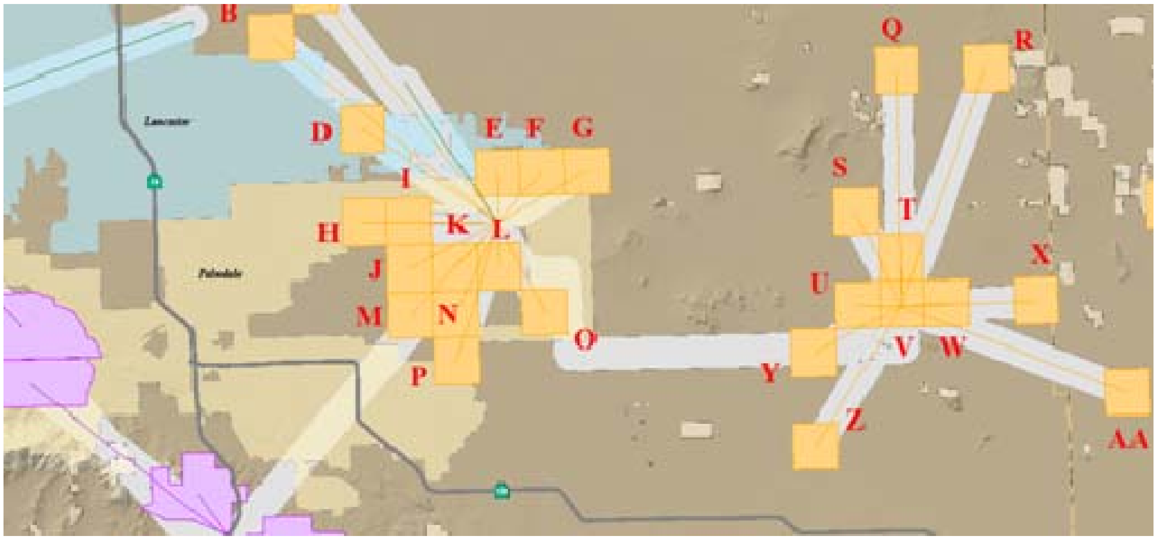


Figure 2-1. Fairmont CREZ Solar Proxy Projects in Phase 1B Report.

During Phase 1 work, no information was available on the degree of parcel and ownership fragmentation of the land underlying these proxy projects. Energy Commission staff obtained and compiled that data and the CRWG analyzed it for all CREZ in Southern California. A few CREZ were found to have highly fragmented ownership. Figure 2-2 below shows the orange squares of Fairmont CREZ proxy projects, with boundaries of underlying parcels shown in black. The map in Figure 2-2 illustrates that land ownership complexity can overwhelm the ability to develop renewable generating projects on lands otherwise identified as attractive for such development.

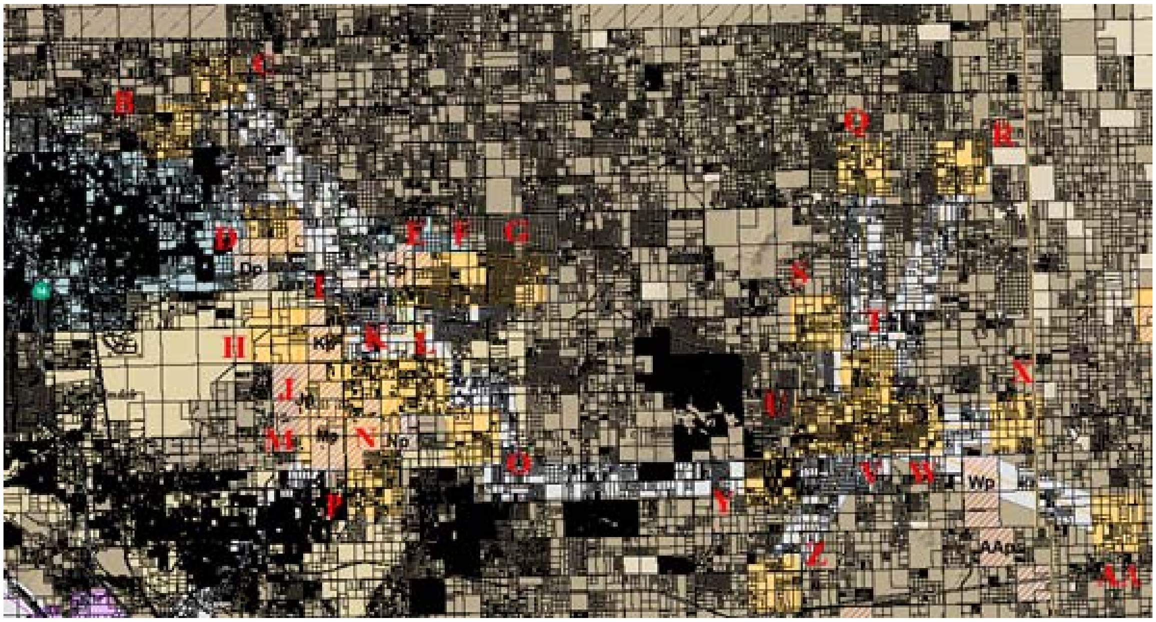


Figure 2-2. Fairmont CREZ Solar Proxy Projects in Phase 1B Report Showing Underlying Parcels.

Proxy projects located on parcels having 20 or more different owners have been removed from the CREZ or reshaped to avoid this problem. Such ownership fragmentation makes it unlikely that projects will be developed on these sites in the 2020 time frame. New proxy projects were placed on qualifying lands.

In the case of the Kramer CREZ, as shown in Figure 2-3, 30 Phase 1 proxy project sites in that CREZ which had more than 20 separate property owners were replaced with new proxy sites on nearby lands that had 20 or fewer property owners for each 2 square mile site. In others, such as the Fairmont CREZ, it proved impossible to identify replacement locations for the many sites that had to be eliminated due to parcelization issues.

Some of the private lands found to be extensively parcelized are close to existing infrastructure or have been disturbed, and thus appear to provide otherwise attractive locations for renewable energy development. With this in mind, several comments on the Phase 2A Draft Report assert that proxy projects should be sited even where there are more than 20 owners per two square mile area.

The CRWG chose the 20-owner criterion based on the experience of solar and wind project developers. As a practical matter, the work of finding and negotiating land lease or purchase agreements with so many owners lengthens development time and increases development cost to levels that make projects on such lands uneconomic.

At the same time, RETI stakeholders agree that utilizing disturbed private lands close to existing infrastructure for renewable energy development should be a priority for the state. County governments and state agencies are in the best position to develop mechanisms to consolidate the ownership of extensively-parcelized lands that have excellent renewable resource potential. For this reason, the RETI Phase 2A Final Report includes a formal recommendation that the California Energy Commission, in conjunction with other state and federal agencies, counties and the renewable energy industry, develop and implement a strategy for consolidating ownership of disturbed or degraded private lands for renewable energy development on an expedited basis.

The SSC believes proxy projects remaining in Phase 2 reflect realistic solar development potential. As a result of the revisions, descriptions of some CREZ have changed significantly, especially in the Western Mojave area where many old subdivisions are located.

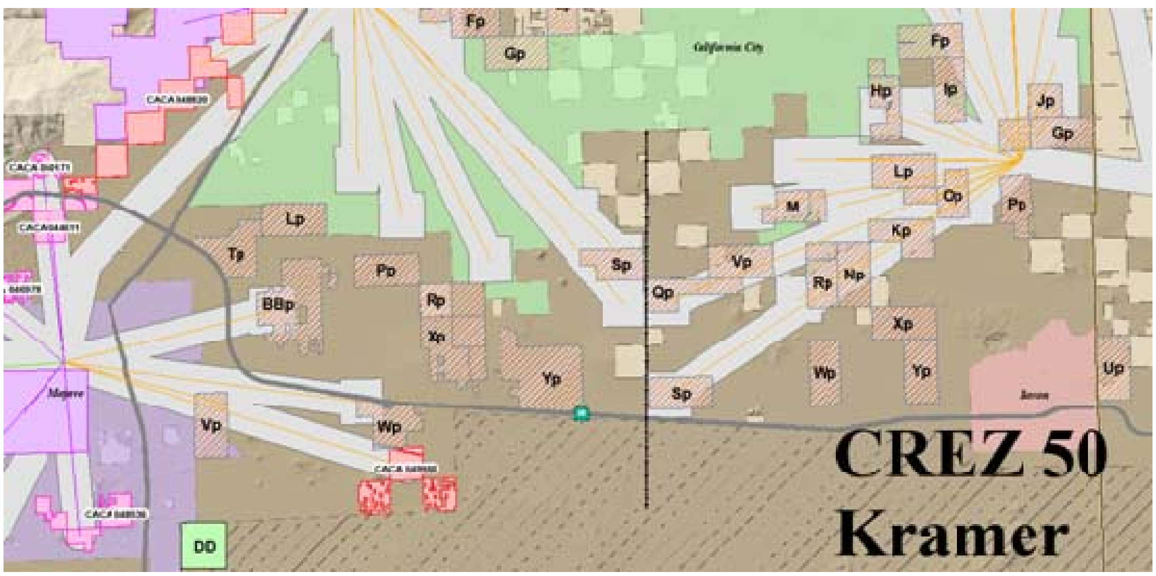


Figure 2-3. Kramer CREZ Solar Proxy Projects Relocated During Phase 2 CREZ Refinement.

2.2.2 BLM Development Caps

Bureau of Land Management (BLM) management plans for certain regions in the California Desert Conservation Area limit all forms of development to 1% of the land acreage of those subject areas. These include Desert Wildlife Management Areas (DWMAs) and federal lands within Mojave Ground Squirrel Management Areas (MGSMAs). The acreage available for energy development in affected areas, if any, is unknown and depends on future decisions by BLM, but it clearly must be less than 1% of the total in all of these areas. For wind energy projects, BLM will estimate development impacts on a case-by-case basis, referring to the Wind Programmatic EIS Record of Decision and existing land use plans.

The CRWG reviewed CREZ areas which are subject to the 1% development cap to ensure that proposed development does not exceed BLM limits. Table 2-1A presents the results of the 1% cap assessment for DWMAs, using the midpoint of the range that BLM says it will use to calculate the surface disturbance of wind projects – 7.5%. Table 2-1B presents the results of the CRWG's 1% cap assessment for MGSMAs.

Table 2-1A. 1% Cap Assessment, Desert Wildlife Management Areas.

Name of DWMA	Superior-Cronese	Fremont-Kramer	Ord-Rodman	Piute-Fenner
DWMA acres	542,739	418,458	224,623	219,092
1% of DWMA	5,427	4,185	2,246	2,191
TT Wind Project Acres	46,460	8,239	7,192	9,270
7.5% Wind Acres	3,485	618	539	695
% of 1%	64.2	14.8	59.9	31.7
TT Solar Project Acres	0	0	806	0

Table 2-1B. 1% Cap Assessment, Mohave Ground Squirrel Management Areas.

Mojave Ground Squirrel Management Area (MGSMA)	Acres
Acres in MGSMA	1,652,693
1% of MGSMA	16,527
TT Wind Project Acres	150,373
7.5% of Wind Projects	11, 278
% of 1%	68.2

2.2.3 CREZ Mapping Issues

CREZ represent the best available estimates of where development of renewable energy resources is most likely to occur in California. Nevertheless, CREZ shapes are approximate and actual development patterns may differ. In addition, RETI has not yet completed review of its preliminary mapping, so depiction of CREZ boundaries and of areas where development is prohibited or limited may not be accurate. In a few cases, proxy solar and wind projects remain to be moved so that they do not encroach on prohibited areas. Any overlap on RETI maps of CREZ and areas where development is prohibited is unintentional will be corrected in future updates.

In the case of a few CREZ, current RETI maps show gen-ties (lines connecting a generating project to the transmission grid) crossing prohibited areas. On the subject maps, these lines depict the shortest distance between a proxy project and a collector point where the power could then be delivered to the grid, in one mile wide strips; they do not depict any actual or proposed route for such a gen-tie or trunkline, and their location on RETI maps is preliminary. The locations of actual gen-ties and trunklines must of course avoid areas in which development is prohibited. RETI will address trunkline routing issues in the near future and will revise its maps now posted on the RETI website accordingly.

2.3 Revised CREZ Output

As a result of CREZ revision activities, estimates of the generation potential of some CREZ have changed, in comparison to amounts identified in Phase 1B. Table 2-2 presents this comparison.

Table 2-2. CREZ Power Estimates in MW, Phase 1B vs. Phase 2A.

CREZ	Phase 1B	Phase 2A	Net Change
Barstow	2136	2336	200
Carrizo North	1600	1600	0
Carrizo South	3000	3877	877
Cuyama	400	800	400
Fairmont	6918	3518	-3400
Imperial East	1723	1623	-100
Imperial North-A	1370	1370	0
Imperial North-B	1830	1830	0
Imperial South	3745	3715	-30
Inyokern	2887	2432	-455
Iron Mountain	5662	4912	-750
Kramer	6627	6412	-215
Lassen North-A	821	1467	646
Lassen North-B	2001	0	-2001
Lassen South-A	410	410	0
Lassen South-B	1200	0	-1200
Mountain Pass	2878	1658	-1220
Needles	1061	461	-600
Owens Valley	1400	1400	0
Palm Springs	770	770	0
Pisgah-A	1800	2550	750
Pisgah-B	3790	0	-3790
Riverside East-A	1000	10550	9550
Riverside East-B	6800	0	-6800
Round Mountain-A	240	384	144
Round Mountain-B	187	187	0
San Bernardino - Baker	1200	3670	2470
San Bernardino - Lucerne	4290	3030	-1260
San Diego North Central	281	281	0
San Diego South	678	678	0
Santa Barbara	433	433	0
Solano	894	894	0
Tehachapi	9642	10837	1195
Twentynine Palms	800	1805	1005
Victorville-A	800	1636	836
Victorville-B	895	0	-895
Victorville-C	340	0	-340
Total	**82509**	**77526**	**-4983**

2.4 Revised CREZ Ranking

The CRWG used revised CREZ descriptions to re-rank CREZ based on economic and environmental issues, employing the same process described in the Phase 1 B Report.[11]

The bubble chart below in Figure 2-4 shows revised CREZ assessments in terms of relative economic cost and environmental concerns per unit energy produced. As in the Phase 1B Report, CREZ to the left in this chart are expected to have fewer environmental concerns per unit energy production, and CREZ toward the bottom are expected to have lower cost/higher economic value per unit energy. As described below, five Out of State resource areas have been included in this chart. Since comparable environmental data is not available, these areas have been assigned an environmental value equal to the median value for California CREZ.

Unlike the bubble chart in the Phase 1B Report, however, the Phase 2 CREZ economic ranking scores presented on the chart below do not include transmission costs associated with each CREZ. In Phase 1, such costs were estimated using assumptions that required simultaneous delivery of 100% of the theoretical electrical output of every CREZ. These assumptions implied an unreasonably large number of transmission upgrades and produced an unrealistically inflated estimate of total transmission costs. Just as importantly, these assumptions made it difficult to compare the transmission facilities likely to be necessary to deliver realistic amounts of energy from individual CREZ.

For this revision, the RETI Conceptual Planning Work Group has instead directly analyzed the cost of individual transmission facilities needed to provide access to each CREZ. Development of transmission costs for each component of the statewide plan is described in Section 3.6 below.

As noted in the Executive Summary, the SSC directed that the RETI conceptual plan identify transmission solutions capable of providing some level of access to every CREZ, in order to accommodate potential future development in many regions of the state. It also directed, however, that the plan include recommendations for phasing or staging the development of transmission to CREZ over time. The state can meet its 2020 goals without accessing every CREZ, even with relatively low levels of renewable energy imports from out of state. Higher levels of imports would reduce the number of transmission upgrades required to access in-state CREZ even further. CREZ rankings, and transmission group ranking scores (which also take CREZ economic and environmental rankings and overall project developability into account) are intended to help transmission owners and regulators decide which new transmission facilities should be built first, to be in service in the 2015 period; which should be built to be in service in the 2020 period; and which should be deferred for later consideration, if additional transmission is subsequently found to be necessary.

As noted in the RETI Phase 1B Report, there was no consensus regarding how the project footprint for wind projects should be defined and applied in assessing potential environmental concern. EWG formulas should not be considered to establish a precedent for evaluating wind project impacts. This is first instance in which the environmental effect of wind projects has been characterized as proportional to the entire project lease area, and the wind industry takes strong exception to such formulas, pointing to the lack of data and systematic study of such impacts. The U.S. Department of Energy 20% Wind Vision report (May 2008) found that wind projects in the U.S. directly disturb on average 2.5%-5% of total project lease area for turbine foundations, access roads and substations.[12] CREZ rankings using calculations based on a wind project footprint of 3.5% of project lease area for Criterion #1 (Project Area), Criterion #3 (Sensitive Areas in CREZ), Criterion #4 (Sensitive Buffer Areas) and Criterion #6 (wildlife corridors) are shown in Appendix N of this report. The EWG formulas used 3.5% of project lease area only for Criterion #1. Appendix N also includes a bubble chart illustrating these alternative rankings, similar to the one on the following page.

[11] As discussed below, an environmental matrix was developed by the CRWG to supplement the Phase 1B ranking process.

[12] U.S. Department of Energy, "20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply," May 12, 2008, p. 110. (Available at http://www1.eere.energy.gov/windandhydro/). The EWG used the midpoint of this range, 3.5% of total project area, in its criterion used to assess generating project footprint. EWG formulas for criteria intended to assess the relative potential effect on sensitive species use the full lease area of wind projects. In response to wind industry concerns about these criteria, a footprint area equivalent to 3.5% of the lease area was tested along with the other EWG criteria.

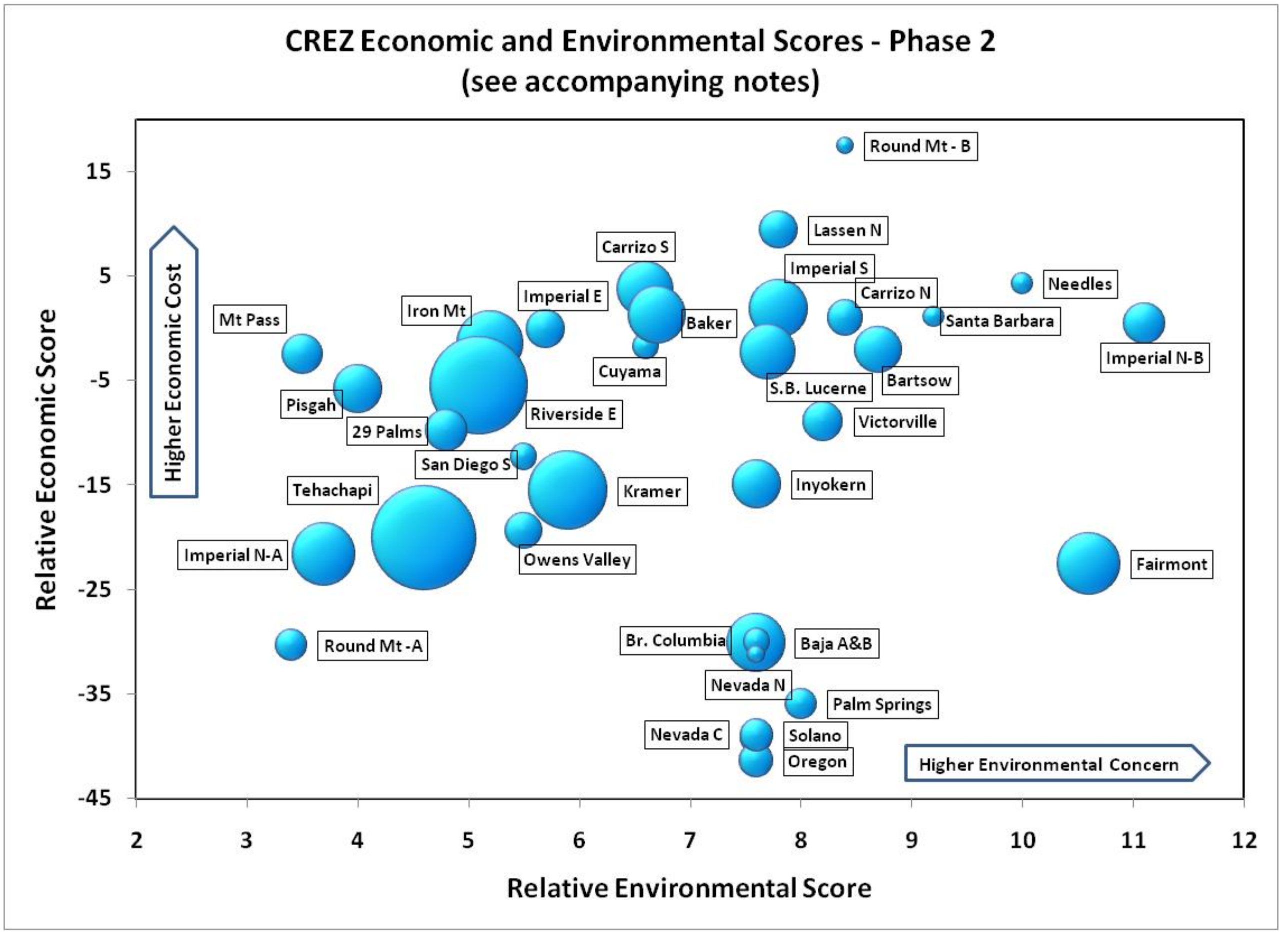


Figure 2-4. CREZ Economic and Environmental Scores Phase 2, Bubble Chart.

Notes:

Areas of the bubbles are proportional to CREZ energy.

Out of state CREZ economic scores include proxy costs for delivering energy to the California border.

Lassen South CREZ is off the right side of the chart.
Economic Score = 1.81
Environmental Score = 19.40
Energy = 1106 GWh

San Diego North Central CREZ is off the right side of the chart.
Economic Score = -0.32
Environmental Score = 22.20
Energy = 739 GWh

CREZ economic assessment depends on many assumptions about generating technology costs and output characteristics, collector system transmission costs, and the locational, seasonal and diurnal value of the electricity generated; and on assumptions about policy support and technology development. Results of CREZ economic assessment presented in this report, for example, do not include the effect of the new tax treatment for renewable energy projects approved by Congress with passage of the American Recovery and Reinvestment Act (ARRA) in early 2009. Despite general SSC agreement on the assumptions to be used in economic evaluation of CREZ, as described in the RETI Phase 1A and Phase 1B Reports, many input assumptions remain inherently uncertain. Phase 1B conducted an uncertainty analysis to illustrate the effects of different input cost and value assumptions. This analysis showed that CREZ rankings are subject to a substantial margin of error, and that different, but reasonable, assumptions about cost parameters make some CREZs relatively more or less economically attractive.

Figure 2-5 presents the Phase 1B CREZ economic supply curve, with a band representing the range of uncertainties for CREZ economic scores. For this report, the SSC committed to update the CREZ economic supply curve and uncertainty band with Phase 2A information. Administrative delays resulting directly from the state budget crisis and mandatory furlough days for state agencies, employees and contractors have delayed preparation of this uncertainty analysis. It will be included in an update of the Phase 2A Final Report planned for later in 2009. Figure 2-5 is presented only to illustrate that economic scores are uncertain; both the economic scores and uncertainty bands are out of date and not consistent with Phase 2A CREZ.

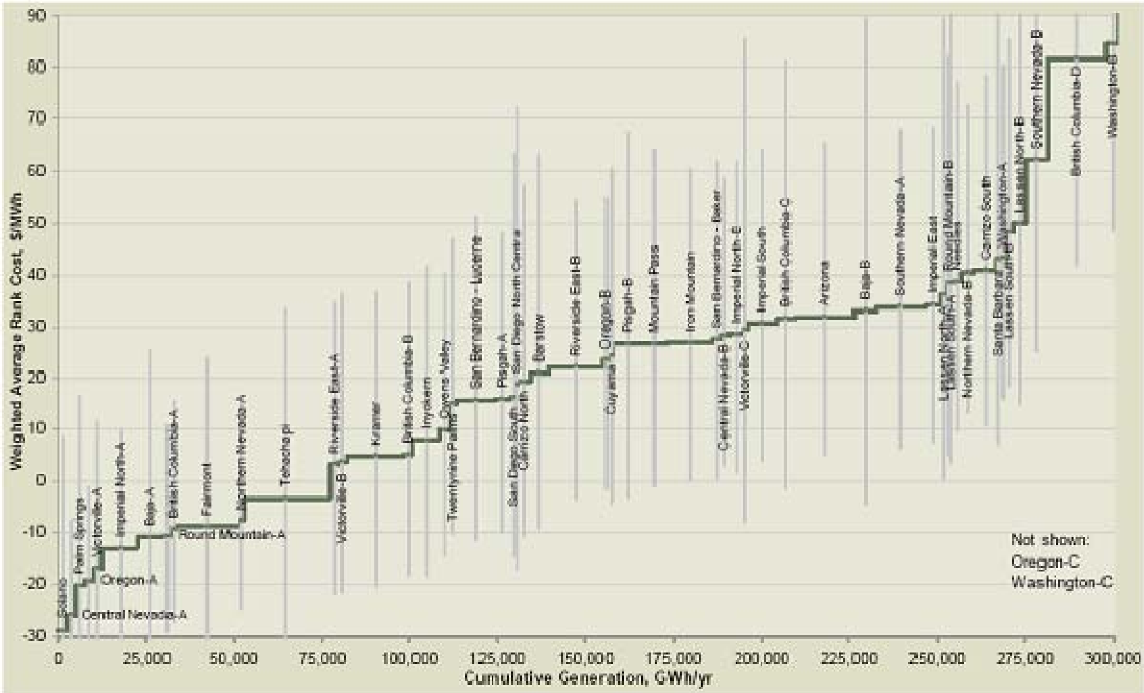


Figure 2-5. Phase 1B CREZ Economic Supply Curve with Uncertainty Band.

2.5 Out of State Resources

Consideration in Phase 1 of renewable resource regions located out of state was limited by the lack of environmental data comparable to that available for California. RETI participants worked to find this information for use in the Phase 2 report, so that out of state areas could be assessed on a basis comparable to that used for California CREZ, but such data does not appear to exist or is otherwise unavailable.

For purposes of conceptual transmission planning, resources from British Columbia, Oregon, Northern and Southern Nevada, and Baja California have been treated as CREZ. Economic scores for resources in those areas were computed on the same basis as California CREZ. In the absence of environmental data on out of state resources, RETI Phase 2 ranking assigned the median environmental score for California CREZ to each of the out of state areas. Resources in areas of neighboring states immediately adjacent to California CREZs, that would have been incorporated within those CREZs if not for the state borders, will be evaluated as part of California CREZs in future RETI work.

In Phase 1, Black & Veatch evaluated the economics of potential of wind and solar *projects* in California, whereas for Out of State regions they evaluated only the development potential of resource areas. (They evaluated biomass and geothermal resources on a project-level basis both in-state and Out of State). For Baja California, they considered wind resources only in the border region; Rocky Mountain resources were not considered at all. Efforts to obtain a more detailed assessment of the economic potential of Out of State resource are underway. The SSC may reconsider its estimates of cost-competitive resources from Out of State areas in future RETI work, and to this end review analyses recently completed by the Western Renewable Energy Zone (WREZ) initiative of the Western Governors Association, and by Nevada's Renewable Energy Transmission Access Advisory Committee (RETAAC). RETI will revise its estimates of the quantities and cost of Out of State resources if new estimates can be well-enough documented to provide a basis for supplanting those used in Phase 1.

2.6 Proposed Mojave Desert National Monument

The Mojave Desert National Monument contemplated by U.S. Senator Dianne Feinstein would affect at least a few CREZ, if in fact it is created in legislation. Monument boundaries have not been established, but very roughly the area that has been talked about runs from Needles, CA to the vicinity of the Pisgah Substation along Route 66, and then north from the northeast boundary of Joshua Tree National Park to the southern border of Mojave National Preserve. Establishment of a monument including this general area could eliminate approximately 11,700 MW of potential solar and wind generation in the Pisgah, Iron Mountain, Baker and Needles CREZ.

Because of the uncertainty surrounding creation of the monument and its boundaries, RETI has not modified the energy and environmental scores of these three potentially affected CREZ in its Phase 2 work. With the assistance of the EWG, however, some transmission line segments were changed to avoid the area potentially affected by the monument. The remaining transmission line segments necessary to access generation in these CREZ were evaluated and rated by the environmental expert panel.

RETI will follow plans for creation of the monument closely and modify CREZ designations and supporting transmission facilities as appropriate.

2.7 Interaction with Military Facilities

The military services participate actively on the RETI Stakeholder Steering Committee. In comments on the Phase 2A Draft Report, the Marine Corps, on behalf of all the military services, notes specific concerns about the interaction of renewable energy development in the California desert area with military operations and proposed base expansion. These include expansion of the Marine Corps Air Ground Combat

Center, 29 Palms, which could cause the relocation or elimination of CREZ in that area; and impacts on the Marine Corps' Chocolate Mountain Aerial Gunnery Range (CMAGR) in Imperial County, where solar projects and transmission corridors have been proposed immediately adjacent to CMAGR.

Low-flying military aircraft may require height restrictions on energy and transmission facilities in many areas of the desert. In addition, the military is studying the potential impact of solar mirror arrays on low-level military aircraft.

The military services point out that many of their installations have become islands of biodiversity, as development in the desert has driven species to the relative protection of military lands, for example at Camp Pendleton, Edwards Air Force Base, Ft. Irwin, China Lake Naval Weapons Test Center, the Chocolate Mountains Aerial Gunnery Range, and the Marine Corps Air Ground Combat Center, 29 Palms. They request that energy development be planned so that the military does not continue to inherit increasing responsibility for endangered species management, at the expense of military missions. They also emphasize the need to plan energy development in ways that preserve and enhance wildlife corridors, in order to ensure the viability of many species.

2.8 Environmental Issues Matrix

As noted in Phase 1, a variety of local environmental issues is expected to affect the commercial viability or permitting of many renewable generation projects. Detailed local information with which to evaluate these concerns quantitatively remains incomplete and RETI work groups made no attempt to incorporate it into the CREZ re-ranking process.

The CRWG, however, developed a matrix of potential environmental issues to serve as a checklist for evaluating CREZ in which these issues may be of significant concern. Table 2-3 below indicates the types of issues included on this matrix. Although it does not provide quantitative information for CREZ re-ranking, the matrix is expected to be useful in estimating the rate of future development and the timing of future transmission needs. An expanded version of the environmental issues matrix for each CREZ is included in the online supporting materials, as referenced in Appendix C.[13] In the next phase of RETI, contents of the matrix will be summarized and analyzed and, under the leadership of the EWG, the SSC will determine how to utilize that information in subsequent transmission planning efforts.

[13] Online supporting materials can be found at http://www.energy.ca.gov/reti

Table 2-3. Example CREZ Environmental Concern Matrix: CREZ 50.

CREZ 50 - Kramer	Solar	Wind	Geothermal	Comment
Phase 1b capacity (MW)	6400 MW	203 MW	24 MW	
Phase 1b CREZ Acres	40960 Ac	16544 Ac		Solar 6185 MW, Wind Testing 0 MW
Process Issues				
PPAs Submitted/Approved to CPUC or Local Regulatory Authority				
Application filed	5033 Ac	16859 Ac		585 MW solar proposed
Wind Testing				
Application actively pursued				
Permit decision issued				
ISO queue - Serial	330 MW			
ISO queue - Transition	2720 MW			
ISO Queue- GIPR	0			
Resource Conflicts/Controversies				
More than 20 owners/2 sq. mile proxy project	40660 Ac			32 Proxies moved to less than 20 owner sites.
Applicable HCP, NCCP	0	0	0	
Williamson Act contract	0	0	0	
Zoning (example: general plan amendment or rezoning required)	34176 Ac.			33527 Ac. CUP/ 648 Rezone
Known cultural resources including historic trails and or highways.		6205 Ac		
ACECs present	0	0	0	
DWMA		6271 Ac 28 Ac		Fremont-Kramer CACA 048537 1.5% of 418458 Acres Fremont-Kramer CACA 050319 <1% of 418458 Acres
Mojave Ground Squirrel habitat		21645 Ac		
Number of special status species present	65			Solar quantity accounts for entire CREZ
Important/Sensitive Habitat				No Assessment performed
Military Constraints				No Assessment performed[14]
Wildlands Conservancy lands present	0	0	0	0
Citizen proposed wilderness present	0	0		
Other (example: BLM says commercial wind is tapped out near Palm Springs)				
Advantages				
Additional lands identified for project development	3296 Ac			Abengoa-Mojave Solar One 250 MW, 2496 Acres, FPL 800 Acres.
Significant acreage of disturbed lands	0	0	0	
Revised CREZ Acres	42099 Ac	41870 Ac		

[14] Renewable energy facilities, particularly wind and transmission, have the potential to negatively impact military activities. Currently, exclusion based solely upon military constraints is not reasonable. However, specific projects will be reviewed by the military to determine impacts, and could affect development.

3.0 Conceptual Transmission Plan

RETI's central task revolves around identifying transmission facilities capable of delivering sufficient renewable energy to meet state goals, in ways that minimize economic cost and environmental impact. The conceptual plan presented in this report summarizes the facilities the SSC has identified for detailed study. They are designed to be developed in phases, over the period to 2020. Perhaps most importantly, this plan integrates the perspectives and concerns of a wide variety of California stakeholders into a consensus recommendation for such transmission development.

This section presents a preliminary conceptual transmission plan and describes the considerations and process used to develop it.

3.1 Conceptual Transmission Planning

Transmission development proceeds through several stages. Conceptual transmission planning is the first of these. In this stage, planners evaluate electrical alternatives for connecting new generation to the grid and ensuring that it will reliably be delivered to population centers. Conceptual planning revolves around analyzing electrical connections between substations, to determine whether existing connections can accommodate injections of power from new resources, whether they must be expanded, or whether new connections must be built. Because it focuses on electrical flows, conceptual planning generally does not identify exact geographic routes. The important exception is that this early-stage planning does consider whether existing transmission facilities can be upgraded or whether new lines can be added in or adjacent to existing corridors.

The RETI Stakeholder Steering Committee unanimously agreed that environmental concerns should be considered from the very first effort to identify potential electrical connections necessary to access renewable generation. This is a major innovation that may help to expedite the later permitting of any facilities that ultimately advance to more detailed study. A later section of this report describes integration of environmental concerns into Phase 2 conceptual planning.

Conceptual plans identify potential transmission projects. Transmission owners, most of whom are also Load-Serving Entities responsible for delivering power to customers, then propose specific transmission projects for detailed study by the CAISO, by IOU planners or by POU planners. Proposed projects must be found to be needed to maintain system reliability, make lower-cost power available to consumers, or to provide access to renewable generation.

To determine whether or not a proposed project is needed, and can be added to the grid without compromising system reliability, the second stage of transmission development is preparation of "plans of service" for each proposed project. Engineers conduct power flow studies to evaluate how every major element of the Western Interconnection grid performs, under a wide range of system conditions, when the proposed transmission facilities and associated generation are added to the grid. These studies identify how system operation will change with the new facilities added, and what electrical equipment may have to be added in specific locations around the grid to ensure that system reliability will not be compromised. Planners also employ production cost models to evaluate how the proposed facilities affect the value of power to generators and the cost to consumers across the entire grid, and affect system fuel consumption and emissions. The benefits of a project can then be compared to its costs. Transmission projects that show net benefits and maintain or enhance system reliability are then presented to POU governing boards or the CAISO board of directors for approval.

Geographic routing of proposed projects often takes place in parallel with preparation of plans of service. Routing involves identification and study of several alternatives. Environmental studies required for most projects typically take more than a year to complete and affect routing decisions. IOU projects must submit an application to the CPUC for a Certificate of Public Convenience and Necessity (CPCN) containing a Proponent's Environmental Assessment of the proposed project and alternatives to that project. POU projects follow a similar process. Agency consideration of transmission applications is a public process and is affected by the considerations and concerns identified by the public.

If the CPUC or POU governing board issues a permit to construct the proposed transmission, the project proponent then completes additional environmental permitting, in compliance with state and federal requirements; land acquisition; performs final engineering, for example of substation layout, and tower alignment and spacing; procures equipment and finalizes construction scheduling. The overall transmission development process typically requires 7-10 years from conceptual planning through construction.

RETI's Environmental Work Group (EWG) applied its collective knowledge of sensitive lands and permitting issues to identify potential electrical connections that would likely face legal, mitigation, or public opposition challenges. It worked with the CPWG to find ways to re-route or remove affected electrical connections from consideration. Because of this screening, the Phase 2 preliminary conceptual plan may draw wider stakeholder support, and later, may result in projects able to be approved more quickly.

3.2 Conceptual Transmission Planning Work Group

The SSC formed a Conceptual Planning Working Group (CPWG) to develop a statewide conceptual transmission expansion plan. Work Group members include representatives of all major transmission providers, Load-Serving Entities (LSEs), regulatory and permitting agencies, renewable energy generators and other stakeholders. The Work Group met bi-weekly beginning in October 2008; from January 2009 on, it then met weekly, in person and via web conference. The Work Group also formed subcommittees to perform focused studies. Environmental organizations occasionally met jointly with the CPWG, and provided important input at several points in the development of the conceptual plan.

3.3 Conceptual Plan Development and Assessment

3.3.1 Transmission Components in the Conceptual Plan

Using its collective judgment, the CPWG first developed a comprehensive list of potential transmission solutions for accessing all CREZ and cost-effective out of state resource areas. Adding approximately 60,000 GWh of energy to the statewide grid and making it deliverable to customers across the state will require upgrade or expansion of many elements of the transmission system as well as the connections necessary to resource areas. Facilities in the plan include not only connections to individual CREZ but also expansions of existing major elements of the high-voltage grid needed to deliver power to load centers. These include, for example, “gateway” substations where large amounts of power enter the Los Angeles Basin, and expansion of transfer capacity between Southern and Northern California.

Many of these facilities had already been identified by transmission owners, and others were added to the list as found necessary to provide transmission access to renewables. All of the components of the preliminary statewide conceptual plan are “network” connections in which, depending on system conditions, power could theoretically flow in both directions. Radial “trunklines” and “gen-ties,” in which power flows predominantly in one direction, from a CREZ to the network, will be considered in future work.

The initial list of new network transmission facilities was then revised with the help of the EWG to eliminate or re-configure facilities in areas of special environmental sensitivity. The resulting shorter list of facilities constitutes this initial RETI conceptual statewide transmission plan. A complete list of new facilities included in the preliminary conceptual statewide plan is found in Appendix H. The plan still includes a few segments likely to be redundant, an issue which will be addressed in future assessments.

Not all of the energy from all CREZ will be needed to meet a 33% RPS goal. Consequently, not all of the facilities in the conceptual plan will be needed. It is impossible to know today which will be needed and which not. Transmission capacity needed to access CREZ and collect renewable energy will be determined by the pattern and rate of CREZ development. Upgrades to Foundation lines, which enable energy to move throughout the state, may be needed to the extent that the existing system has insufficient capacity to do so. RETI has not assessed such need.[15] Upgrades required to deliver energy to load centers depend on load growth, changes in local generation, including local PV installation, and grid reliability-related factors.

RETI's mandate is to identify, from a statewide perspective, additional transmission capacity sufficient to provide access and delivery of renewable energy equal to the net short in 2020. To account for the uncertainty in the pattern and timing of renewable resource development, the RETI Stakeholder Steering Committee directed that the RETI conceptual transmission plan be developed sufficient to provide access to 160% of the RETI net short in year 2020. As discussed above, which conceptual plan components will be needed for this purpose by 2020 will be determined by further study and future developments.

3.3.2 Minimizing New Rights of Way

RETI developed its conceptual transmission plan from the outset with a goal of minimizing the impacts of transmission development associated with meeting state renewable energy and greenhouse gas reduction goals. The most effective way to do this

[15] At the beginning of the Phase 2A process, LADWP, IID and SDG&E initially proposed, and began implementation of, an incremental generation-addition methodology that provided an indication of the extent to which the existing system has capacity to accommodate increased renewable energy development within each identified CREZ. This methodology systematically increased generation within each CREZ to determine the point at which grid contingencies would result in maximum permissible power flows (i.e., when a line's thermal rating was reached) or minimum acceptable voltage levels. This level of CREZ generation is a measure of the capacity of the existing grid to accommodate increased renewable energy development. Transmission upgrades would then be identified to comport with reliability criteria. The amount of generation within each CREZ would then be further increased and the process repeated. A majority of the Conceptual Planning Work Group participants did not support this approach and a

is first, to establish the extent to which the existing grid can accommodate new renewable generation; and then to minimize the number and amount of new Rights of Way required to meet the renewable net short goal. While RETI did not determine the extent to which the existing grid can accommodate new renewable generation, the upgrades included in the conceptual transmission plan utilize existing transmission corridors and existing Rights of Way (ROW) to the greatest extent possible. The CPWG looked first for situations where existing lines could simply be reconductored or upgraded with new towers, and then for situations where new lines could be added in parallel to existing lines. In some cases, this would require widening the existing ROW or co-locating the lines adjacent to existing ROW.

Adding lines in parallel to existing facilities can minimize environmental impact where defined corridors exist or where widening a right of way is feasible. Some of the lines built over the last many years, however, are in locations no longer considered acceptable, where changes in land classification have made expansion of existing ROW undesirable, or where residential and commercial development has encroached on existing ROW. These factors, which can make it infeasible to add new lines to existing ROW, have not been taken into account in RETI analysis.

Environmental evaluation of transmission facilities in the conceptual plan is outlined in Section 3.7 below.

3.3.3 Plan Assessment Methodology

The electrical function of each proposed line segment was evaluated to assess its relative usefulness in providing access to renewable energy resources in California and neighboring states, enabling energy transfers between major load centers, and delivering energy to those loads. Individual proposed line segments were combined into functional groups, and the line segment information was combined to provide information for each group. This methodology is shown schematically in the flow chart in Figure 3-1.

The plan assessment methodology can be thought of as a five-step process:

1. Transmission system modeling – In the first step, all of the proposed new network transmission elements in the plan were added to the western regional transmission system expected by the Western Electricity Coordinating Council (WECC) to be in place for the year 2018.

judgment-based conceptual planning approach was used instead to identify many of the RETI upgrades.

2. Shift Factor Calculations – This transmission system configuration, with the proposed new network facilities added, was analyzed for RETI by San Diego Gas & Electric Company using the ABB GridView computer program. The program injects a small amount of energy from each RETI CREZ, one at a time, and withdraws this energy at LSE load centers, in proportion to each LSE's net short estimates. The program calculates the fraction of these small energy injections which would flow in every segment of the WECC grid, including the proposed RETI line segments. These fractions are known as "power distribution factors" or "shift factors." They provide the basic information on the energy from each CREZ which flows in each line segment of the conceptual plan.
3. The shift factors were then combined with four different sets of energy information associated with each CREZ to provide a renewable energy rating for each line segment. The four rating criteria employed capture the economic and environmental score of each CREZ, as revised in Phase 2; the energy output of each CREZ; and commercial interest, represented by the amount of energy able to be provided by projects having Power Purchase Agreements and/or queue positions in each CREZ.
4. The line segments were then combined into functional groups, with line segment information combined to provide overall results for each group.
5. Environmental ratings and investment cost for each line segment were also compiled for each group, alongside group energy ratings. This information is summarized for comparison purposes on Tables 3-7 and 3-8 below.

If all the proposed line segments were in place, the assessment provides a relative measure of how much renewable energy can be expected to flow in any line segment. The shift factor assessment does not provide information about whether any line segment is "needed" for renewable energy to move from CREZ to loads. For example, the existing transmission system may be adequate to transmit a significant portion of this energy from CREZ to loads; but the shift factor analysis used in the Phase 2A process sheds little light on this possibility.

Future RETI work may include removing some of the proposed line segments from the plan and assessing the amount of renewable energy carried by those remaining. This could provide additional information to help prioritize line segments and groups of segments electrically. It will not, however, determine whether or not any new line segment or group of segments is needed on an electrical basis to transmit renewable energy.[16] Doing so requires use of more sophisticated power flow and economic dispatch models, and the studies involved are beyond RETI's scope.

Despite its limitations, shift factor analysis is a useful assessment tool in transmission planning. It provides information regarding the *likelihood* that any individual line segment or group of segments will be a valuable addition to the system under, in this case, the conditions assessed by RETI, for purposes of providing access to resource areas and delivering renewable energy to consumers.

[16] The RETI EWG and environmental expert panel has completed a preliminary environmental screening of all line segments whose renewable energy transfer capabilities may be studied further. Environmental impacts of any conceptual electrical connections incorporated into proposed transmission projects will be studied in detail, as required by CEQA.

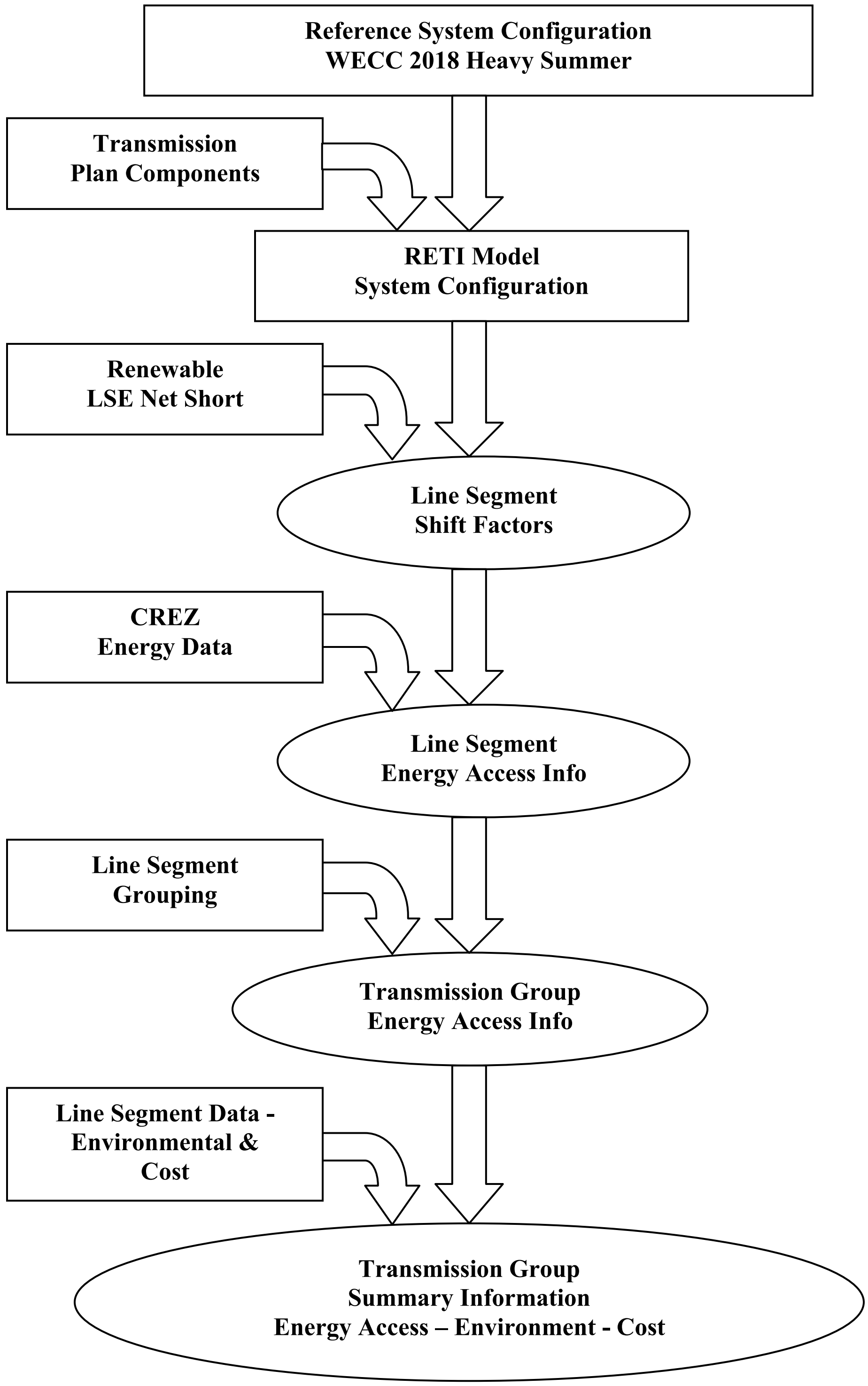


Figure 3-1. RETI Conceptual Plan Assessment Methodology Flow Chart.

3.3.3.1 Conceptual Plan Renewable Net Short

An essential input to the assessment methodology for calculating shift factors is identification of the expected demand for renewable energy in each load center. In essence, this information tells the computer program where the energy from the CREZ needs to go.

The collective need in California for additional renewable energy to meet a 33% Renewable Portfolio Standard (RPS) was computed in RETI Phase 1 and is referred to as the statewide renewable net short. The statewide net short was revised in Phase 2 to correct the earlier inclusion of cogenerated electricity in retail sales and to more accurately reflect renewable energy likely to be generated locally from photovoltaic (PV) installations, thereby reducing the need to transmit renewable energy from remote CREZ.[17]

RETI notes further that small-scale geothermal and wind technologies can and should play a role in meeting our energy needs. For instance, as part of its "Energy Independence" Program, Sonoma County is considering deployment of geothermal "ground-source" heat pump technology, direct use and small-scale geothermal heating and cooling applications. Mammoth Lakes, CA, is exploring creation of a "geothermal heating district" similar to one in place in Boise, Idaho. Studies such as the High Distributed Generation scenario recently examined by the CPUC provide new information and perspective on the amount of small-scale renewable generation likely to be deployed.[18]

For purposes of conceptual plan assessment, the net short for each LSE was computed from estimated demand in 2020 and RPS eligible retail sales in 2008. The total for all LSEs was in excellent agreement with the original Phase 1 net short estimate. In the absence of information about LSE expectations for local PV generation, the values of individual LSE net short requirements were used for purposes of system modeling and shift factor calculations, despite the fact that their total was higher than the revised estimate. However, because the assessment is based on small increments (not aggregate quantities) of power, the results would not be different if the net short positions of LSEs had been uniformly scaled downward to reflect assumed uniform penetration of local PV generation.

[17] RETI Phase 1B Final Report Update: Net Short Recalculation and New PV Assumptions With Revisions Adopted February 24, 2009. Available at: www.energy.ca.gov/reti.
[18] "33% Renewables Portfolio Standard Implementation Analysis: Preliminary Results," California Public Utilities Commission, June 2009.

LSE net short positions used for shift factor calculations are shown in Table 3-1 below. In this table, the column headed, "Total Retail Sales (2020)" shows the amount of electricity, in GWh, that each LSE projects it will sell to retail customers in the year 2020. Each LSE's RPS requirement in 2020 is equal to 33% of that amount. The column headed, "RPS Retail Sales 2008" shows the amount of electricity from renewable resources each LSE sold to retail customers in that year. The right-hand column, "Net Short 2020" shows each LSE's 33% RPS requirement in 2020, less the amount of RPS energy it sold in 2008. This is the amount of electricity from renewable sources each LSE must procure and sell in 2020 but does not now have (i.e., the amount it is short of). To take PG&E as an example: PG&E Total Retail Sales in 2020 are projected to be 93,627 GWh. PG&E's RPS requirement in 2020 is 33% of that amount, or 30,897 GWh. In 2008, PG&E sold 9,774 GWh of RPS energy. Assuming PG&E continues to sell 9,774 GWh of RPS energy every year, it needs 21,1223 GWh additional renewable energy to meet its 2020 RPS requirement (30,897 GWh total requirement, less 9,774 GWh = 21,123 GWh Net Short).

Table 3-1. Forecast of LSE Renewable Net Short Positions in 2020.

LSE Name	Total Retail Sales (2020) (GWh)	RPS Retail Sales 2008 (GWh)	Net Short 2020 (GWh)
SMUD	NA	NA	2,084
Other TANC	NA	NA	2,000
PG&E	93,627	9,774	21,123
PG&E Direct Access	6,814	NA	2,249
SCE	99,142	12,573	20,144
SCE Direct Access	9,405	NA	3,104
LADWP	27,776	1,968	7,754
IID	4,216	671	720
Other SCCPA	9,969	498	2,791
SDG&E	21,113	1,047	5,920
SDG&E Direct Access	3,113	NA	1,027
Totals			**68,916**

RETI will continue to update estimates of how much distributed energy is likely to be deployed as well as the amount of energy likely to be needed after existing resources are considered to comply with the state's Renewable Portfolio Standard. RETI conceptual planning is based on the judgment that it is prudent to plan today for large-scale generation-transmission development, even if such facilities are later found not to be necessary and are never built.

3.3.3.2 Shift Factors

In the complex network of the electric grid, energy from any generator spreads throughout every network link in the Western Interconnection at almost the speed of light. Energy used by any customer is drawn from the complete network and cannot be said to come from any individual generator. Evaluating the degree to which a particular line segment is useful in distributing renewable energy from a particular CREZ is therefore a sophisticated process.

The assessment process adopted by the SSC computes a set of "shift factors", also known as distribution factors. These numerical shift factors provide a relative measure of each new line segment's usefulness in transmitting energy from each CREZ.

To calculate shift factors for individual transmission line segments, all of the segments in the conceptual plan were assumed to be connected. Demand for renewable energy by each LSE was assumed to be equal to its net short, as discussed above. In order to ensure that energy from the CREZ flows to LSEs sufficient to meet renewable energy and greenhouse gas reduction goals, LSEs also identified the proxy location or locations at which the renewable energy was to be considered delivered for purposes of shift factor calculations.

The shift factor calculation process sequentially inserts one megawatt of power into the grid from each CREZ and computes the percentage of this additional power that flows in every line segment throughout the Western Interconnection to designated locations that represent load. The percentages flowing in each of the line segments included in the RETI conceptual statewide plan are tabulated in a matrix. Since more than 100 new line segments were considered to provide access to 35 CREZ, more than 3,500 shift factors were computed. The complete shift factor matrix is found in the Online Supporting Materials posted with this report. A small sample of the matrix is shown in Table 3-2 below.

Table 3-2. Extract of Shift Factor Matrix.

Line Segment ID→ CREZ Name↓	BANN_DEVR_1	BANN_ELCN_1	BANN_GEO_1
Imperial South	0.4269	-0.0580	-0.0010
Inyokern	-0.0326	0.0020	-0.0002
Iron Mountain	-0.0206	0.0009	0.0017
Kramer	-0.0323	0.0020	-0.0002
Lassen North	-0.0246	0.0016	-0.0003

Shift factors represent the percentage of energy from each CREZ flowing in each line segment. A positive value indicates that energy from the CREZ moves from the first substation listed to the second. A negative value indicates that the flow is in the opposite direction. For example, the first row of the table shows that 42.7% of the energy from the Imperial South CREZ flows in the BANN_DEVR_1 segment from the Bannister substation to the Devers substation. The negative value in the second row of the table shows that 3.3% of the energy from the Inyokern CREZ flows from Devers to Bannister. The implication of the offsetting signs is that the flow in this segment from the Inyokern CREZ would cancel out some of the flow from the Imperial South CREZ.

However, since flows from different CREZ may occur at different times of day or year, opposing flows cannot be counted on to cancel each other out. Therefore, the absolute values all shift factors are used in the plan assessment. This provides a measure of each line segment’s energy access to all CREZ.

3.3.3.3 CREZ Data

CREZ data used in the conceptual plan assessment has been updated from Phase 1 using the same methodology. Summary results are shown in Table 3-3.

On Table 3-3, the column headed **Total Energy** shows the total amount of energy that each CREZ is estimated to be able to produce, in Gigawatt-hours (GWh). The column headed **Net Short Energy** shows CREZ energy output, in GWh, with that output reduced proportionally so that the aggregate of all CREZ equals the Renewable Net Short, in GWh, estimated to be required statewide in 2020. The column headed **Economic Score** represents the revised Phase 2 economic ranking of each CREZ, as presented on the CREZ bubble chart in Figure 2-4. As on that chart, lower economic scores represent lower-cost (higher value/more attractive) energy. The column headed **Environmental Score** lists the environmental ranking of each CREZ, again as presented on the CREZ bubble chart in Figure 2-4. In this column, as on the CREZ bubble chart, lower environmental scores indicate relatively less environmental concern.

Values in the columns headed **Adjusted Economic Score** and **Adjusted Environmental Score** are used in the rating criteria formulas, described below, to evaluate the energy access provided by transmission line segments.

Table 3-3. Summary CREZ Data.

CREZ Name	Total Energy	Net Short Energy	Economic Score	Adjusted Economic Score	Environmental Score	Adjusted Environmental Score
Baja-A (La Rumorosa)	8,035	2,072	-30.11	47.57	6.80	15.40
Baja-B (Santa Catarina)	8,931	2,303	-30.11	47.57	6.80	15.40
Barstow	5,856	1,510	-2.10	19.56	8.70	13.50
British Columbia	1,849	477	-30.00	47.46	6.80	15.40
Carrizo North	3,395	876	0.95	16.51	8.40	13.80
Carrizo South	8,323	2,147	3.72	13.74	6.20	16.00
Cuyama	1,784	460	-1.77	19.23	0.00	22.20
Fairmont	10,355	2,671	-22.55	40.01	10.40	11.80
Imperial East	3,959	1,021	-0.09	17.55	5.70	16.50
Imperial North-A	10,626	2,741	-21.62	39.08	2.70	19.50
Imperial North-B	4,507	1,162	0.44	17.02	9.30	12.90
Imperial South	9,167	2,364	1.84	15.62	6.80	15.40
Inyokern	6,322	1,631	-14.95	32.41	7.60	14.60
Iron Mountain	11,611	2,995	-1.48	18.94	5.20	17.00
Kramer	16,553	4,269	-15.55	33.01	5.80	16.40
Lassen North	3,784	976	9.41	8.05	7.80	14.40
Lassen South	1,106	285	1.81	15.65	19.40	2.80
Mountain Pass	4,336	1,118	-2.50	19.96	3.50	18.70
Needles	1,187	306	4.26	13.20	10.00	12.20
Nevada N	822	212	-31.20	48.66	6.80	15.40
Nevada C	2,624	677	-39.20	56.66	6.80	15.40
Oregon	3,062	790	-41.38	58.84	6.80	15.40
Owens Valley	3,613	932	-19.38	36.84	5.20	17.00
Palm Springs	2,595	669	-35.94	53.40	8.00	14.20
Pisgah	6,281	1,620	-5.81	23.27	4.00	18.20
Riverside East	25,473	6,570	-5.49	22.95	5.10	17.10
Round Mountain-A	2,691	694	-30.31	47.77	3.40	18.80
Round Mountain-B	742	191	17.46	0.00	8.40	13.80
San Bernardino - Baker	8,707	2,246	1.23	16.23	6.70	15.50
San Bernardino - Lucerne	8,143	2,100	-2.25	19.71	7.70	14.50
San Diego North Central	739	191	-0.32	17.78	22.20	0.00
San Diego South	1,926	497	-12.29	29.75	5.50	16.70
Santa Barbara	1,180	304	1.07	16.39	9.20	13.00
Solano	2,865	739	-38.93	56.39	7.60	14.60
Tehachapi	29,473	7,602	-20.09	37.55	4.60	17.60
Twentynine Palms	4,616	1,191	-9.83	27.29	4.80	17.40
Victorville	4,270	1,101	-8.92	26.38	8.20	14.00
Totals	**231,508**	**59,710**				

The CPWG developed four CREZ energy metrics, or rating criteria, to incorporate different dimensions of renewable energy availability. These four criteria are:

1. **Criterion A**: Total CREZ energy potential (the **Total Energy** column in Table 3-3, and in criteria formulas below);
2. **Criterion B1:** Total CREZ energy weighted by CREZ adjusted economic scores (**Adjusted Economic Score** in Table 3-3 and in criteria formulas below);
3. **Criterion B2:** Total CREZ energy weighted by CREZ adjusted environmental scores (**Adjusted Environmental Score** in Table 3-3 and in criteria formulas below);
4. **Criterion C:** CREZ energy having known commercial interest.

Economic scores on Table 3-3 represent CREZ renewable energy cost relative to the estimated cost of gas-fired generation. Higher values represent higher, less desirable costs, and the scores include negative values. In order to create an economic weighting factor, the economic scores were adjusted so that higher scores are more desirable and negative values are avoided. The *relative* adjusted scores for the CREZ are in the same order as the original scores, but are inverted. The ***adjusted*** economic scores shown in Table 3-3 are calculated from the original economic scores by subtracting the economic score for each CREZ from the maximum value for all CREZ.

Environmental scores on Table 3-3 represent relative environmental concern associated with development of the CREZ. There are no negative values, but higher scores are less desirable. To be able to be used in rating criteria formulas, CREZ environmental scores were adjusted to create scores in which higher values are more desirable. This was done by subtracting the environmental score for each CREZ from the maximum value for all CREZ. These are the ***adjusted*** environmental scores shown in Table 3-3.

The fourth energy metric is a measure of the amount of CREZ energy having known commercial interest. Power Purchase Agreements (PPAs) and requests to transmission authorities for interconnection to the grid (interconnection queue positions) are indications of commercial interest. Since the CAISO and POUs have different requirements for joining their respective interconnection queues, the CPWG developed alternative indications of commercial interest for CREZ in which these different requirements were at issue. The commercial energy metric used in the assessment sums the energy having PPAs and energy having queue positions for each CREZ.

3.3.3.4 Line Segment Energy Access Information

The renewable energy access provided by each line segment in the conceptual plan is estimated by multiplying the absolute values of the shift factors for the line by one of the four energy metrics for every CREZ, and summing the result. These sums provide a numerical result for each of the four energy criteria. This is useful to compare the energy access provided by the line segment.

Criterion A – Total Energy Score

SegmentScore(j) = SUM [ShiftFactor(j,k) × TotalEnergy(k)]

In which:
SegmentScore(j) is the j^{th} line segment in the plan;
ShiftFactor(j,k) is the absolute value of the shift factor for segment(j) and CREZ(k);
TotalEnergy(k) is the total energy potential of CREZ(k)
SUM indicates that the results of the multiplications are to be added together.

Similarly:

Criterion B1 – Energy Weighted by Adjusted Economic Score

SegmentScore(j) = SUM [ShiftFactor(j,k) × TotalEnergy(k) × AdjEconScore(k)]

Criterion B2 – Energy Weighted by Adjusted Environmental Score

SegmentScore(j) = SUM [ShiftFactor(j,k) × TotalEnergy(k) × AdjEnviroScore(k)]

Criterion C – Energy of Commercial Interest Score

SegmentScore(j) = SUM [ShiftFactor(j,k) × CommIntEnergy(k)]

Since each of these metrics includes the shift factors, and three of the four include the CREZ energy, all four scores are highly correlated. In other words, the *relative* scores for line segments from any of the four metrics are similar. The four scores can thus be aggregated into a single “combined energy score” which provides a kind of average energy score for each line segment. Details of this combination process are included in the Online Supporting Materials, along with a chart showing the correlation of the four scores.

A short extract of the line segment scoring results is shown in Table 3-4 below. A complete list of these energy access scores for each line segment in the conceptual plan can be found in the Online Supporting Materials.

Table 3-4. Sample Line Segment Energy Access Results.

Segment	CREZ Energy Score (GWh)	CREZ Econ Score	CREZ Enviro Score	CREZ Commercial Interest Score (GWh)	Combined CREZ Energy Score (GWh)
PRDE_VINC_2	629	18,090	9,938	1,562	639
RIOH_VINC_2	487	14,618	7,844	1,531	546
SCEJ_CAMI_1	962	21,228	14,931	2,500	955
SCEJ_PISG_1	1,932	40,830	32,001	3,752	1,746

The **Combined Energy Score** combines CREZ energy, CREZ economics, CREZ environmental concerns and commercial interest into a single quantitative score for each segment, which can then be used for comparison purposes. Conceptual plan assessment results report the results of all four energy metrics as well as the combined energy score.

As illustrated in Table 3-4, the **Combined Energy Score** for each segment may be greater or less than the total **CREZ Energy Score**, depending on the relative values of economic, environmental and commercial interest scores for the CREZ accessed. The average difference is less than 10%.

3.4 Limitations of the RETI Rating Methodology

In order to establish priorities for future detailed study of upgrades in its conceptual transmission plan, RETI estimated the usefulness of identified line segments to access and transmit renewable energy. To do this, the CPWG developed a methodology based on shift factors, as discussed above. Understanding the significant limitations of this methodology is essential for understanding the usefulness of the conceptual plan itself. There are several categories of limitations:

- Shift factors provide only an approximation of how power would flow on the network, including the lines of interest. Shift factors provide no information about congestion, reactive power, or other crucial dynamics of how the system would respond to large amounts of power injected at CREZ. Shift factor calculations employ a linear process to model complex, non-linear dynamics. They cannot substitute for full power flow studies of potential transmission system additions. A full explanation of the shift factor analysis and its technical limitations is included in Appendix J.

- Shift factors have been calculated based on LSE projected net short. Lines that carry CREZ energy to LSE service areas having relatively smaller proportions of the state-wide net short will necessarily have smaller shift factors. From a statewide perspective, it is valuable to understand which lines carry the most renewable energy. This may be less helpful to smaller load centers intent on meeting renewable energy and greenhouse gas reduction goals.
- Shift factor magnitudes are highly sensitive to the assumed grid configurations that connect CREZ to the network. For example, an assumption that a CREZ will only be connected to a new line, and not to an adjacent existing line where the cost of looping-in the existing line may be relatively small, will result in shift factors for the new line that may be twice as high than would be the case if the CREZ were assumed to be connected to both the new line and the adjacent existing line.
- The RETI evaluation methodology is based on current estimates of CREZ energy potential within the designated RETI study area,[19] and these estimates are likely to change in the future. Discovery of larger amounts of low cost out-of-state resources, for example, could make import lines more cost-effective than they appear in shift factor-based ratings today.
- RETI assessments do not provide information needed for long-term benefit/cost analyses. Both the benefits and the costs of transmission projects must be evaluated over their 50^{+}year lives. The RETI plan, however, looks only to the year 2020. RETI has produced no estimate at all of the benefits that the lines identified might provide in reducing congestion, providing access to lower-cost generation or improving grid reliability; and it provides only a rough estimate of the initial capital cost of each group of projects. RETI cannot and does not make any judgment about the overall benefits and costs of any specific transmission line proposal.

Some RETI participants point out that the line segment rating scores developed by the CPWG methodology, based as they are on shift factor calculations, may be interpreted to imply a level of certainty about the relative usefulness of the lines that is not well supported by RETI analysis or data. Further caveats regarding the significance of assessment results are discussed in Section 3.8.

[19] The RETI study area includes California; Arizona; Nevada; Oregon; Washington; northern Baja California, Mexico; and British Columbia, Canada.

Many of the limitations of the RETI evaluation methodology are inherent in conceptual planning. Conceptual planning is a preliminary step in the transmission development process, and cannot substitute for full electrical or environmental feasibility studies. It is crucial to keep in mind that this initial conceptual plan is intended primarily to identify priority lines for detailed power flow study and production cost modeling.

3.5 Line Segment Groups

Line segments are conceptual electrical connections between substations. In this initial conceptual plan, the CPWG considered only those segments that form network connections. Network connections are ones in which power may flow in both directions on the line.[20] Trunklines and other radial connections, in which power flows predominantly in one direction (for example, from a generator to the grid), are not considered in the present analysis.

Individual transmission line segments function together with other network elements to collect energy and allow it to move efficiently throughout the system. The CPWG combined electrically-adjacent line segments into groups according to their primary function. The current plan identifies 13 groups, as described briefly below. Tables 3-5 and 3-6 relate the CREZ to the groups of line segments that provide access to them. Individual line segments belonging to each group are listed in Appendix F, and described in detail in Appendices G, H and I.

3.5.1 Renewable Foundation Group

The 23 line segments comprising the Foundation Group increase the capacity of the California transmission network between Palm Springs and Sacramento, which allows energy to flow north or south as needed. Additional capacity is likely to be essential to facilitate delivery of renewable energy from CREZ and out of state areas to consumers in all major load centers. The usefulness of the Foundation Group is not limited to renewable energy. The increased capacity the Foundation Group provides is likely be needed to meet growing energy demand regardless of generation source. Maps showing Foundation Group lines are included below as Figures 3-2 (Southern California) and 3-3 (Central and Northern California).

[20] To be more precise, network connections are lines in which the amount of power flow depends on the physical characteristics of the remainder of the interconnected grid. They are distinguished from trunk lines and generation tie lines (gen-ties), which function like extension cords to connect generating projects to the grid. In radial connections to the grid, as gen-ties are called, the amount of power flow depends only on the quantity of generation connection to the line.

Specifically, new line segments within the Foundation Group may significantly increase bi-directional power transfer capability of WECC Path 26 between Northern and Southern California. The Path 26 transmission network is currently comprised of three existing Midway–Vincent 500 kV lines. The RETI Conceptual Plan adds new line segments between Midway and a new Gregg 500 kV substation in central California, and between Midway and Kramer 500 kV substations in Southern California.

3.5.2 Renewable Delivery Group

The Delivery Group includes 13 line segments. It provides additional capacity needed to move energy from Foundation lines to major load centers. Some of the line segments within the Delivery Group may offer an alternate back-up transmission path for the renewable power in case of a critical outage of a line segment within the Foundation group, thus serving a significant complementary role in assuring the reliability of the overall transmission grid network in California. The increased capacity that this group provides is likely to be needed to meet growing energy demand regardless of generation source. Maps showing Delivery Group lines are included below as Figures 3-2 (Southern California) and 3-3 (Central and Northern California).

In Southern California, the Delivery Group includes two new Devers–Valley single circuit 500 kV lines (Devers–Valley #2 and #3), and a Devers2-Century single circuit 230 kV line #1. The new Devers–Valley single circuit 500 kV line #2 is an integral component of the California portion of the proposed Devers–Palo Verde single circuit 500 kV line #2 (DPV2) project. Current status of the DPV2 project is summarized in the description of the Riverside Group below.

3.5.3 Tehachapi Group

The 12 line segments of the Tehachapi Group provide access to the large wind and solar resources in the Tehachapi region, and in addition serve as Foundation and Delivery lines. Some northern segments in the Tehachapi Group function primarily as Collector Lines, accessing wind and solar energy, and also strengthen the transmission path for transferring renewable power to Northern California load centers. Southern line segments in this group function primarily as Renewable Delivery lines, transporting that power to the Los Angeles load center.

This group includes Southern California Edison's Antelope Transmission Project (ATP) and Tehachapi Renewable Transmission Project (TRTP). Segments 1-3 of the Antelope Transmission Project are now under construction. SCE filed an Application for a Certificate of Public Convenience and Necessity (CPCN) for segments 4-11 of the

Tehachapi Renewable Transmission Project at the CPUC in June 2007; Evidentiary Hearings in this proceeding are currently underway.

RETI Phase 2A CREZ revision work identified 10,837 MW of renewable resources at the Tehachapi CREZ and 3,518 MW at the nearby Fairmont CREZ. The CAISO Generator Interconnection Request Queue for the Tehachapi region contains 7,833 MW, or about 55% of identified renewable resource potential in the area. The ATP and proposed TRTP project together will provide the electrical facilities necessary to integrate up to 4,500 MW of this renewable generation, and to deliver it to Los Angeles basin load centers. Future updates of the RETI conceptual plan may identify additional transmission capacity to access Tehachapi region resources in excess of 4,500 MW.

The two SCE Tehachapi projects are comprised of 11 line segments. The RETI conceptual plan added one segment in the region. Details of each of proposed 12 line segments of this Group are described in Appendix G.

3.5.4 LEAPS Group

The "LEAPS Group" is named for the Lake Elsinore Advanced Pumped Storage project now under development. This transmission group includes five segments of the 500 kV Talega-Escondido/Valley-Serrano (TE/VS) line and associated transmission facilities. As represented in RETI, it does not include the pumped storage project.

The TE/VS facilities may function as Foundation and Delivery lines, to move power north and south between San Diego and the rest of the state. They may also potentially function as Renewable Collector lines, providing access to the San Diego-North CREZ.

Future RETI work may evaluate the extent to which the TE/VS line could facilitate delivery of energy from the Palm Springs, Twentynine Palms, and Riverside East CREZs south to the San Diego area, via the west-of-Devers and Talega-Escondido/Valley-Serrano (TE/VS) transmission systems, as well as delivery of energy from the Imperial Valley and Baja CREZs north to the Los Angeles area, via the Southwest Powerlink/Sunrise Powerlink/San Diego network. If some of the proposed lines in the Imperial Valley area connecting to Devers substation and some of the west-of-Devers upgrades are not built or are delayed, for example, the LEAPS Group might carry a substantially greater amount of renewable energy from the Imperial Valley and Baja CREZs northward to the Los Angeles area via the SDG&E and CFE transmission systems and the TE/VS line.

The LEAPS Group has an environmental rating score slightly below (better than) the median score for all groups. Even though the TE/VS line is one of the shortest proposed, it utilizes new right-of-way that is neither adjacent to nor in an existing right-of-way, nor within a federally-designated corridor. The TE/VS line and associated transmission upgrades have already undergone extensive environmental review at the Federal Energy Regulatory Commission (FERC), and permitting and regulatory approval of the project is at an advanced stage:

- FERC issued a final Environmental Impact Statement (FEIS) for the TE/VS project in January 2007.
- The project received interconnection approval from the CAISO, for interconnections both to the SCE and SDG&E systems in March 2007.
- The route for the TE/VS line through the Cleveland National Forrest received preliminary approval by the United States Forest Service (USFS) in August 2006, when considered as part of the LEAPS hydroelectric pumped storage project. Final approval may follow CPUC or FERC action.
- Interconnection Agreements with SDG&E/CAISO were approved by the FERC.
- FERC granted rate-base treatment for the TE/VS Interconnect in March 2008.
- Engineering for the TE/VS project is now underway.
- The project expects to receive designation as a CAISO Participating Transmission Owner (PTO) by the end of 2009.

One major remaining permitting requirement for the TE/VS project is to obtain a Certificate of Public Convenience and Necessity (CPCN) from the CPUC. The project submitted a CPCN application in October 2007. The CPUC rejected this application, without prejudice, in May 2009, and indicated that the project could re-file its application when it reaches agreement with the US Marine Corps as to the location of the project's southern substation. The project developer continues to work closely with FERC on this issue, and plans to re-file its CPCN application later in 2009. If TE/VS receives a CPCN, the Project will be considered a public utility in the State of California.

In addition to the CPUC permitting process, there are two federal backup permitting paths for the TE/VS transmission project: obtaining a FERC hydro license; and expedited permitting under the Energy Policy Act of 2005. A FERC hydro license would allow construction of the TE/VS transmission facilities. The project's location in a National Interest Transmission Corridor, as designated by DOE under Section 1221 of the Energy Policy Act of 2005, allows project sponsors to petition FERC to issue a permit to construct the project.

Given the advanced status of the permitting and regulatory approvals needed to construct the TE/VS project, and a final design and construction period of 18 to 24 months, project developers estimate that the transmission project can be constructed and placed in service by 2012.

3.5.5 Renewable Collector Line Groups

The nine remaining groups in the assessment serve primarily to collect energy from one or more CREZ and deliver this energy to a substation in the Foundation Group for distribution around the state.[21] For example, the INYK_KRAM_1 segment is part of the Inyo Group which runs through the Owens Valley east of the Sierra. This segment delivers to the Kramer substation, a hub in the Foundation Group. The individual line segments in each Collector Line Group are listed in Appendix F.

3.5.6 Imperial Group

The Imperial Group is a network of collector line segments which provide access to geothermal, solar and wind resources totaling nearly 9,000 MW from three CREZ in Imperial County and two CREZ in northern Baja California. They deliver this energy to Foundation lines at the Devers substation near Palm Springs and to the Sunrise Powerlink at the Imperial Valley substation near El Centro.

The Imperial Group as presently configured includes three sets of component facilities: upgrades of the Imperial Irrigation District (IID) system; 500 kV line segments between Imperial Valley substation and Devers substation; and two new 500/230 kV transformers at Imperial Valley substation. These are described briefly below, and in more detail in Appendix G of this report. Some of the line segments in the Imperial Group may improve the power transfer capability of major WECC Path 42 between IID and SCE in southeastern California.

Whether the IID system upgrades, new 500 kV line segments, two new 500/230 kV transformers at Imperial Valley substation, or some combination of these projects would adequately facilitate access to renewable energy sources depends on the amount and timing of renewable generation coming into service in Imperial County, southeast San Diego County and Baja California. RETI has not yet completed its analysis of the relative merits of the individual segments of the Imperial Group. Including both the two 500 kV line segments and the IID system upgrades in RETI Phase 2 analysis drives up the environmental score and the investment cost of the Imperial Group.

IID System Upgrades. These are designed in large part to support export of renewable energy from the Imperial Valley. Some of these new facilities have already been approved by the IID board. Several line segments in IID's transmission expansion plan have been fully permitted. These include the Midway to Geo substation to Bannister line, and Coachella Valley to Devers facilities. Several other line segments, including

Imperial Valley substation to Dixieland, and Imperial Valley to El Centro Switching Station (ECSS) are in the process of being permitted. The remainder of the line segments set forth in IID's transmission expansion plan will be addressed in a programmatic EIR/EIS with the Bureau of Land Management, which manages the federal land for much of the existing IID transmission rights of way.

IID as publicly-owned utility has the ability to site and permit transmission facilities as a CEQA lead agency. IID works with the BLM under NEPA on federal land that surrounds most of the Imperial County. In addition, because the majority of IID's transmission plan utilizes existing BLM and private rights-of-way, IID will need to acquire only 17 miles of new right-of-way. This allows IID's transmission expansion plan to have a much smaller environmental footprint than many other new transmission projects seeking to access renewables.

New 500/230 kV Transformers. Replacement of an existing 500/230 kV transformer at Imperial Valley substation, and the addition of a third 500/230 kV transformer at Imperial Valley substation, were identified by contingency-based powerflow analysis using the WECC 2018 heavy summer case as the starting point grid configuration.[22] Currently there are two 500/230 kV transformers at Imperial Valley substation, one with a 600 MVA normal/732 MVA emergency rating, the other with a 1120 MVA normal/1194 MVA emergency rating. Increasing the output of the CREZ connected closest to the Imperial Valley 230 kV bus, and taking transmission contingencies, eventually resulted in overloads of the smaller Imperial Valley transformer for the loss of the larger Imperial Valley transformer. Continued increments in the amount of generation in the closest CREZ, coupled with contingencies, eventually overloaded even the larger bank requiring the addition of a third transformer. This powerflow result is broadly in line with historical limitations at Imperial Valley due to the smaller bank. The two new banks each have thermal ratings of 1120 MVA normal/1194 MVA emergency.

Permitting requirements for the two new 500/230 kV transformers at Imperial Valley substation are expected to be minimal, because the facilities and all of the construction activity will take place within the perimeter of the existing Imperial Valley substation.

[21] Line segments in each Group are listed in Appendix F, and are described in detail in Appendix G. Appendix H list the length, cost and environmental ranking of all line segments.

[22] Extensive upgrades to IID's system were added to the 2018 heavy summer case. These upgrades were similar to, but not exactly the same as, the final set of IID system upgrades included in the RETI conceptual transmission plan and described in Appendix G of this report.

New 500 kV Line Segments. The addition of a new 500 kV line between Imperial Valley substation and Devers substation was also identified through contingency-based powerflow analysis using the same modified 2018 heavy summer powerflow case. In the RETI conceptual plan this project is configured as two 500 kV segments: the first between the existing Imperial Valley 500 kV substation and the proposed new Bannister 500 kV substation; and the second between Bannister 500 kV substation and the existing Devers 500 kV substation.

Initially, the need for a new 500 kV line between Imperial Valley substation and Serrano substation was identified to provide additional outlet capability for CREZ electrically close to the Imperial Valley substation (Baja – La Rumorosa, San Diego South, and Imperial South), creating a robust path to Southern California load centers. This initial configuration mitigated post-contingency overloads on CFE's 230 kV system and SCE's west-of-Devers system. The initial configuration was later modified as other west-of-Devers upgrades were added to the RETI conceptual transmission plan. With these west-of-Devers upgrades it was assumed that the initial configuration could be modified to increase transfer capability between Imperial Valley substation and Devers substation. This modified configuration was further changed at the request of SCE by looping the 500 kV line into Bannister substation and adding 500/230 kV transformation capability at Bannister substation. Bannister substation will be electrically close to much of the new geothermal generation at the southern end of the Salton Sea. The 500 kV Imperial Valley-Bannister-Devers conductor is assumed to have a thermal rating of 2600 MVA.

Permitting requirements for the new 500 kV Imperial Valley-Bannister-Devers line are not currently known because no route has been identified or studied. The current working assumption is that this line will be built on new right-of-way immediately adjacent to existing 161 kV and 230 kV IID transmission lines (which IID plans to rebuild as 230 kV lines). These existing lines are on the western side of the Salton Sea as well as north of the Salton Sea. Because new right-of-way is expected to be required, and because the new 500 kV line will probably have to pass through certain environmentally sensitive areas in the Imperial Valley, permitting is likely to be challenging.

3.5.7 BarrenRidge Group

The Barren Ridge Group is in advanced stages of development by Los Angeles Department of Water and Power (LADWP). This group provides access to the Tehachapi and Kramer CREZ, delivering renewable energy from these and other CREZ to LADWP customers. Some components of this group arguably could be assigned to the Delivery Group.

3.5.8 Inyo Group

Line segments of Inyo Group generally follow the Owens Valley east of the Sierra, starting at a new Control 500 kV substation near Bishop, California and extending southward to a new Kramer 500 kV substation. Today, WECC path 52 between central Nevada and California, which is comprised of a double circuit 55 kV line between Silver Peak and Control substations, provides very low transfer capability. The three line segments of the Inyo Group improve power transfer capability between central Nevada and California. This increased transmission capacity will provide transmission access for geothermal generating projects proposed in central Nevada. The State of Nevada recently completed its own conceptual transmission plan. This plan includes upgrades of Nevada Energy's transmission network across that state, and identifies transmission necessary to export Nevada renewable resources.[23] RETI Phase 2B will consider how best to coordinate Inyo Group upgrades with those planned for western and central Nevada.

Inyo Group line segments are intended to increase capacity on the SCE transmission system north of the Kramer Junction area, in order to access the 2,000 MW of renewable resources in the Nevada, Owens Valley and Inyokern CREZs identified in RETI Phase 1B, and to then deliver that energy to Foundation lines at the proposed new Kramer substation. The SCE and LADWP systems connect at the Control substation. Upgrading this tie could enable the LADWP transmission system to access renewable resources in these CREZ as well.

3.5.9 Carrizo Group

The Carrizo Group consists of two line segments in central California which provide access to solar resources in eastern San Luis Obispo County and deliver energy to substations at Gates and Midway on Path 15. These resources are relatively small, but the required transmission upgrades are relatively simple and inexpensive to construct, and the Group environmental score is low, indicating relatively less environmental concern.

3.5.10 Mountain Pass Group

The Mountain Pass Group, located mainly in San Bernardino County, is comprised of four line segments. They extend from Eldorado substation, southwest of

[23] The conceptual transmission plan and Phase II Report of Nevada's Renewable Energy Transmission Access Advisory Committee (RETAAC) is available at: http://www.retaac.org/phase-ii#H.

Las Vegas, to Lugo substation, near Victorville. They provide access to 3,065 MW of renewable resources in the Mountain Pass, San Bernardino-Baker, and Barstow CREZs, and transfer this renewable energy to the Lugo substation. The line segments within the Mountain Pass Group may improve the power transfer capability of WECC Path 46 (West of the Colorado River), between Arizona/Nevada and California.

3.5.11 Iron Mountain Group

The Iron Mountain Group provides access to 2,689 MW of solar and wind resources the Iron Mountain and Needles CREZ, connecting to a new Pisgah substation, and to the existing Metropolitan Water District (MWD) Iron Mountain and Camino substations. The pace and extent of potential renewable development in these areas is uncertain, as it may be substantially affected by the contemplated Mohave Desert National Monument. Given this uncertainty, RETI Phase 2 resource estimates for the Iron Mountain, Needles and Pisgah CREZ have not been changed from Phase 1 levels.

In addition, potential conflicts with MWD facilities may complicate access to the Iron Mountain and Needles CREZ. Such conflicts may prohibit rebuilding MWD’s existing 230 kV line between Iron Mountain and Camino substations to 500 kV, and prohibit 500 kV interconnections at Iron Mountain and Camino substations, as proposed in the RETI conceptual transmission plan. In this case, the Iron Mountain Group would become a long “trunkline” rather than a network connection. This would likely increase the amount of new right-of-way required to construct the 500 kV facilities. It would also raise the cost of transmission access for generators seeking to connect in those areas since, unlike network upgrades, interconnecting generators have full cost responsibility for their pro rata share of trunkline costs.[24]

3.5.12 Pisgah Group

As anticipated in the description of the Pisgah Group in the RETI Phase 2A Draft Report, the conceptual transmission plan for this area has been modified to include connections between Pisgah and Kramer substations. The resulting Kramer-Pisgah-Mira Loma connection has been moved to the Foundation Group. As a result, the Pisgah transmission group has been eliminated. Renewable energy from the Twentynine Palms CREZ is now assumed to be injected at a new Lucerne Valley substation via a trunkline.

[24] As noted elsewhere, the Stakeholder Steering Committee has decided to evaluate trunklines later in the RETI conceptual transmission planning process.

3.5.13 Riverside Group

The Riverside Group, located in Riverside County, is comprised of three line segments. These link SCE's proposed Midpoint 500 kV substation, a proposed Desert Center 500 kV substation, and SCE's existing Devers 500 kV substation. The proposed Midpoint substation is a component of the California portion of the Devers–Palo Verde single circuit 500 kV line #2 (DPV2) project. The California portion of the DPV2 project also includes the Devers-Valley single circuit 500 kV line #2 which is included under the "Delivery Group" in the RETI Conceptual plan.[25]

The proposed Green Energy Express (GEE) merchant transmission project noted in the RETI Phase 2A Draft Report is no longer included in the Riverside Group. This does not represent any judgment by the CPWG on the competition between GEE and the western portion of the DPV2 project. Rather, including both GEE and DPV2 artificially inflated the cost and environmental scores of the Riverside Group without adding significantly to the energy score. The CPWG chose the Midpoint-Desert Center-Devers option rather than GEE because: a) it provides access to the entire Riverside East CREZ; b) it had undergone CAISO and CEQA review as part of DPV2; and c) it is being re-reviewed by the CPUC as a stand-alone project.

The Riverside Group provides access to 3,120 MW of renewable resources in the Riverside East CREZ, with 60% of those resources located in the vicinity of Midpoint substation and the remaining 40% in the Eagle Mountain area, about 15 miles north of Desert Center substation. The CAISO Generator Interconnection Request Queue includes 4,900 MW of renewable generation in the Eastern Riverside County area, a larger amount than identified by RETI. Of this, 2,950 MW of interconnection requests are near Midpoint and the remaining 1,950 MW are near Julian Hinds and Eagle Mountain substations, to the north of the proposed Desert Center substation.

CREZs will be connected to both Midpoint and Desert Center substations via generator owned gen-ties. The Conceptual Planning Work Group decided to assume that all new renewable generation in the Eagle Mountain areas of the Riverside East CREZ would be delivered via trunkline, to the new Desert Center substation. This decision

[25] The California Public Utilities Commission issued a CPCN for DPV2 to SCE in January 2007. SCE filed a Petition for Modification of the DPV2 CPCN in May 2008, seeking authorization to construct DPV2 facilities in California, to allow SCE to access potential new renewable and conventional gas-fired generation in the Blythe, California area. A CPUC decision on SCE's Petition for Modification is expected by third quarter 2009. The California portion of the DPV2 Project includes a single circuit 500 kV transmission line starting from the new Midpoint 500 kV substation located West of the Colorado River near Blythe, to SCE's existing Devers substation and extending it further to SCE's Valley 500 kV substation.

assumes away the possibility of redundancy between the proposed GEE project and the Desert Center-Devers segment of the DPV2 project.

All three line segments proposed to access the Riverside East CREZ are single circuit 500 kV construction. The Riverside Group transmission system includes a re-configuration of SCE's existing DPV1 single circuit 500 kV line and the California portion of the proposed new DPV2 single circuit 500 kV line, with both lines being looped into a proposed Desert Center substation.

In response to a request by Metropolitan Water District to the RETI SSC, Riverside Group line segments have been reconfigured so that they do not connect to existing MWD network facilities between Eagle Mountain and Julian Hinds substations, and do not require any upgrade of MWD's existing Eagle Mountain substation.

In addition to providing renewable energy access, the new substations and line segments proposed in the RETI Conceptual plan for the Riverside Group may likely improve the power transfer capability across WECC Path 46 (West of Colorado River), between Arizona/Nevada and California.

3.5.14 Northeast Group

In the Phase 2A conceptual plan, access to the Round Mountain and Lassen CREZ and Northern Nevada renewable resources was provided by line segments associated with a transmission project sponsored by the Transmission Authority of Northern California (TANC). Elements of the TANC Transmission Project (TTP) were also included in RETI Foundation and Delivery groups. The Phase 2A conceptual plan assessed all of these components of the TTP.

On July 15, 2009 however, TANC ended development of the TTP. It issued the following statement:

> **"TANC Commission Votes to Terminate TANC Transmission Project**
>
> The Transmission Agency of Northern California (TANC) announced today that its Commission has voted to terminate the environmental review process for TANC's Transmission Project (TTP).
>
> Without the financial support of key TANC utility members to proceed with this process, TANC cannot undertake a detailed environmental analysis of the proposed alternative routes. As such, the TTP and the proposed alternative routes are no longer being considered.

> Despite today's decision, TANC still agrees with the assessments of the California Public Utilities Commission, the California Energy Commission and the California Independent System Operator (CAISO) that additional transmission must be built to meet California's goals for renewable clean energy and greenhouse gas reduction. TANC is committed to continue working with transmission owners, utilities, and others to identify solutions for providing reliable and cost-effective transmission service to customers throughout northern California, in accordance with California's energy goals and policies."

The TTP extended from Lassen County in Northern California to Santa Clara and Fresno Counties in the South. Fifteen of the 102 line segments included in the Phase 2A conceptual plan belonged to the TTP, including three segments in the Foundation Group, eight in the Delivery Group, and four in the Northeast Collector Group. It has not been possible to revise the conceptual plan to reflect the TANC decision and update the assessment for purposes of this Report; all calculations, tables and charts include all of the TTP components in the conceptual plan.

TANC members are reassessing the entire project, and it is likely that the TTP will be revised to include at least some of the components included in the Phase 2A assessment. When further information is available, the Phase 2A conceptual plan will be updated as appropriate.

3.5.15 North Group

The North Group is a proposed collector line that would reach from British Columbia to a Foundation substation at Tracy, between the Bay Area and Sacramento. The middle segment, between a planned Northeast Oregon (NEO) hub and a Collinsville, CA substation, is proposed as a Direct Current (DC) segment. PG&E, Avista, British Columbia Transmission Corporation (BCTC), and PacifiCorp are currently studying the collector line, which aims to achieve three main objectives:

- Provide access to significant incremental renewable resources in Canada and the northwestern United States.
- Improve regional transmission reliability.
- Provide other market participants with beneficial opportunities to use the facilities.

The geographic location of the North Group line would allow for potential future access to renewable energy resources in other areas of the west in addition to Oregon, Washington and British Columbia.

The Western Renewable Energy Zones Initiative (WREZ), a joint effort of the Western Governors' Association and the U.S. Department of Energy, has also identified significant renewable resource potential in British Columbia. The WREZ Phase 1 Report, released in June 2009, identified 21,315 MW of potential renewable energy generating capacity in British Columbia, corresponding to 66,010 GWh/yr of potential generation. This amount includes: 13,943 MW of wind capacity with generating potential of 34,104 GWh/yr; 340 MW of discovered geothermal with generating potential of 2,540 GWh/yr; 6,092 MW of hydro (22,372 GWh/yr);[26] and 939 MW of biomass (6,994 GWh/yr). The WREZ Report also identified a 16,000 GWh shaped energy product at the British Columbia-Washington border to illustrate the benefits of a firmed and shaped energy product. The ability to firm and shape variable-output renewable resources may increase utilization of transmission facilities exporting renewable generation from British Columbia and reduce the integration costs for resources in the North Group. RETI did not consider integration costs in its analysis.

The RETI Phase 1B analysis found much of the British Columbia renewable resource potential not to be cost-competitive with in-state resources. Further analysis of resources accessed by the North Group is needed to determine the conditions under which these out-of-state resources can be competitive with in-state options. The relative value Northwest resources is highly dependent upon the cost and feasibility of developing and deploying renewable generating technologies in California. Given the uncertainty surrounding renewable resource project development and siting in California, PG&E plans to continue to explore commercial arrangements for Canadian and out-of-state renewable resources, and transmission needed to access them.

The capacity of this transmission project as proposed is much larger than the amount of British Columbia renewable resource potential found to be economic in the scenario assessed in RETI's Phase 1 investigation. As further information becomes available through future studies and commercial negotiations, the relative economic score for this group could change. Access to generation in other regions, which would utilize more of the capacity of the transmission project, and evaluation of potential regional benefits of the proposed line for load centers outside of California, is beyond the scope of

[26] The WREZ analysis includes both small and large hydroelectric resources in this figure. PG&E's analysis indicates that small, run-of-river, hydroelectric resources could account for between 3,100 and 6,150 MW of potential capacity or 12,500 to 24,700 GWh/yr of potential energy by 2016. The PG&E Phase 1 British Columbia Renewables Study, which informed the amount of renewable resources considered by RETI for the North Group, is available online at: http://www.pge.com/mybusiness/customerservice/nonpgeutility/electrictransmission/canada/publicationsreports.shtml

RETI. Such benefits are likely to be important in the development of such a major interstate and international facility.

3.5.16 Maps of Line Segment Groups

Figure 3-2 below shows Renewable Foundation lines, Renewable Delivery lines and Renewable Collector lines in Southern California, along with CREZ and major existing transmission lines. **Figure 3-3** shows these categories of lines in Central and Northern California, also in relation to CREZ and major existing transmission. **Figure 3-4** below shows only Foundation lines in Southern California; **Figure 3-5** shows only Renewable Collector lines in Southern California. **Figure 3-6** shows only Renewable Collector lines, statewide.

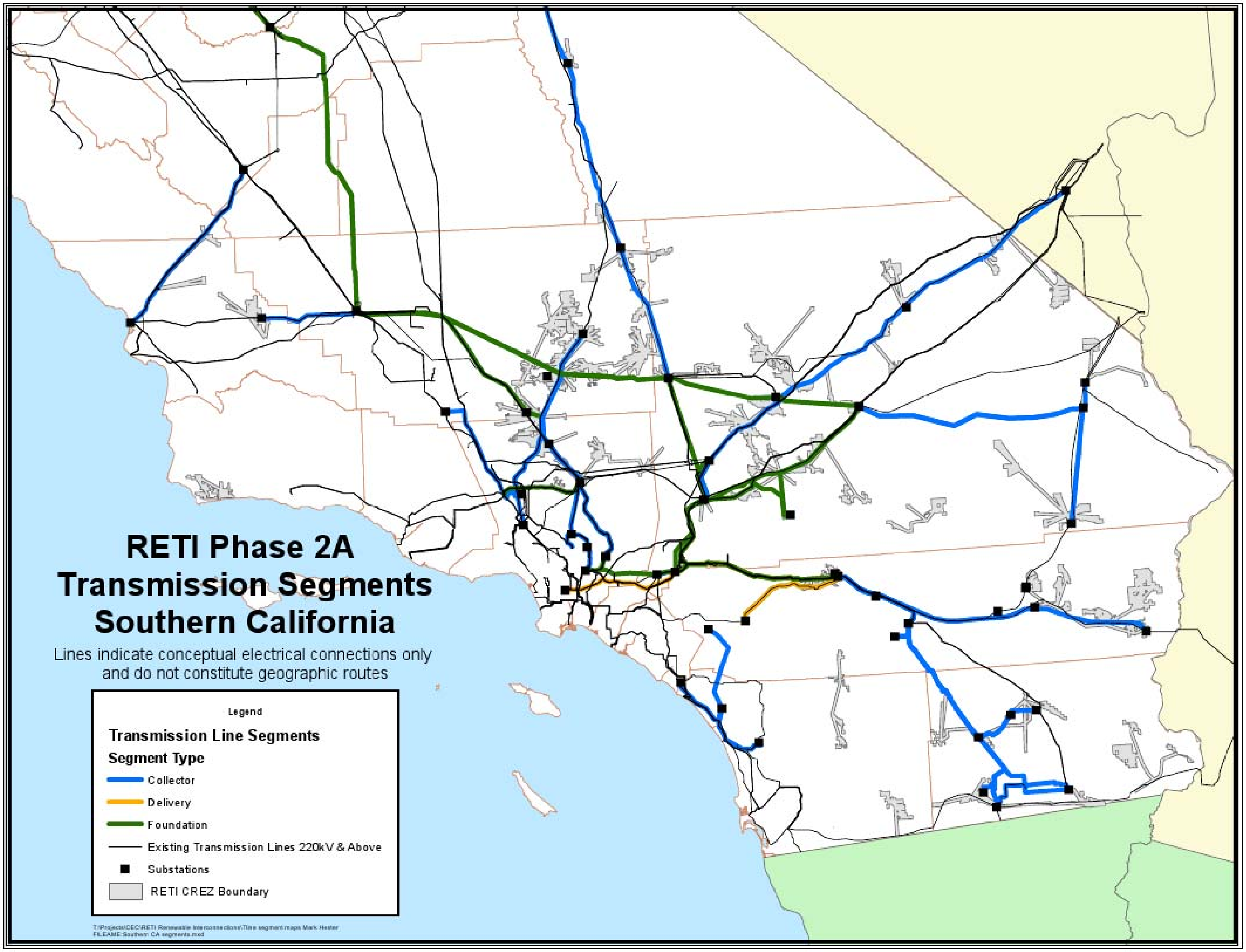


Figure 3-2. Map of Southern California Transmission Segments.

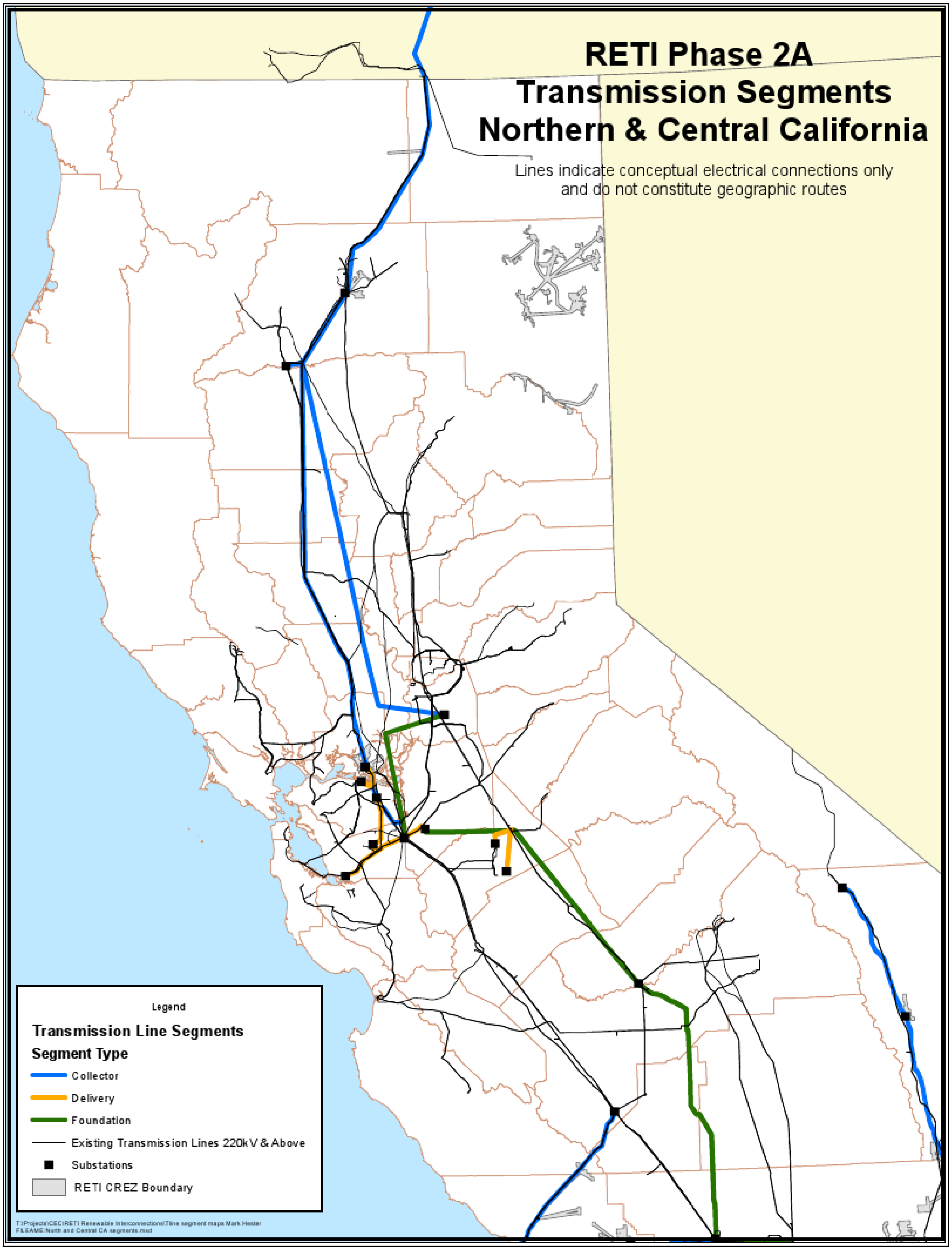


Figure 3-3. Map of Northern California Transmission Segments..

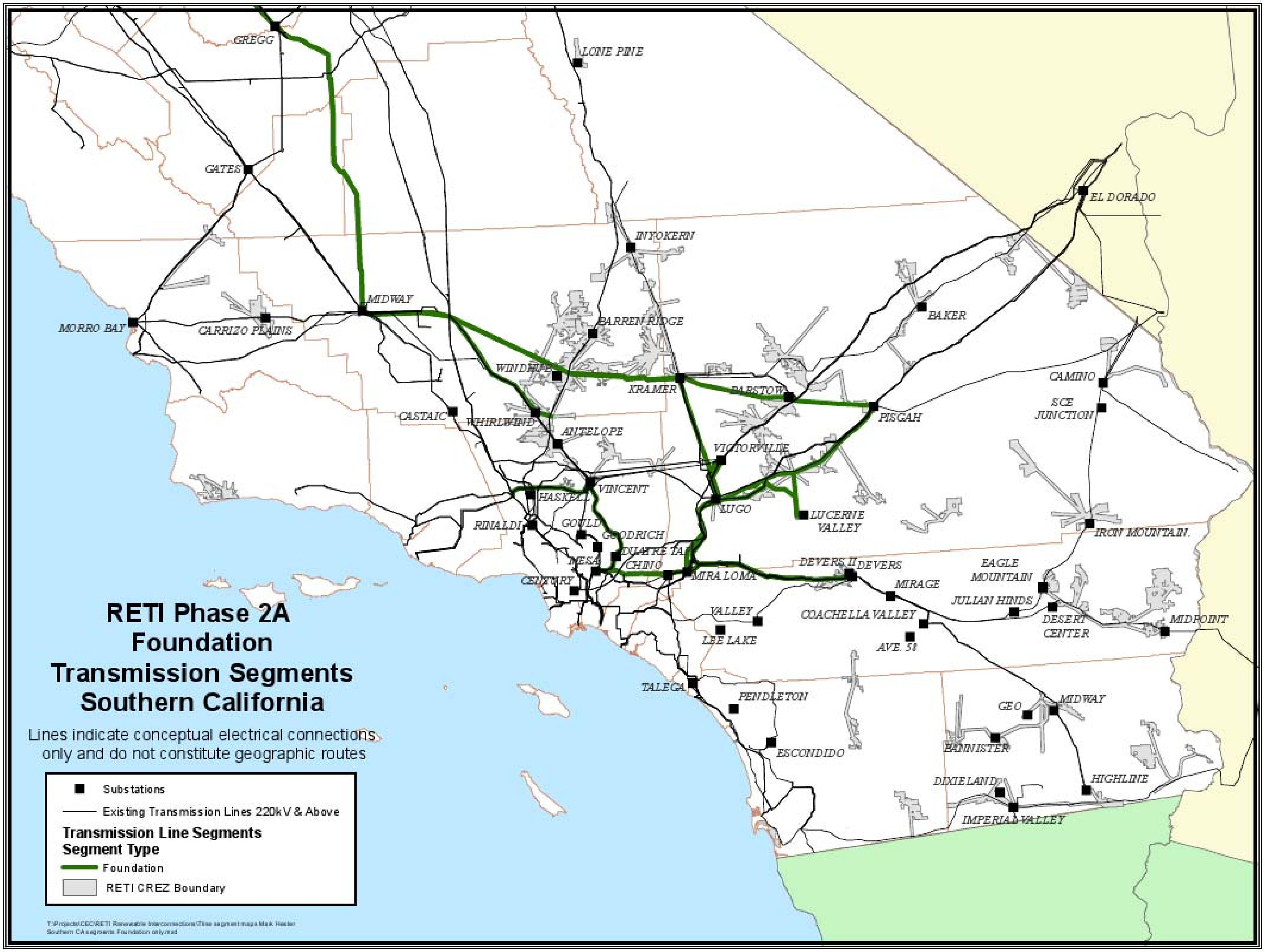


Figure 3-4. Map of Southern California Foundation Group Segments.

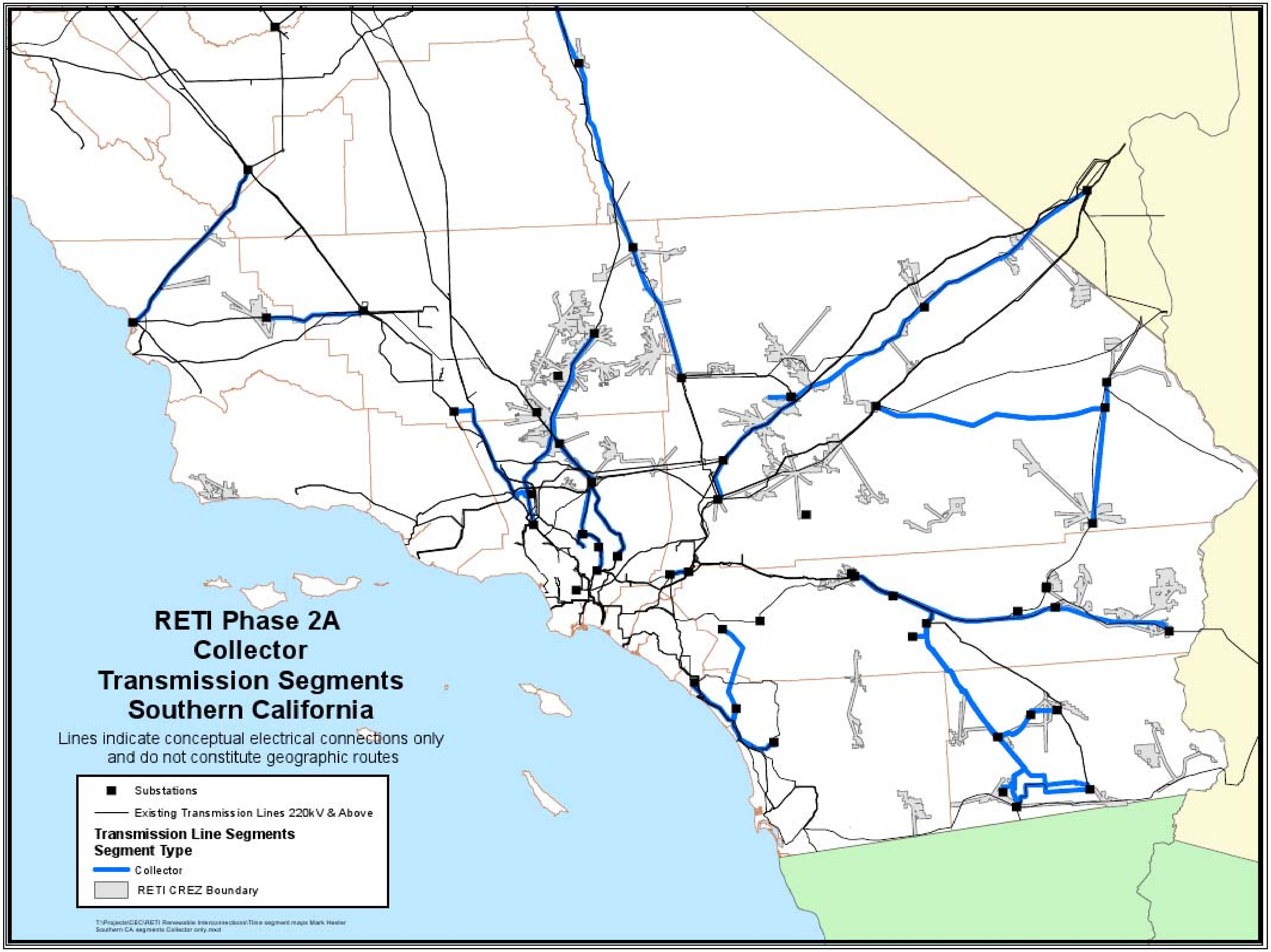


Figure 3-5. Map of Southern California Collector Group Segments.

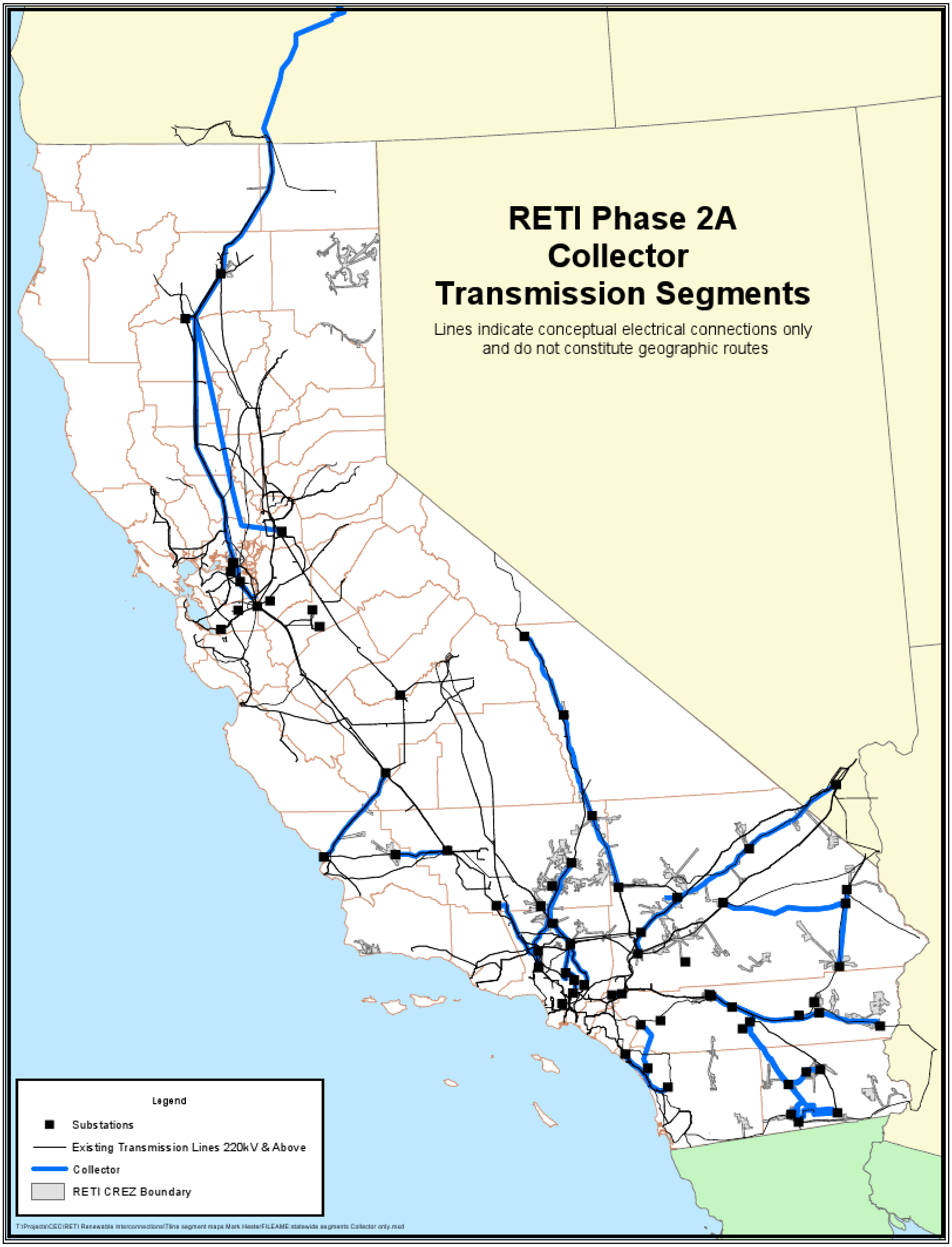


Figure 3-6. Map of Collector Group Segments Statewide.

3.5.17 CREZ and Line Segment Groups

Table 3-5 and **Table 3-6** loosely relate CREZ to line segment Groups that provide access to them. All of the transmission lines considered in the Phase 2A conceptual plan are network facilities. Because the entire western grid is interconnected, some amount of power from each CREZ will flow on every line segment. The identified line segments, however, are critical for accessing large amounts of power from indicated CREZ.

Table 3-5. Collector Line Groups and CREZ Accessed.

Line Segment Group	CREZ Accessed
Tehachapi	Tehachapi, Fairmont
Imperial	Imperial North A&B; Imperial South; Imperial East; Baja
IronMt	Iron Mountain; Pisgah; Needles
BarrenRidge	Kramer, Tehachapi
LEAPS	San Diego North Central
MtPass	Mtn Pass, Baker, Barstow, Victorville
Riverside	Riverside East; Palm Springs
NorthEast	Round Mtn A&B; Lassen N&S; N. Nevada
Inyo	Central Nevada, Inyokern, Owens Valley, Kramer
North	British Columbia, Oregon, Round Mtn
Carrizo	Carrizo North, Carrizo South, Cuyama

Table 3-6. CREZ and Collector Group(s) Providing Access.

CREZ	Line Segment Group Providing Access
Baja-La Rumorosa; Baja-Santa Catarina	Imperial
Barstow	Mountain Pass
British Columbia	North
Carrizo North	Carrizo
Carrizo South	Carrizo
Cuyama	Carrizo
Fairmont	Tehachapi
Imperial East	Imperial
Imperial North-A	Imperial
Imperial North-B	Imperial
Imperial South	Imperial
Inyokern	Inyo
Iron Mountain	Iron Mountain; Foundation
Kramer	Foundation; Inyo
Lassen North	Northeast
Lassen South	Northeast
Mountain Pass	Mountain Pass
Needles	Iron Mountain; Pisgah
Nevada N	Northeast
Nevada C	Inyo
Oregon	North
Owens Valley	Inyo
Palm Springs	Riverside; Foundation
Pisgah	Foundation
Riverside East	Riverside
Round Mountain-A	Northeast; North
Round Mountain-B	Northeast; North
San Bernardino - Baker	Mountain Pass
San Bernardino - Lucerne	Foundation
San Diego North Central	existing transmission; LEAPS
San Diego South	existing transmission
Santa Barbara	existing transmission
Solano	existing transmission
Tehachapi	Foundation; Tehachapi
Twentynine Palms	Riverside; Foundation
Victorville	existing transmission

3.6 Line Segment Investment Costs

The capital investment required to build any segment or group of segments includes the cost of towers, wires, substations, transformers, other ancillary equipment located at the segment terminals, and the cost of Rights of Way (ROW). Transmission owner representatives on the CPWG first provided cost estimates for segments in their service territories. However, they have different cost structures, different costs of capital, and use different methods to estimate transmission development costs, and it became obvious that the line segment cost estimates were not comparable.

Further, land acquisition costs for ROW are notoriously difficult to estimate and vary widely depending on terrain, proximity to population centers and other factors. In addition, specific routes of many potential line segments have not been determined. For these reasons, the CPWG decided to exclude ROW costs from the line segment cost estimates in the Phase 2 evaluation methodology.

The cost estimates for all facilities in the conceptual plan have now been prepared using a single methodology for all facilities and a standardized set of component costs, regardless of owner. The cost estimates presented in Appendix H have thus been prepared on a consistent and comparable basis. Because they are standardized, they may differ by large amounts from costs prepared by transmission owners for their proposed projects.

SCE-proposed projects provide two specific examples of the discrepancies between standardized RETI cost estimates and the costs filed by transmission developers in regulatory proceedings. 1) Tehachapi. The total cost of the Tehachapi line segments in the RETI conceptual plan, calculated using RETI's standardized approach, is $989.8 million; while the cost of the Tehachapi Segment 4-11 Project, as filed by SCE at the CPUC, is $959.6 million (in 2008 dollars), when calculated on a comparable basis, accounting for similar project elements and their costs under both options. (The total cost of the Tehachapi Segment 4-11, including land costs and other factors excluded in the RETI simplified approach, as filed in CPUC CPCN proceedings, is $1,643.8 million (2008 dollars) or $1,715.5 million (2009 dollars)).

2) RETI Riverside Group (representing the California portion of the DPV2 Project). The total cost of the three RETI Riverside line segments is $490.8 million (2008 dollars); while the cost of those segments SCE filed with the CPUC is $504.3 million (2008 dollars) and $526.3 million (2009 dollars), again when calculated on a comparable basis, accounting for similar project elements.

The reasons for these discrepancies are straightforward. RETI line segment costs are based on a generic set of standardized unit cost factors that include costs of existing line tear down, new line construction, line re-conductoring, and line termination at a fixed value of 25% for all line segments. RETI costs do not include cost for line relocation, multiplying factors for different ROW terrain considerations, land costs, Special Protection Schemes (SPS) and telecommunication modification costs and minor protection and control work costs.

Conceptual-stage costs are by definition preliminary and are subject to wide margins of error. The costs included in the assessment summary do, however, provide a rough estimate of the relative investment required of the RETI transmission groups.

The CPWG's initial evaluation criteria formulas divided each of four energy-related factors for each line segment by the capital cost of that line segment. This produced a benefit/cost metric equal to renewable energy access per dollar of investment. Despite having now used standardized numbers to estimate line segment costs, CPWG members think current cost estimates are too uncertain to use in the RETI evaluation methodology. As a result, the CPWG decided to keep energy access factors and cost estimates separate, and to report both instead of combining them.

3.7 Evaluation of Line Segment Environmental Concerns

A major goal of the RETI conceptual planning process is to anticipate environmental concerns and to be able to compare the environmental attributes of various transmission options. The CRWG developed a rating system specifically for this purpose. This system incorporates both objective scores and expert judgment.

Some of the factors determining the level of environmental concern associated with a new line segment can be readily identified. Is new right of way required, or is the new line being placed on existing towers with no right of way expansion? Is the new line parallel to an existing line or does it go off in a new direction? Has the corridor in which the line is place been previously identified as a transmission corridor or not? The formula developed by the CRWG provides an objective way of assigning a quantitative value to features of concern such as line length, location, and type of construction.

Many essential environmental concerns which may make it difficult or impossible to permit a line cannot, however, be captured in a quantitative formula. Reluctantly departing from RETI's commitment to complete objectivity, the CRWG impaneled two groups of environmental experts, one for Southern California and one for Northern California, to provide an overall environmental rating for each line segment in the plan using their professional judgment. Using a lengthy checklist of potential issues, the experts assigned overall value of 1, 2, or 3 to indicate low, medium or high levels of concern respectively:

1. Low levels of concern and/or potential impacts relatively easy to mitigate;
2. Medium levels of concern and/or some difficulty expected with mitigation;
3. High levels of concern and/or difficulty identifying adequate mitigation.

Each of these panels met separately to review the segments within their respective regions. The meetings were conducted via WebEx to enable all experts to participate and to allow interested members of the SSC, the EWG and the public to observe. Only panel members participated in scoring discussions and decisions. Participants on the expert panel are listed in Appendix E. The issues checklist and environmental scores for each line segment are included in the online supporting materials referenced in Appendix D. This includes an index to the environmental information assembled by the expert panels for every line segment. Clicking on the name of any line segment in the index takes you to the checklist for that segment. An example of a completed checklist is presented in **Figure 3-7** below.

Environmental Concerns Checklist	**21**	**22**	**23**	**24**	**25**	**26**	**27**
Segment length in miles	**52**	**68**	**48**	**36**	**13**	**0.025**	**120**
Category One Lands (some limited tx may be allowed)							
Designated Federal Wilderness Areas/Wilderness Study Areas (BLM)							
National Park Service Units (including Mojave Preserve)							
National Wildlife Refuges							X
Inventoried Roadless Areas (USFS)							
BLM Natl. Recreation Areas/Natl. Monuments/Natl. Conservation Areas							
National Historic and/or Scenic Trails/National Wild, Scenic and/or Recreational Rivers							
Lands in Pending Wilderness Bills							
HCP and NCCP Hard Reserves							X
State Wildlife Areas and Ecological Reserves (DFG)/California State Wetlands							X
State Parks/State Wilderness Areas							
Wildlands Conservancy and Other Private Preserves							
Research Natural Areas (RNA) or Special Interest Areas (SIA)							
Category Two Lands (limited tx)							
BLM Areas of Critical Environmental Concern (ACEC)	X	X	X				
Designated Critical Habitat T&E Species		X	X				
Desert Wildlife Management Areas (DWMA)		X	X				
Mojave Ground Squirrel Conservation Areas (MGSCA)	X	X	X				
Wildlands Conservancy acquisitions under BLM ownership							
Proposed and Potential Conservation Reserves in HCPs and NCCPs							X
Conservation Easements							
Other Environmental Concerns							
Identified cultural resources	X	X	X				X
Visual resources	X	X	X				X
Williamson Act							X
Other important plant and wildlife habitat				X			X
Citizen-proposed wilderness areas							
Proposed Mother Road National Monument							
Other Relevant Information (e.g., line size)	X			X			X
ROW/Corridor Information							
1 ROW no change	X					X	
2 ROW expansion		X	X		X		
3 New ROW in designated corridor							
4 New ROW co-located but NOT in a designated corridor.							
5 New ROW not colocated and NOT in a designated corridor				X			X
Segment/Section Information							
1 Upgrade/no footprint change							
2 Rebuild/footprint changes	X					X	
3 New line		X	X	X	X		X
Environmental Concern (Low, Medium, High)	M	H	H	L	L		H

Figure 3-7. Environmental Issues Checklist for Transmission Line Evaluation.

To obtain an overall environmental score for each segment, the subjective rating score produced by the expert panel was multiplied by the objective measures of ROW characteristics, line length and construction category, as shown in the formula for Criterion D below:

Criterion D –Environmental Concern

Environmental Score =
EnvFactor × LenVal × ROW_Val ×CharVal

Where:
EnvFactor = Value assigned for each type of right of way associated with the line segment assigned by expert panel.
LenVal = Value assigned to section according to segment length.
ROW_Val = Value assigned to the segment's right of way category.
CharVal = Value assigned to the segment's construction category.

To calculate ROW values for this formula, the CRWG developed the following methodology: a segment that was in an existing ROW was given a score of 1; a segment in an existing ROW that would require expansion of that ROW was given a score of 2; a segment that would require a new ROW in a designated corridor was given a score of 3; a segment that would require a new ROW not in a designated corridor but could be co-located with another line was given a score of 6 and a segment that would require a new ROW that was neither co-located nor in a designated corridor was given a score of 10. To calculate the value assigned to the segment's construction category, the group assigned a score of 1 to an upgrade that would not change the existing footprint; a score of 2 to a rebuild that would change the existing footprint and a score of 4 to a new line.[27]

A few of the proposed line segments are comprised of sections having different characteristics. For these segments, a score for each section is computed using the above formula and the scores are combined based on relative length.

3.8 Group Assessment Results

Scores for any group are obtained from the scores of the line segments in the group by simple summation. Summation is appropriate for group investment cost and environmental scores, but is problematic when applied to group energy access scores obtained from shift factors. For example, two line segments in series (e.g. ZETA1_OLND_1 and OLND_DILL_1) may carry the same energy but do not provide twice the access to renewable energy. Adding the energy scores of the two segments to

[27] See lines 37 to 45 on Figure 3-7, Environmental Issues Checklist for Transmission Line Evaluations.

obtain an energy score for the group overstates the energy access provided by the group. Simple summation of segment energy scores is a significant weakness of the conceptual plan assessment, and, the CPWG is investigating a more complex methodology for combining segment energy scores into group scores.

An Excel spreadsheet table with complete assessment results for the groups using the summation methodology is available as Online Supporting Material. This table can be sorted on any of the criteria results used in the assessment to identify which groups have the highest scores in for any criterion category. Summary energy, environmental, and cost results using the current assessment methodology for the 14 transmission groups are shown in Table 3-7, sorted on combined energy score.

Table 3-7. Transmission Group Energy, Environmental and Cost Summary.

Group Name	CREZ Energy (GWh)	CREZ Econ Score	CREZ Enviro Score	CREZ CommInt (GWh)	Combined CREZ Energy (GWh)	Group Enviro Score	Group Cost ($Million)
Foundation	79,660	2,309,025	1,278,227	208,200	82,739	1,700	$5,144
Delivery	8,414	256,532	135,199	21,677	8,767	739	$788
Imperial	22,666	741,957	367,394	47,566	22,377	837	$1,311
Tehachapi	15,539	507,187	257,282	51,928	18,167	77	$531
IronMt	8,071	170,336	133,667	15,608	7,282	131	$832
MtPass	7,166	172,059	115,810	16,554	6,939	252	$798
NorthEast	3,459	92,710	50,000	18,470	4,849	600	$735
BarrenRidge	3,812	139,144	64,521	14,023	4,738	77	$208
Riverside	5,316	125,451	89,928	8,867	4,687	123	$608
LEAPS	4,318	125,941	68,422	11,232	4,472	246	$162
Inyo	4,771	194,476	75,743	5,211	4,217	88	$656
North	3,156	124,081	49,469	7,187	3,295	401	$3,898
Carrizo	2,813	56,136	45,036	5,349	2,491	20	$78

Table 3-8 shows the combined energy score, environmental score, and cost associated with each transmission group, with each column sorted separately.

Table 3-8. Group Combined Energy, Environmental Score and Cost, Sorted.

Collector Lines

Group	Group Combined CREZ Energy (GWh)	Group	Group Enviro Score	Group	Group Cost ($Million)
Imperial	22,377	Carrizo	20	Carrizo	$78
Tehachapi	18,167	Tehachapi	77	LEAPS	$162
IronMt	7,282	BarrenRidge	77	BarrenRidge	$208
MtPass	6,939	Inyo	88	Tehachapi	$531
NorthEast	4,849	Riverside	123	Riverside	$608
BarrenRidge	4,738	IronMt	131	Inyo	$656
Riverside	4,687	LEAPS	246	NorthEast	$735
LEAPS	4,472	MtPass	252	MtPass	$798
Inyo	4,217	North	401	IronMt	$832
North	3,295	NorthEast	600	Imperial	$1,311
Carrizo	2,491	Imperial	837	North	$3,898
Median	**4,738**	**Median**	**131**	**Median**	**$656**

Foundation & Delivery Lines

	Group Combined CREZ Energy (GWh)	Group Enviro Score	Group Cost ($Million)
Foundation	82,739	1,700	$5,144
Delivery	8,767	739	$788

These numerical results are based on the best data available and the compositions of each transmission group. They are subject to change as data is updated, line segments are added or subtracted from the conceptual plan, or improvements in the rating methodology are made.

These scores have meaning only in relation to one another. The value of any single score has no significance. It should be noted that the sum of the combined energy scores is over 177,000 GWh, about three times the estimated net short. This result is an artifact of the methodology and in no way indicates the amount of new transmission capacity available on the identified potential line segments.

Evaluation results for the transmission Groups are presented graphically in **Figure 3-8** and **Figure 3-9**. Notes to the bubble chart in Figure 3-8 are included below the chart. As in the bubble chart comparing relative CREZ rankings (Figure 2-4), lower environmental scores in Figure 3-8 indicate less environmental concern.

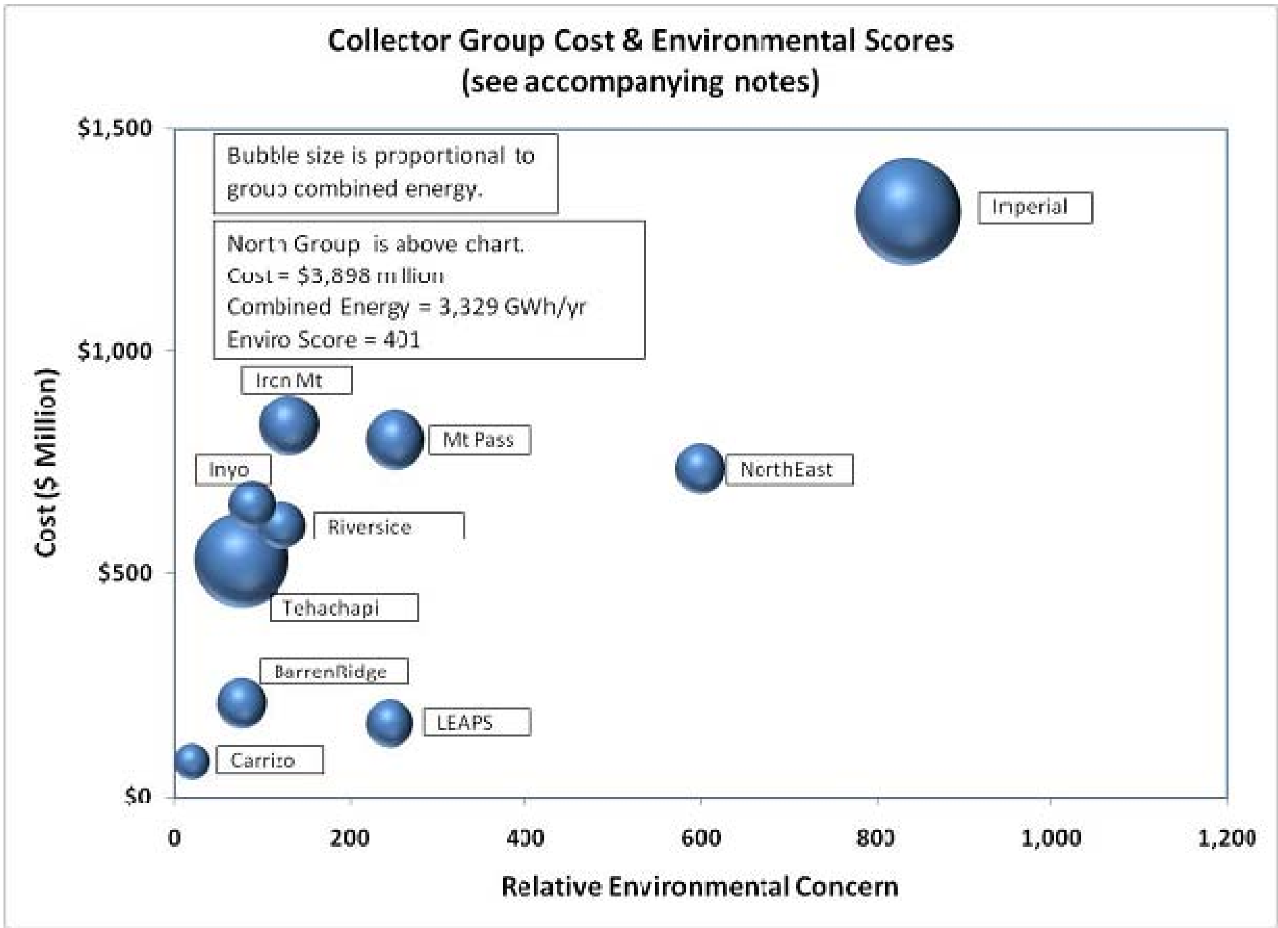


Figure 3-8. Transmission Group Cost, Environmental Scores and Group Combined Energy, Bubble Chart.

Notes
Areas of bubbles are proportional to Group combined energy.
Some transmission groups may contain duplicative line segments, which artificially increase environmental scores and costs. Identification of duplicative segments requires detailed analysis, which is beyond the scope of Phase 2A.
Foundation Group is off the top of the chart. Combined energy = 52,780 GWh Environmental score = 1,119 Estimated cost = $3,481 Million
North Group is off the top of the chart since its cost includes all proposed line segments whose capacity is much greater than needed to access estimated CREZ energy. Combined energy = 3,596 GWh Environmental score = 401 Estimated Cost = $3

Figure 3-9 presents the same information contained on the bubble chart in Figure 3-8, as a bar chart.

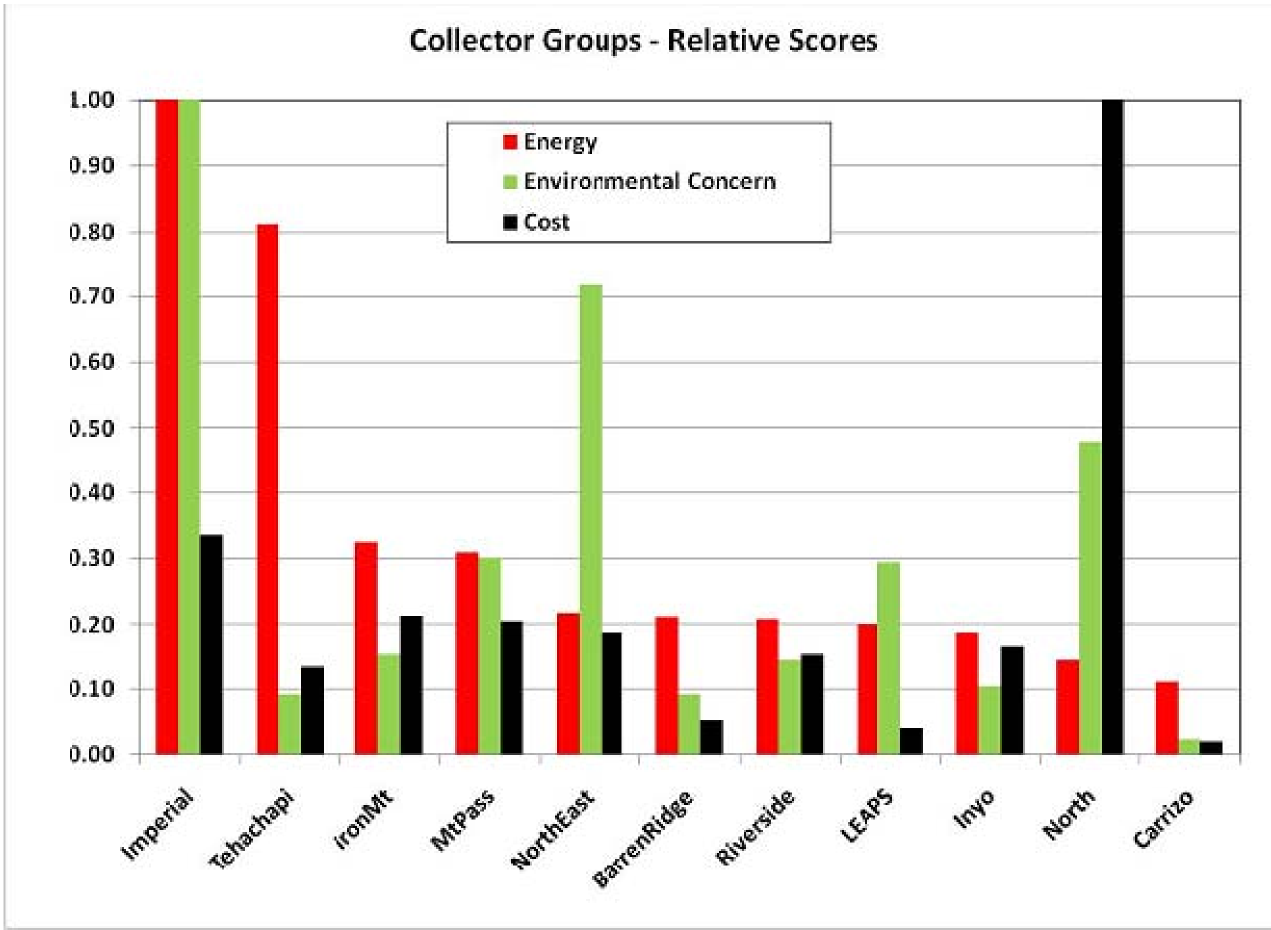


Figure 3-9. Transmission Group Cost, Environmental Scores and Group Combined Energy, Bar Chart.

Notes to Figure 3-9: Values for each bar have been converted from direct assessment results and are relative to maximum value in each category. Bigger energy bars are more desirable. Bigger cost and environmental concern bars are less desirable. In order to produce bars of comparable sizes, assessment results had to be translated into a common format. In this case, the values for each category represent the value for each group relative to the maximum value for each group. The groups have been ordered on relative energy values. In general, environmental scores and costs would be expected to be more or less proportional to energy. Green or black bars higher than the red bar indicate that the group has higher costs or environmental concerns than might be expected. Green or black bars lower than the red bar indicate that environmental concerns are lower than might be expected.

Inherent uncertainty in the data necessarily creates uncertainty in the results, and conclusions should be qualified accordingly. Although it has not been possible to estimate the amount of uncertainty in these results, a difference of a few percent between two scores in the same category is almost certainly not significant. Moreover, since groups serve different functions, comparisons between all groups are not appropriate. A group with a low combined energy score can be expected to be a valuable addition if it also has low cost and a high environmental rating score. It is inappropriate to use individual results out of context.

3.9 Recommendations for Study and Development of Line Groups

A few of the components of the RETI conceptual transmission plan are already under development, as described below; but all require additional and detailed study. This section recommends which potential upgrades should be studied immediately, and which should be deferred for later consideration.

As studies and development proceed, the RETI stakeholder collaborative is in position to help identify geographic routings that minimize environmental concerns and stand the best chance of being approved with a minimum of controversy.

3.9.1 Renewable Foundation Group

Lines in the Foundation Group expand transmission capacity between major California load centers. CAISO and POUs should undertake detailed studies of the line segments in the Foundation Group that they do not already have underway and reassess the timelines proposed by RETI in light of current LGIP renewable queues and signed Power Purchase Agreements. Renewable Foundation lines represent least-regrets upgrades of the California grid likely to be required within a reasonable timeframe regardless of where renewable generation develops, to improve reliability and reduce congestion. They form the core of this conceptual plan.

Of special concern in the Foundation Group are two line segments included in the TANC Transmission Project (TTP). On July 15, 2009, the Transmission Agency of Northern California announced that it was terminating work on the proposed TTP, as described more fully in Section 3.5 and in the discussion of the Northeast Group below. Two segments of the TTP included in the RETI Foundation Group would have provided increased transmission capacity between Fresno and the Bay Area.[28] PG&E has informed the CAISO that the company will assume planning responsibility for these segments which, in conjunction with seven other segments proposed by PG&E, would supply energy to the eastern San Joaquin Valley, relieve congestion on Path 15, and improve reliability.[29] RETI supports PG&E's decision and recommends that these segments be included in near-term detailed planning studies, in cooperation with TANC.

The Foundation Group also includes a segment increasing transmission capacity between Sacramento and the Bay Area, which also was part of the TANC project. This segment provides additional capacity projected to be necessary to transport renewable energy from Southern California to the Sacramento area. Reliable and expanded access to Southern California resources appears necessary to help SMUD and other Northern California LSEs achieve their renewable and greenhouse gas reduction goals. RETI recommends that this connection be given special attention when the TANC project is reassessed.

Since the Draft Phase 2A Report was released, the Foundation Group has been augmented by the addition of line segments connecting Pisgah-Barstow and Barstow-Kramer substations and expanded capacity between Devers and Mira Loma. Together with existing facilities and LADWP's Green Path North, these additions strengthen the Foundation line network west and north of Devers and are expected to play a major role in transmitting renewable energy to Northern California from the important Riverside and Imperial CREZ. Since the line segments which formerly comprised the Pisgah Group in the Draft Report are now included in the Foundation Group, the Pisgah Group has been omitted in this Report. The west-of-Devers transmission bottleneck has been a concern for many years, and RETI recommends that detailed planning for needed upgrades in that electrical region proceed on a fast track.

Additional transmission capacity provided by the Foundation Group is expected to be required to reduce congestion to meet expected load growth in urban centers regardless of the source of energy. Flows of renewable energy from resource-rich Southern California to urban areas in the North are expected to increase the importance of the proposed Foundation Group upgrades. Since this Group provides major economic and

[28] The two segments proposed by TANC that would have increased transmission capacity between Fresno and the Bay Area are listed in Appendix H as: Segment 42 (Dill_TRCY2_1) and Segment 94 (TRCY2_ALPH4_1).

[29] These seven segments are: Segment 95 (TRCY2_ALPH4_2); Segment 50 GREG_ALPH4_1; Segment 51 GREG_ALPH4_2; Segment 72 MIDW_GREG_1; Segment 73 MIDW_GREG_2; Segment 74 MIDW_KRAM_1; and Segment 74 MIDW_KRAM_2.

reliability benefits, only a fraction of the cost of these facilities should be attributed to California's renewable energy program.

3.9.2 Renewable Delivery Group

The Delivery Group is comprised of 3 segments connecting Devers to the Los Angeles basin, 2 segments in the San Joaquin/Sacramento Delta connecting Collinsville and Pittsburg, and 8 segments belonging to the TANC project. The Delivery Group upgrades are expected to be required to meet growing demand in urban load centers regardless of the source of energy, similar to the Foundation Group described above. Little, if any, of the cost of these improvements should be attributed to California's renewable energy program.

RETI recommends that detailed planning for the Delivery Group proceed immediately to identify priority segments needed in the near term. Since many of the segments in this Group were proposed by the TANC project, RETI also recommends that TANC reconsider these segments when the project is revised.

3.9.3 Tehachapi Group

The Tehachapi area is rich in solar and wind resources, and provision of transmission access was studied and recommended by the Tehachapi Collaborative Study Group in 2006. The CAISO performed detailed studies of this Tehachapi plan, and the project was approved by the CAISO board of directors in January 2007. The first three segments of the project have received Certificates of Public Convenience and Necessity (CPCNs) from the CPUC, and applications have been submitted for the remaining eight components. The 12 line segments and associated facilities yet to receive permits have been included in the RETI conceptual plan and assessment.

The Tehachapi Group is unique since the line segments included in the conceptual plan serve foundation and delivery functions as well as collecting renewable energy in the area. For convenience, RETI has considered the Tehachapi Group as collector lines despite their multiple roles.

Detailed planning for the Tehachapi Group is nearly complete, although controversy over some transmission line routes remains to be resolved. RETI recommends that outstanding issues be resolved and CPCNs issued for the remaining components as quickly as possible. The planned completion date of 2012 should be accelerated if feasible.

3.9.4 LEAPS Group

Ability of the LEAPS Group to carry renewable energy from the Imperial Valley and Baja CREZs north to the Los Angeles area may be studied during later phases of RETI that consider the staging or phasing of the proposed Imperial Valley and west-of-Devers transmission lines.

3.9.5 Northeast Group; Consequences of the Decision To Terminate Work on the TANC Transmission Project

The Northeast Group is comprised of 3 line segments all belonging to the TANC Transmission Project (TTP). This group would have provided transmission access to the Lassen and Round Mountain CREZ and Northern Nevada and potentially other out of state resources. As described in Section 3.5, TANC announced on July 15, 2009, that it had stopped work and did not intend to pursue the TTP.

The conceptual transmission plan and assessment described in this Report includes line segments of a project proposed by the Transmission Authority of Northern California (TANC). Components of the TANC project are included in the Foundation, Delivery and Northeast Groups. Moreover, their inclusion in the conceptual plan influences energy flows in all other line segments. The decision to suspend work on the project therefore creates uncertainty in the ratings of all line segments and the composition of the Foundation and Delivery Groups.

RETI recommends that TANC and its members revise their renewable energy transmission plans quickly, giving special attention to potential collaborative development of key segments with other utilities. RETI will update its conceptual plan and assessment when TANC’s transmission plans have been revised.

Future RETI work may be needed to identify alternative transmission solutions for accessing the Lassen and Round Mountain CREZ.

3.9.6 Barren Ridge Group

The Barren Ridge Group, consisting of 4 line segments and associated facilities, is a proposed LADWP project to access resources in the Tehachapi region and deliver renewable energy to Los Angeles. For purposes of the RETI assessment, resources in the region are assumed to be shared between the Tehachapi and Barren Ridge Groups. The Barren Ridge Group is expected to provide valuable access to a large amount of renewable energy in close proximity to Los Angeles. RETI recommends that development of the Barren Ridge Group already underway be completed as quickly as possible.

3.9.7 North Group

The North Group consists of four line segments and associated facilities reaching from Selkirk, British Columbia to a proposed NEO substation in Northeastern Oregon, and on to the Bay Area. The purpose of the Group is to provide access to renewable resources in the US Northwest and British Columbia; improve regional transmission reliability; and provide other market participants with opportunities to use the facilities. The geographic location of the North Group would allow potential future access to renewable resources in other areas of the west in addition to those in Oregon, Washington and British Columbia.

The relatively low Energy Access score of the North Group may change if Northwest CREZ energies are revised, or if in-state renewable technologies are deployed at higher costs than assumed in Phase 2A estimates. PG&E is actively exploring commercial arrangements for such resource development in the region, and Out of State resources may be re-assessed in RETI Phase 2B.

The length of the line to British Columbia, in combination with the relatively small amount of renewable energy accessed in the RETI evaluation result in an Environmental Rating Score for the project below the mean for all Groups. If the line were to access larger amounts of renewable energy, it would raise its overall environmental score. This line was assigned an environmental expert judgment score of “Medium Concern” as a proxy, in the absence of more detailed information.

RETI recommends that the North Group be considered a potential long-term option for renewable energy access. Evaluating the potential reliability and other regional benefits of this project is beyond the scope of RETI.

3.9.8 Imperial Group

The Imperial Irrigation District (IID) has proposed 19 of the line segments in the Imperial Group, as upgrades of its 230 kV system. A few of these facilities have undergone CEQA review and have been approved by the IID board of directors. As described in Section 3.5, the Group also includes a potential 500 kV project from the Imperial Valley substation to Devers via the Bannister substation; and the addition of two transformers at the IV substation. Costs, environmental concerns and energy scores of the Imperial Group are divided approximately equally between the IID and IOU projects. In

Phase 2B, RETI should evaluate the relative merits and timelines of proposed IID system upgrades and the 500 kV project, along with the relative merits of the LEAPS Group, as discussed above.

As with proposed transmission projects in other areas of the state, development of facilities in the Imperial Group could be facilitated by negotiation of joint ownership and operation agreements among POUs and the CAISO and IOUs, including the harmonization of tariffs. RETI recommendations in Section 3.10 address these issues.

3.9.9 Carrizo Group

The conceptual transmission plan includes two upgrades of existing PG&E lines. These upgrades, considered as the Carrizo Group, are expected to be needed for access to Cuyama, Carrizo North, and Carrizo South CREZ in western San Luis Obispo County. The upgrades are relatively minor, having low levels of concern and cost. RETI recommends that PG&E be prepared to undertake the improvements required as soon as generator commitments are finalized.

3.9.10 Inyo and Mountain Pass Groups

Proposed facilities in the Inyo and Mountain Pass Groups increase transmission capacity for energy imported from out of state through Nevada in addition to providing access to California CREZ. Energy would be delivered to the Kramer and Pisgah substations, respectively. Considerable uncertainty remains regarding a) the amount of economically attractive resources to be developed in Nevada and other western states for import to California and b) the extent to which imported fossil-fueled energy may decrease in the future, thereby freeing capacity for imported renewable energy. Both groups also provide opportunities for collaborative POU/IOU transmission solutions.

Development of a Mountain Pass – Eldorado line Segment in the MtPass Group is progressing with SCE’s filing of a CPCN under a proposed plan of service to interconnect and access renewable resources in the Mountain Pass area for Power Purchase Agreements under Large Generator Interconnection Process (LGIP) protocols.

RETI plans to update its data on out of state resources and availability in the near future. In addition, RETI recommends that detailed studies for proposed segments in these groups begin immediately with a focus on providing access to California CREZ and out of state areas in which generation developers have provided firm commitments of commercial interest. Collaboration between the POU and IOU transmission systems is strongly encouraged.

3.9.11 Iron Mountain Group

The Iron Mountain Group faces special challenges and opportunities. Generation development in the Iron Mountain CREZ may be constrained by the proposed Mohave Desert National Monument. Potential transmission routes are constrained by other protected areas as well as the proposed Monument. On the other hand, BLM recently identified lands in this CREZ as a Solar Energy Study Area, under its Solar Programmatic Environmental Impact Statement (PEIS) analysis.

Transmission access to the Iron Mountain CREZ from the south is constrained by a narrow right of way currently controlled by the Metropolitan Water District (MWD.) MWD also opposes any interconnection to their facilities by other transmission owners and any use of their existing rights of way.

As currently configured in the RETI conceptual plan and assessment, the Iron Mountain group consists of 5 line segments which avoid MWD facilities and protected areas by going north to the Edison Junction substation with a further connection to the Needles CREZ and then going west to Pisgah. As a result of the weak link to the south, the Iron Mountain Group is tantamount to a long trunkline rather than a strong network connection, a rather unsatisfactory transmission solution.

RETI recommends further exploration of transmission options to provide access to the Iron Mountain and Needles CREZ, and encourages MWD, SCE, and other interested parties to resolve technical issues creating obstacles to collaborative solutions involving MWD. RETI will reassess potential generation development in the area when the boundaries of the Monument have been identified and plans for the BLM solar study zone are more fully described.

3.9.12 Riverside Group

In this Report, the Riverside Group consists of three line segments which were components of the previously approved SCE Devers-Palo Verde 2 project (DPV2). In the Draft Phase 2A Report, this group also included a competing merchant project known as the Green Energy Express (GEE). Inclusion of both projects in the Draft Report led to unrealistic energy, environmental, and costs results for the group. With no intention of prejudging the competing GEE project, only the SCE segments have been included in the Riverside Group for purposes of the Final Phase 2A Report, in order to ensure a more realistic evaluation of the group than that provided in the Draft Report.

The configuration of the SCE segments in the Riverside Group has been modified from those assessed in the Draft Report in response to the concerns raised by MWD mentioned above. In addition, BLM has identified lands accessed by the Riverside Group as a BLM Solar Energy Study Area. This is expected to increase the potential for solar energy development in this region, if BLM subsequently designates parts of the study area as Solar Energy Zones.

The California segments of DPV2 included in the Riverside Group previously approved by the CPUC as part of the larger project are being reassessed by the CPUC. RETI recommends that the review process proceed quickly and that the competing GEE project be considered in appropriate venues. As discussed above, RETI also recommends resolution of technical issues obstructing the integration of MWD facilities.

3.10 Policy Recommendations

Sorting line segments into functional groups and applying the rating methodology summarized below produces the quantitative results shown on Table 1-1. Energy access scores, environmental scores, investment costs and detailed recommendations for each group of transmission projects are discussed in Section 3. In addition to this technical assessment of proposed new transmission facilities, the recommendations below propose measures that may help minimize the costs and environmental impacts, and facilitate approval and public acceptance of expanding transmission capacity to access renewable resources.

New transmission lines are understandably controversial, especially those which require new rights of way. CEQA and NEPA require that the public be given the opportunity to comment on proposed transmission lines and alternatives to them. Early and active involvement by interested parties in the selection and assessment of alternate routes prior to the formal approval process increases the possibility of public support for the final selection, even though it is perhaps impossible to avoid all opposition to new lines. The CEC has developed an interactive Web-based application known as Planning Alternative Corridors for Transmission lines (PACT) to support more useful and informed stakeholder involvement in corridor identification and selection.

RETI's planning horizon extends to 2020 and planning on even longer time scales is beginning in other agencies. Many years may elapse before planned transmission lines are constructed. In the meantime, population growth and land development may encroach on transmission corridors in which these transmission lines are expected to be constructed. The CEC was given authority to designate transmission corridors under Public Resources Code §25331. After going through a public process to prepare a programmatic Environmental Impact Report, a designated corridor can become part of local general plans and thereby provide assurances that the corridor will be available for new transmission facilities when needed.

To support expedited approval and development of the infrastructure required to enable California to meet its policy goals while minimizing environmental and economic costs, the RETI SSC recommends that:

1. The CAISO, IOUs and POUs perform detailed, contingency-based technical analysis of Renewable Foundation lines and Renewable Delivery lines as soon as possible to determine which are needed, and how construction should be phased to ensure that sufficient transmission is placed in service to meet state goals by 2020.
2. In order to avoid duplicative or redundant facilities, California transmission-planning authorities work closely with one another to identify, propose, study and approve joint IOU-POU projects, and eliminate barriers to joint use of such facilities.
3. The California Energy Commission, working with the California Public Utilities Commission, CAISO, IOUs, and POUs, conduct a study to determine the extent to which multiple transmission charges present barriers to achieving state renewable energy and greenhouse gas reduction goals, and recommend measures to eliminate or mitigate these barriers while ensuring that transmission owners recover their costs.
4. The California Department of Conservation expand and expedite its efforts to define, identify and map vacant and disturbed lands throughout California, focusing first on counties RETI has identified as having large renewable energy and transmission development potential, and make this information available as soon as possible.
5. The California Energy Commission, in conjunction with other state and federal agencies, local governments and renewable energy stakeholders, identify an action plan to address land ownership consolidation of disturbed or degraded private lands for renewable energy development on an expedited basis.
6. Entities planning new transmission lines engage local governments, environmentalists, and other interested parties in a collaborative process to identify and assess potential alternatives, including other transmission alternatives, non-transmission alternatives, as well as alternative routes for the proposed line, early in their planning processes. The California Natural

Resources Agency should provide participants with pertinent data and information in GIS format together with assistance in using the Web-based PACT assessment application.

7. The California Energy Commission, as authorized by Public Resources Code §25331, should begin immediately to consider the RETI transmission line segments to determine which are the best candidates for corridor designation. The Energy Commission should immediately initiate public outreach to agencies and stakeholders that would participate in a corridor designation proceeding. Corridors considered for designation should be beyond those already established by federal agencies or utilities' rights of way and should reserve and protect transmission access to areas where renewable energy development is likely to occur. Designated corridors should include likely routes for Renewable Foundation lines, Renewable Delivery lines, Renewable Collector lines, and potential expansion of existing rights-of-way. Corridor designation must be coordinated among local, state and federal agencies and tribal governments and support access to, for example, BLM Solar Energy Zones, and Desert Renewable Energy Conservation Plan (DRECP) generation development areas, as well as to CREZ most likely to be developed.

Appendices

Contents of Online Supporting Materials

On-line Supporting Materials are an integral part of the RETI Phase 2A Report. These materials consist of spreadsheet-based data used in RETI CREZ and transmission line segment evaluation. This information is organized into the three appendices listed below. All are publicly available and can be freely accessed at the RETI website, www.energy.ca.gov/reti.

Appendix A. Phase 2A Data Workbook.

This master Excel file contains 24 linked spreadsheets. Appendix A lists the names and contents of each spreadsheet. They contain the scenario inputs, calculations and results used in preparing the Phase 2A Report and conceptual transmission plan.

Appendix C. CREZ Environmental Issues Matrices.

Environmental considerations and other issues that could potentially affect the ability to site and permit renewable energy generating projects were evaluated for each of the 29 California CREZ using environmental issues matrices. These can be found in online supporting materials, at http://www.energy.ca.gov/reti.

Appendix D. Transmission Line Environmental Issues Checklist.

The environmental expert panel used the checklists in Appendix D to evaluate every line segment considered in compilation of the RETI conceptual transmission plan. Appendix D contains an index to make it easy to find the information considered and rating assigned to each segment. Clicking on the name of a line segment in the index takes you to that segment.

Appendix A. Phase 2A Data Workbook

Draft Phase 2A scenario inputs, calculations, and results are publicly available online at the RETI web site in an Excel workbook file named Conceptual_Plan_Data_09-05-31.

Contents – workbook sheet names and material:

1. **Flow Chart** – assessment flow chart included in Section 2 of the draft Report.
2. **PlanComponents –** complete list of all transmission facilities included in the plan.
3. **SegmentData** – list of line segments included with associated data.
4. **NetShort –** LSE net short data used to compute shift factors.
5. **ShiftFactorMatrix –** shift factors computed by SDG&E.
6. **ABS-SFmatrix –** absolute values of the shift factors.
7. **CutOffSFmatrix –** identifies shift factors greater than 5%.
8. **CREZdata –** complete revised CREZ data used in plan assessment.
9. **CREZ Bubble Chart –** CREZ economic and environmental scores in bubble chart format with CREZ energy determining bubble size.
10. **Crez Bubble Chart Notes**
11. **SegCREZEnergyMatrix –** shift factors multiplied by CREZ energy.
12. **SegEconScoreMatrix –** shift factors multiplied by CREZ energy weighted by adjusted CREZ economic scores.
13. **SegCREZEnviroScoreMatrix** - shift factors multiplied by CREZ energy weighted by adjusted CREZ environmental scores.
14. **SegCommIntEnergyMatrix –** shift factors multiplied by CREZ energy of commercial interest.
15. **SegSummary** – data and calculation results for all line segments.
16. **GroupSegNames –** names of line segments included in each group.
17. **SegCorrelationChart** – line segment results charted to show correlations.
18. **GroupSegSummary** – SegSummary copied as a data table used for pivot table summary.
19. **GroupSummaryTable –** Excel pivot table based on GroupSegSummary
20. **GroupSumSort** – group totals, sorted by category.
21. **GroupRelMedian –** group totals relative to median values
22. **Group Bubble Chart** – group cost and environmental scores in bubble chart format with group energy determining bubble size.
23. **Group Bubble Chart Notes**
24. **Group Bar Chart –** normalized group energy, environmental score and cost in bar chart format.

Appendix B. CREZ Energy, Capacity, and Economic, Environmental and Commercial Interest Scores

Tables in Appendix B present CREZ capacity, energy, economic and environmental scores and commercial interest scores, updated to reflect the CREZ revisions described in Chapter 2.

Table B-1 presents estimates of developable capacity, by CREZ, for each renewable generating technology, in MW.

Table B-2 presents estimates of the total energy output of each CREZ, in GWh, for each renewable generating technology; and the pro rata contribution of that CREZ to the statewide renewable net short in 2020. In the column headed, **Net Short Total**, the energy output of each CREZ has been reduced by the ratio of its total output to total statewide net short, so that the aggregate output of all CREZ adds up to the statewide net short.

Table B-3 shows CREZ economic ranking scores and adjusted economic ranking scores; and CREZ environmental ranking scores and adjusted ranking scores. Economic and environmental scores were adjusted for use in the criteria formulas employed to evaluate transmission line segments in this analysis. The criteria formulas and the adjustment process is described in Section 3.3.3.2 and Section 3.3.3.3 of the Phase 2A Draft Report.

Table B-4 presents CREZ commercial interest scores. The column headed, **GWhPPA** shows the amount of CREZ energy contracted for under Power Purchase Agreements; the column headed, **GWhQUE** shows the amount of CREZ energy represented in CAISO or POU interconnection queues. The final column is the sum of the two other columns, also in GWh.

Table B-1. Phase 2A CREZ Developable Capacity

	Phase 2A Capacity (MW)				
CREZ Name	**Biomass**	**Geoth.**	**Solar Th.**	**Wind**	**Total**
Baja-A (La Rumorosa)	0	0	0	2,368	2,368
Baja-B (Santa Caterina)	0	0	0	2,632	2,632
Barstow	0	0	1,400	936	2,336
British Columbia	0	90	0	250	340
Carrizo North	0	0	1,600	0	1,600
Carrizo South	0	0	3,877	0	3,877
Cuyama	0	0	800	0	800
Fairmont	138	0	2,000	1,380	3,518
Imperial East	0	0	1,500	123	1,623
Imperial North-A	0	1,370	0	0	1,370
Imperial North-B	30	0	1,800	0	1,830
Imperial South	36	64	3,570	45	3,715
Inyokern	0	0	2,145	287	2,432
Iron Mountain	0	0	4,850	62	4,912
Kramer	0	24	6,185	203	6,412
Lassen North	0	0	0	1,467	1,467
Lassen South	0	0	0	410	410
Mountain Pass	0	0	780	878	1,658
Needles	0	0	200	261	461
Nevada N	0	115	0	0	115
Nevada C	0	352	0	0	352
Oregon	0	392	0	0	392
Owens Valley	0	0	1,400	0	1,400
Palm Springs	0	0	0	770	770
Pisgah	0	0	2,550	0	2,550
Riverside East	0	0	10,550	0	10,550
Round Mountain-A	0	384	0	0	384
Round Mountain-B	55	0	0	132	187
San Bernardino - Baker	0	0	3,670	0	3,670
San Bernardino - Lucerne	91	0	2,340	599	3,030
San Diego North Central	0	0	0	281	281
San Diego South	0	0	0	678	678
Santa Barbara	0	0	0	433	433
Solano	0	0	0	894	894
Tehachapi	37	0	7,195	3,605	10,837
Twentynine Palms	0	0	1,805	0	1,805
Victorville	0	0	1,200	436	1,636
Totals	**387**	**2,791**	**61,417**	**19,131**	**83,726**

Table B-2. Phase 2A CREZ Energy, by Technology

	Phase 2A Energy (GWh)					
CREZ Name	**Biomass**	**Geoth.**	**Solar Th.**	**Wind**	**Total**	**Net Short**
Baja-A (La Rumorosa)	0	0	0	8,035	8,035	2,072
Baja-B (Santa Caterina)	0	0	0	8,931	8,931	2,303
Barstow	0	0	3,369	2,487	5,856	1,510
British Columbia	0	710	0	1,139	1,849	477
Carrizo North	0	0	3,395	0	3,395	876
Carrizo South	0	0	8,323	0	8,323	2,147
Cuyama	0	0	1,784	0	1,784	460
Fairmont	967	0	5,251	4,136	10,355	2,671
Imperial East	0	0	3,623	337	3,959	1,021
Imperial North-A	0	10,626	0	0	10,626	2,741
Imperial North-B	210	0	4,297	0	4,507	1,162
Imperial South	250	449	8,349	119	9,167	2,364
Inyokern	0	0	5,609	713	6,322	1,631
Iron Mountain	0	0	11,460	151	11,611	2,995
Kramer	0	168	15,914	471	16,553	4,269
Lassen North	0	0	0	3,784	3,784	976
Lassen South	0	0	0	1,106	1,106	285
Mountain Pass	0	0	1,900	2,436	4,336	1,118
Needles	0	0	488	699	1,187	306
Nevada N	0	822	0	0	822	212
Nevada C	0	2,624	0	0	2,624	677
Oregon	0	3,062	0	0	3,062	790
Owens Valley	0	0	3,613	0	3,613	932
Palm Springs	0	0	0	2,595	2,595	669
Pisgah	0	0	6,281	0	6,281	1,620
Riverside East	0	0	25,473	0	25,473	6,570
Round Mountain-A	0	2,691	0	0	2,691	694
Round Mountain-B	385	0	0	357	742	191
San Bernardino - Baker	0	0	8,707	0	8,707	2,246
San Bernardino - Lucerne	638	0	5,837	1,669	8,143	2,100
San Diego North Central	0	0	0	739	739	191
San Diego South	0	0	0	1,926	1,926	497
Santa Barbara	0	0	0	1,180	1,180	304
Solano	0	0	0	2,865	2,865	739
Tehachapi	259	0	18,433	10,781	29,473	7,602
Twentynine Palms	0	0	4,616	0	4,616	1,191
Victorville	0	0	3,048	1,222	4,270	1,101
Totals	**2,710**	**21,152**	**149,767**	**57,879**	**231,508**	**59,710**

Table B-3. Phase 2A CREZ Economic and Environmental Scores

CREZ Name	Phase 2 EconScore	Phase 2Adj EconScore	Phase 2 EnviroScore	Phase 2Adj EnviroScore
Baja-A (La Rumorosa)	-30.11	47.57	7.60	14.60
Baja-B (Santa Caterina)	-30.11	47.57	7.60	14.60
Barstow	-2.10	19.56	8.70	13.50
British Columbia	-30.00	47.46	7.60	14.60
Carrizo North	0.95	16.51	8.40	13.80
Carrizo South	3.72	13.74	6.60	15.60
Cuyama	-1.77	19.23	6.60	15.60
Fairmont	-22.55	40.01	10.60	11.60
Imperial East	-0.09	17.55	5.70	16.50
Imperial North-A	-21.62	39.08	3.70	18.50
Imperial North-B	0.44	17.02	11.10	11.10
Imperial South	1.84	15.62	7.80	14.40
Inyokern	-14.95	32.41	7.60	14.60
Iron Mountain	-1.48	18.94	5.20	17.00
Kramer	-15.55	33.01	5.90	16.30
Lassen North	9.41	8.05	7.80	14.40
Lassen South	1.81	15.65	19.40	2.80
Mountain Pass	-2.50	19.96	3.50	18.70
Needles	4.26	13.20	10.00	12.20
Nevada N	-31.20	48.66	7.60	14.60
Nevada C	-39.20	56.66	7.60	14.60
Oregon	-41.38	58.84	7.60	14.60
Owens Valley	-19.38	36.84	5.50	16.70
Palm Springs	-35.94	53.40	8.00	14.20
Pisgah	-5.81	23.27	4.00	18.20
Riverside East	-5.49	22.95	5.10	17.10
Round Mountain-A	-30.31	47.77	3.40	18.80
Round Mountain-B	17.46	0.00	8.40	13.80
San Bernardino - Baker	1.23	16.23	6.70	15.50
San Bernardino - Lucerne	-2.25	19.71	7.70	14.50
San Diego North Central	-0.32	17.78	22.20	0.00
San Diego South	-12.29	29.75	5.50	16.70
Santa Barbara	1.07	16.39	9.20	13.00
Solano	-38.93	56.39	7.60	14.60
Tehachapi	-20.09	37.55	4.60	17.60
Twentynine Palms	-9.83	27.29	4.80	17.40
Victorville	-8.92	26.38	8.20	14.00
Median California			7.60	

Table B-4. Phase 2A Commercial Interest Scores

CREZ Name	GWHPPA	GWHQUE	SUM GWHPQ
Baja-A (La Rumorosa)	0	10,246	10,246
Baja-B (Santa Caterina)	0	0	0
Barstow	0	586	586
British Columbia	0	0	0
Carrizo North	227	1,272	1,499
Carrizo South	1,245	2,224	3,469
Cuyama	0	234	234
Fairmont	0	1,155	1,155
Imperial East	0	2,173	2,173
Imperial North-A	0	3,469	3,469
Imperial North-B	0	0	0
Imperial South	2,105	5,439	7,543
Inyokern	0	118	118
Iron Mountain	0	4,726	4,726
Kramer	0	8,491	8,491
Lassen North	4,555	5,194	9,749
Lassen South	0	1,612	1,612
Mountain Pass	731	1,636	2,367
Needles	0	802	802
Nevada N	0	1,501	1,501
Nevada C	0	1,580	1,580
Oregon	0	0	0
Owens Valley	0	0	0
Palm Springs	339	2,146	2,485
Pisgah	5,135	16,005	21,140
Riverside East	0	10,019	10,019
Round Mountain-A	2,000	0	2,000
Round Mountain-B	0	0	0
San Bernardino - Baker	0	3,948	3,948
San Bernardino - Lucerne	0	998	998
San Diego North Central	0	298	298
San Diego South	0	2,007	2,007
Santa Barbara	327	327	654
Solano	1,000	4,743	5,743
Tehachapi	8,494	28,836	37,330
Twentynine Palms	0	5,115	5,115
Victorville	0	2,445	2,445

Appendix C. CREZ Environmental Issues Matrices

Environmental considerations and other issues that could potentially affect the ability to site and permit renewable energy generating projects were evaluated for each of the 29 California CREZ using environmental issues matrices. These can be found in online supporting materials, at http://www.energy.ca.gov/reti.

Appendix D. Transmission Line Environmental Issues Checklist

Matrices listing the 108 line segments evaluated by the environmental expert panel can be found in online supporting materials at http://www.energy.ca.gov/reti.

Appendix E. Environmental Expert Panel Participants

Two groups or panels of experts – one each for northern and southern California – were assembled by the co-chairs of the EWG, with the advice of RETI coordinators and other RETI participants. Participants were selected for their knowledge of the natural and cultural resources potentially affected by potential line segments and/or the impacts of construction, maintenance and operation of transmission lines.

Members of the Northern California panel were: Billie Blanchard, CPUC; Peter Cross, US Fish and Wildlife Service (USFWS); Robert Dowds, Westlands Water District; Scott Flint, California Department of Fish and Game (DFG); Bob Hawkins, consultant to the US Forest Service (USFS); Roger Johnson, CEC; Julie Tupper, USFS; Johanna Wald, NRDC; and Carl Zichella, Sierra Club. Participating experts for Southern California segments were Ileene Anderson, Center for Biological Diversity (CBD); Billie Blanchard, CPUC; Ray Bransfield, Jody Frazier, and Tannika Engelhard, USFWS; Ashley Conrad-Saydah, BLM; Scott Flint, DFG; Roger Johnson, CEC; Russell Scofield, US Department of the Interior (DOI); Julie Tupper, USFS: Johanna Wald, NRDC; and Carl Zichella, Sierra Club.

Each of these panels met separately to review the segments within their respective regions. The meetings were conducted via WebEx to enable all experts to participate and to allow interested members of the SSC, the EWG and the public to observe. Only panel members participated in scoring discussions and decisions.

Scoring involved use of the checklist, which can be found in the online supporting materials for Appendix C, that identified potential environmental and other issues of concern as well as other information relevant to the scoring process, in particular the rating formula developed by the CRWG and accepted by the other members of the Phase 2 Working Group. The checklists shown in the online supporting materials for Appendix C were filled out for each conceptual transmission segment. The completed checklists provide a documentary record of the considerations taken into account by the experts in arriving at each judgment score.

Appendix F. Line Segments in Each Group

Line segment identifiers include the names of the two substations they connect. Segments comprising each Group are listed below, by their abbreviated identifier. In Appendix H, these are referred to as Segment Short Names. Appendix I lists the full names and descriptions of the segments below, in alphabetical order. To take an example, the segment, DILL_TRACY2_1 below is shown in Appendix H to refer to the first 500 kV line circuit between the Dillard Road substation and the Tracy 2 substation.

Foundation	Foundation(cont)	Delivery	Tehachapi	LEAPS
BARS1_KRAM_1	MIDW_KRAM_1	ALPH4_ALPH1_1	ANTE_VINC_1	CMPL_ECND_1
DEVR_MIRA_1	MIDW_KRAM_2	ALPH4_ALPH1_2	ANTE_VINC_2	CMPL_ECND_2
DEVR_MIRA_2	MIDW_WRLW_1	ALPH4_PARK_1	CHNO_MIRA_1	CMPL_TALG_1
DILL_TRCY2_1	PISG_BARS1_1	ALPH4_PARK_2	CHNO_MIRA_2	CMPL_TALG_2
DVR2_VICT_1	PISG_LUCV_1	COLL_PITT_1	CHNO_MIRA_3	LELK_CMPL_1
GREG_ALPH4_1	PISG_MIRA_1	COLL_PITT_2	GULD_EGLR_1	
GREG_ALPH4_2	PRDE_VINC_2	DEVR_VALL_2	MESA_VINC_2	
KRAM_LUGO_1	TRCY2_ALPH4_1	DEVR_VALL_3	RIOH_VINC_2	
KRAM_WHUB_1	TRCY2_ALPH4_2	DVR2_CENT_1	WHUB_ANTE_1	
LUCV_LUGO_1	VINC_MIRA_1	LIVR_DELT_1	WHUB_WRLW_1	
LUGO_VICT_2		TESL_NEWK_1	WRLW_ANTE_1	
MIDW_GREG_1		TRCY2_LIVR_1	WRLW_VINC_1	
MIDW_GREG_2		TRCY2_TRCY_1		

North	NorthEast	Carrizo	BarrenRidge	Inyo
COLL_TRCY2_1	OLND_DILL_1	GATE_MBAY_1	BRNR_HASC_1	CONT_LPIN_1
NEO_COLL_1	ZETA1_OLND_1	MIDW_CARZ_1	BRNR_HASC_2	INYK_KRAM_1
SELK_NEO_1	ZETA1_RDMT_1		CAST_HASC_2	LPIN_INYK_1
SELK_NEO_2			HASC_RNLD_1	

MtPass	IronMt	Riverside	Imperial	Imperial (cont)
BAKR1_BARS1_1	IRMT_SCEJ_1	DESC_DEVR_1	AV58_CHCV_1	DIXL_BANN_1
BARS1_LUGO_1	IRMT_SCEJ_2	DESC_DEVR_2	BANN_AV58_1	ELCN_HILN_1
MTPS1_BAKR1_1	SCEJ_CAMI_1	MIDP_DESC_1	BANN_CHCV_1	ELCN_HILN_2
MTPS1_ELDO_1	SCEJ_PISG_1		BANN_DEVR_1	ELCN_IMPV2_2
	SCEJ_PISG_2		BANN_ELCN_1	IMPV_BANN_1
			BANN_GEO_1	IMPV_XFMR_2
			BANN_GEO_2	IMPV_XFMR_3
			CHCV_DVR2_1	MIDW_GEO_1
			CHCV_DVR2_2	MIDW_GEO_2
			CHCV_MIRG_1	MIRG_DEVR_1
			CHCV_MIRG_2	MIRG_DEVR_2
			DEVR_DVR2_1	

Appendix G. Description of Line Segments

Brief descriptions of the electrical location and purpose of potential line segment connections are included below. Many are conceptual or planned components of transmission projects proposed by Imperial Irrigation District, Los Angeles Department of Water and Power, PG&E, Southern California Edison Company, and Transmission Agency of Northern California, who have provided these descriptions.

I. Southern California Segments

Imperial Irrigation District Upgrades

Imperial Irrigation District (IID) has been at the forefront of promoting renewable energy in the Imperial Valley. Nearly twenty years ago, IID upgraded its transmission system by building a 230 kV collector system to accommodate the interconnection of new geothermal generation and export this renewable energy to Southern California Edison (SCE). Today, IID wheels approximately 550 MW of geothermal energy from Imperial Valley into the California Independent System Operator (CAISO) balancing authority area.

IID has developed a detailed long-term transmission plan (ten years-plus timeframe) to define the transmission improvements necessary to continue meeting load service requirements in future years as well as to facilitate the export of renewable resources from the Imperial Valley area. The plan has primarily focused on the upgrade of certain sections of IID's 161 kV transmission system to 230 kV to integrate the existing 230 kV collector system and create a 230 kV transmission loop that will cover most of IID service area to facilitate the export of renewable generation to the north, south and east of IID's service area.

Planned IID upgrades are organized into Phases A, B and C:

- IID Phase A will establish a double circuit 230 kV transmission path from IV substation (SDG&E/IID) to the SCE's Mirage-Devers substations interties, These upgrades will be built in conjunction with a new sixteen (16) mile 230 kV double circuit transmission line to access geothermal resources in the Salton Sea Area (Midway to Geo 1 line segments) with a thermal rating of 1200 MW. IID's intertie with SCE will be upgraded from 800 to 1600 MW thermal rating through the bundling of the existing double circuit 230 kV line (CV to Mirage/Devers 1&2) and the IID's intertie with SDG&E will be upgraded to double circuit 230 kV with a thermal rating of 1200 MW. These upgrades will only require 17 miles of new ROW which have been already permitted and are in construction phase.

IID's Phase A is expected to be completed by the 4th quarter of 2012.

- IID Phase B will establish a redundant 230 kV double circuit transmission path from the Salton Sea area to Imperial Valley Substation (SDG&E/IID) through a new line segment from Geo sub to new Bannister (16 miles of new ROW already permitted), and the upgrade of an existing 161 kV line to double circuit 230 kV from new Bannister to El Centro Switching Station. IID's Phase B is expected to be completed by the 4th quarter of 2013.
- IID Phase C will complete a South to North 230 kV double circuit transmission path west of the Salton Sea from Imperial Valley Substation (SDG&E/IID) to SCE's Devers and new Devers II substations. The existing 161 kV line from Bannister to Coachella Valley substation (CV) will be upgraded to double circuit 230 kV continuing with a new 230 kV double circuit 230 kV line (already permitted) from Coachella Valley to Devers/Devers II substations.
- Once IID's three phases are completed, IID's intertie with SCE and LADWP at Mirage/Devers/Devers II is expected to have a thermal rating of 3200 MW and IID's intertie with SDG&E at Imperial Valley substation is planned to have a thermal rating of 1800 MW. This will be accomplished with minimum use of new ROW and minimum environmental impacts.

  IID's Phase A is expected to be completed by the 4th quarter of 2014.

The individual project components of this plan are described in detail below.

1. **El Centro Switching Station (ECSS) to Highline Station double circuit 230 kV transmission line.**

   Upgrade to double circuit 230 kV, the ECSS to Pilot Knob 161 kV and the ECSS to Drop 4 92 kV line sections (18 miles) from ECSS to one mile south of Highline Station, build one mile of double circuit 230 kV line to extend the line from ECSS into Highline station. Build one mile of double circuit 230 kV line to interconnect the remaining 161 kV line to Pilot Knob and the 92 kV line to Drop 4 into Highline station.

2. **Bannister Switching Station and single circuit 230 kV line to the proposed GEO Station**

   Build a 230 kV switching station (Bannister) in the southwest area of the Salton Sea, build 16 miles of single circuit 230 kV transmission line (prepared for double circuit) from Bannister switching station to GEO station

3. **El Centro Switching Station (ECSS) to Dixieland substation single circuit 230 kV transmission line**

   Build 15.5 miles of single circuit 230 kV transmission line from ECSS to Dixieland substation.

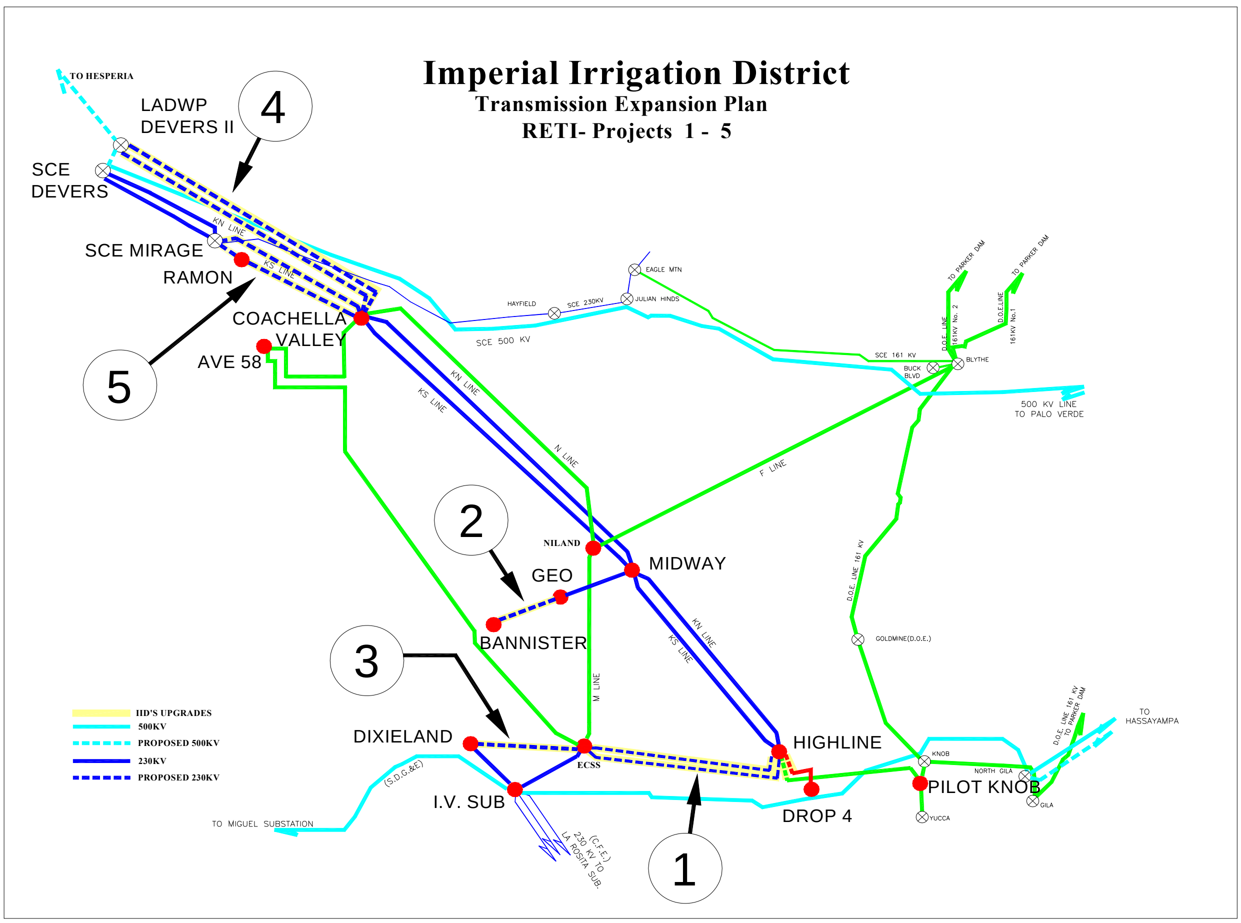
4. **Coachella Valley Substation (ECSS) to proposed Devers II 500/230 kV Substation 230 kV transmission line path**

   Build 35 miles of double circuit 230 kV transmission line between Coachella Valley substation to a proposed Devers II substation.

5. **Coachella Valley Substation to Mirage Substation (Path 42) double circuit 230 kV line upgrade from 800 MW to 1600 MW**

   Upgrade 20 miles of existing double circuit single conductor 230 kV transmission line to Bundle (two conductors per phase) conductors. The project will increase the thermal rating capacity of the Imperial Irrigation District to Southern California Edison (SCE) interconnection from 800 MW to 1600 MW.

The following figure depicts projects 1 through 5



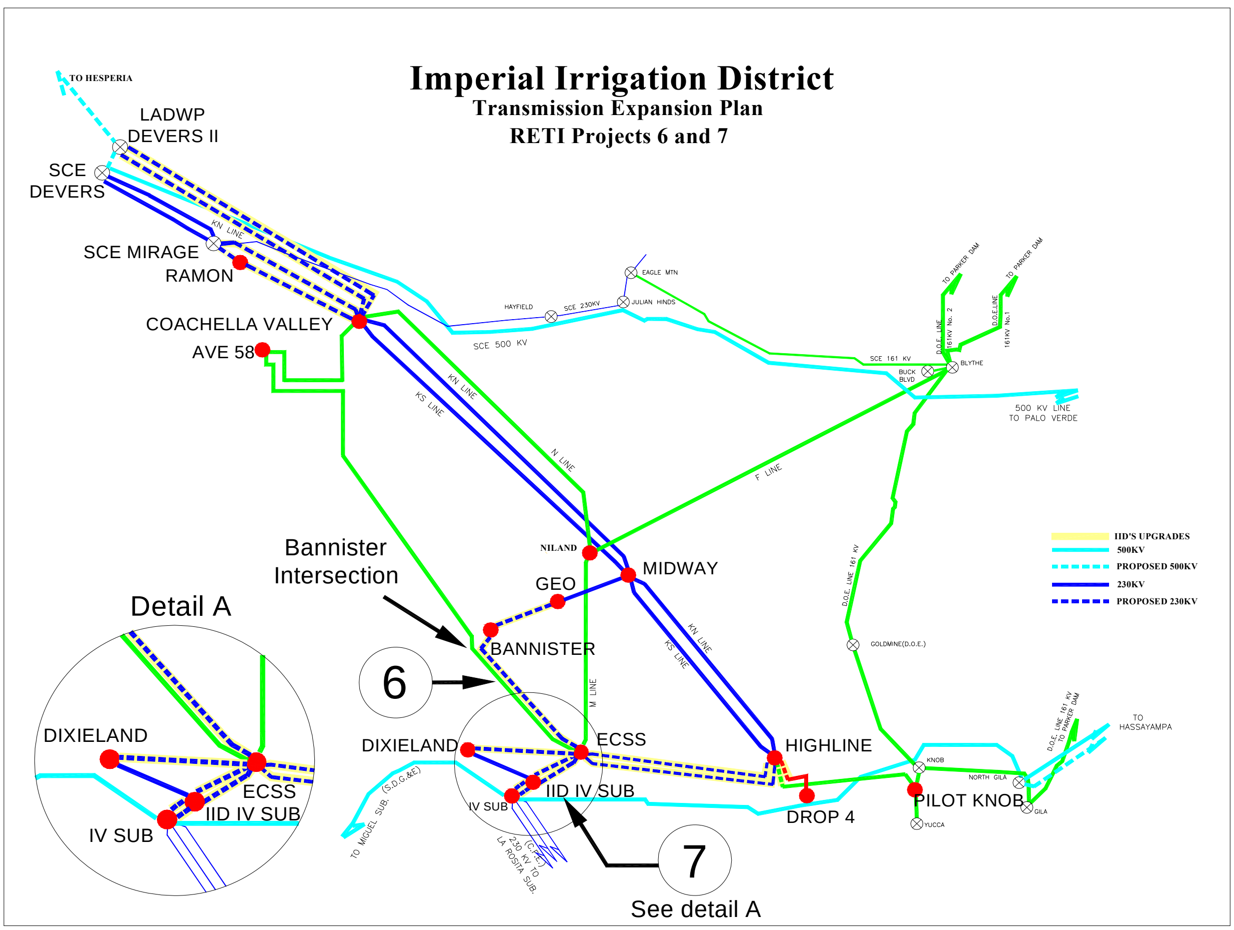
6. **El Centro Switching Station (ECSS) to Bannister switching station double circuit 230 kV transmission line**

   Rebuild 24 miles of the ECSS to AVE 58 substation 161 kV single circuit line to double circuit 230 kV from ECSS to 3.5 miles west of the proposed Bannister substation (Bannister intersection), build 3.5 miles of single circuit 230 kV (prepared to double circuit) line, from Bannister intersection to Bannister substation. One circuit will establish the 230 kV line from ECSS to Bannister and the second circuit from ECSS to Bannister intersection will be operated at 161 kV to interconnect to the remaining 161 kV single circuit line to Ave 58 Substation.

7. **IID IV Sub switching station and to IID IV Sub to ECSS double circuit 230 kV transmission line**

   Build a 230 kV switching station (IID IV SUB) adjacent to SDG&E/IID's Imperial Valley Substation (IV Sub), looping existing IV Sub to Dixieland substation and IV Sub to ECSS 230 kV lines. Establishing the IID IV Sub to Dixieland and IID IV Sub to ECSS 230 kV lines and rebuild the single circuit 230 kV IID IV Sub to ECSS 230 kV line to double circuit 230 KV.

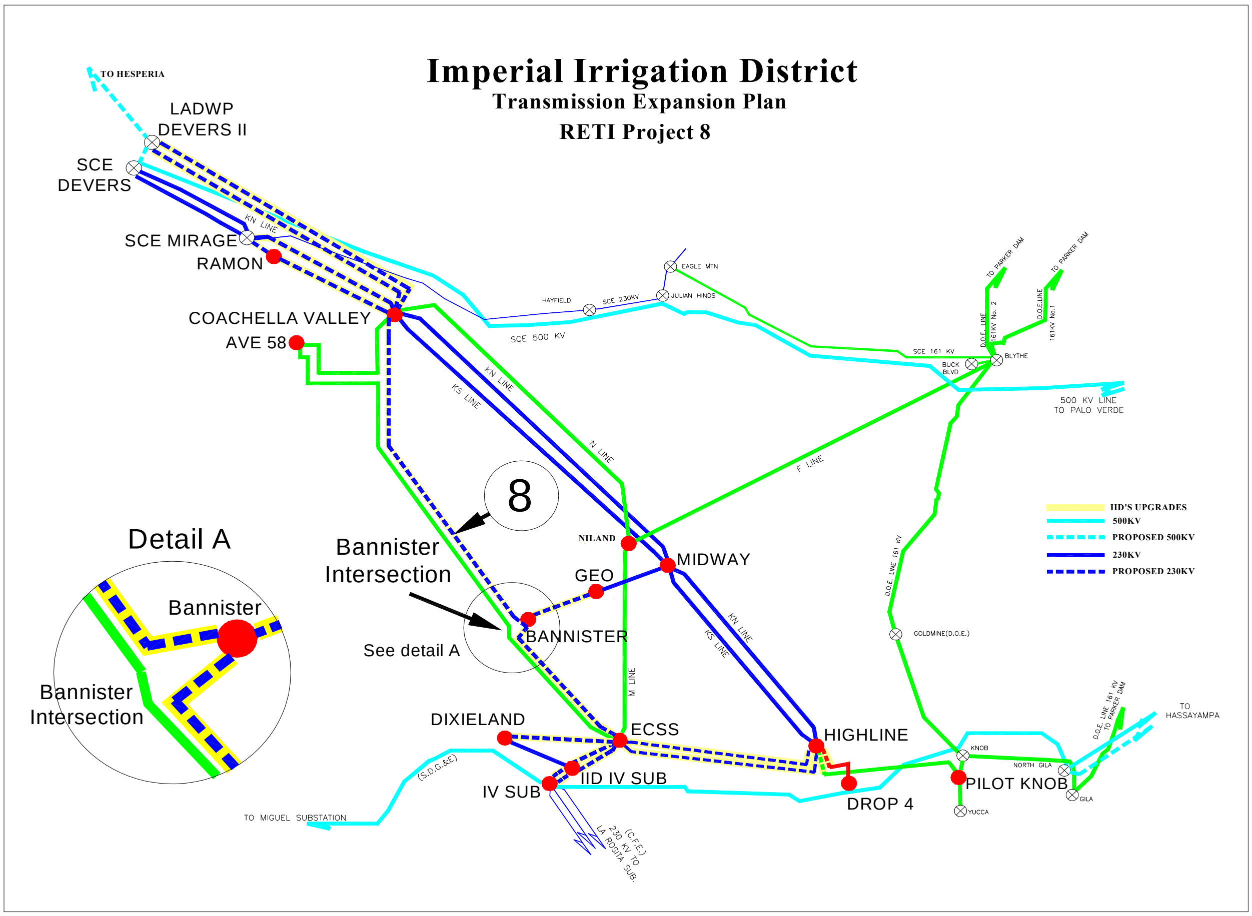
The following figure depicts projects 6 and 7



8. **Bannister SS to Coachella Valley 230 kV transmission line**

Build 3.5 miles of single circuit 230 kV line (prepared to double circuit), from Bannister substation to Bannister intersection; rebuild 46.2 miles of the ECSS to Ave 58 substation single circuit 161 kV line, from Bannister intersection to the intersection with the double circuit 161 kV line into Ave 58 Substation (Ave 58 intersection); upgrade 11.3 miles of double circuit 161 kV line from Ave 58 intersection to Ave 58 Substation; rebuild 6.3 miles of single circuit line to double circuit 230 kV, from Ave 58 intersection to Coachella Valley substation. One circuit will establish the 230 kV line from Bannister substation to Coachella Valley substation and the second circuit will be operated at 161 kV from ECSS to Ave 58 substations and from Ave 58 to Coachella Valley Substations.

The following figure depicts project 8



9. **Midway Station to the proposed GEO Station transmission line; second 230 kV circuit addition**

Add a second sixteen (16) miles 230 kV circuit to the Midway station to GEO station 230 kV transmission line.

10. **GEO station to Bannister Switching Station; second 230 kV circuit addition**

    Add a second sixteen (16) miles 230 kV circuit to the GEO station to Bannister Station 230 transmission line.

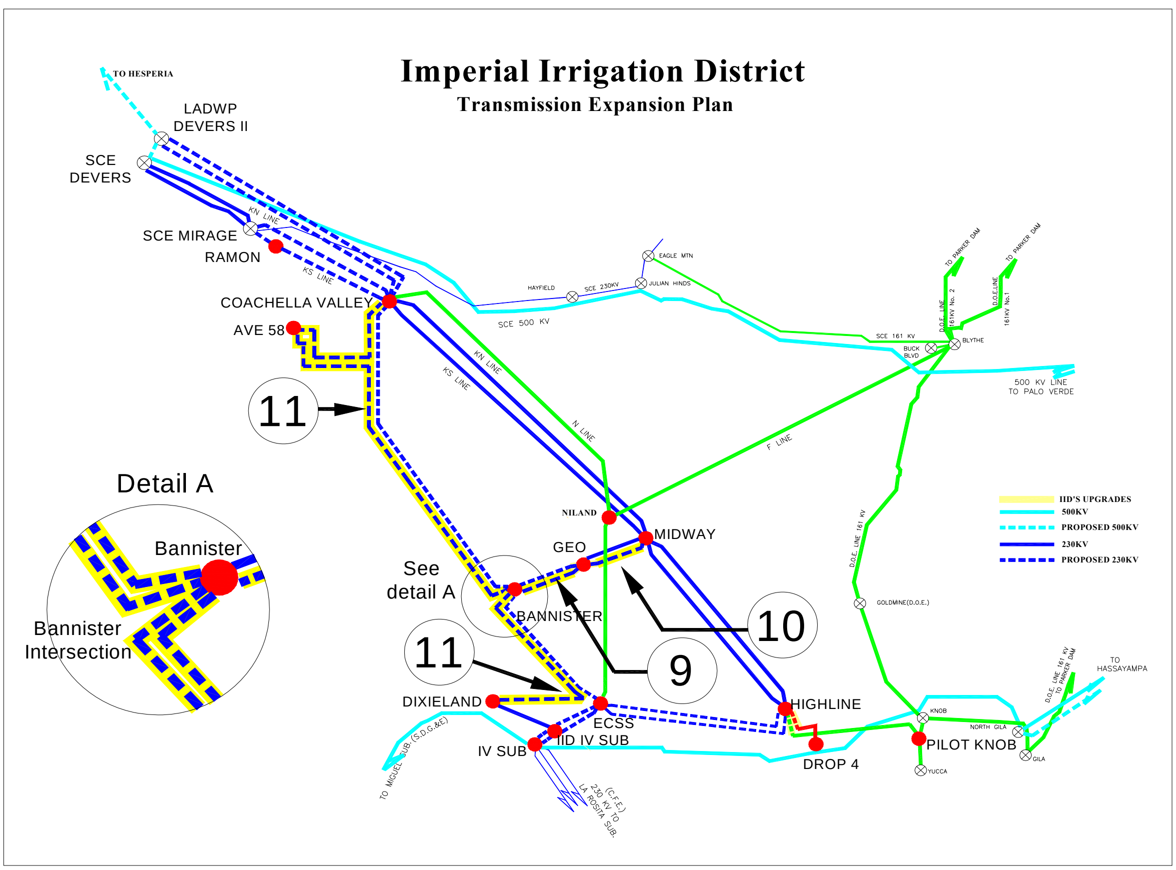
11. **Dixieland Substation - Bannister Switching Station (Bannister SS) - Ave 58 substation - Coachella Valley Substation 230 kV transmission lines.**

    Disconnect the ECSS to Ave 58 and Ave 58 to Coachella Valley substations 161 kV lines (prepared for 230 kV); upgrade the Ave 58 substation 161 kV bus and transformation capacity to 230 kV, re-connect the Ave 58 to Coachella Valley 230 kV transmission line.

    Re-connect the northern end of the ECSS to Ave 58 substation transmission line to Ave 58 230 kV bus, the southern end of the line will be re-routed to Dixieland substation using the Dixieland to ECSS 230 kV transmission line that will be disconnected from ECSS to temporary establish the Dixieland to Ave 58 230 kV line

    Add a second circuit to the 3.5-mile section (Bannister intersection to Bannister SS) of the ECSS to Bannister SS and Bannister SS to Coachella Valley 230 kV lines, loop the Dixieland to Ave 58 230 kV line into Bannister SS using the two new 3.5-mile circuits to establish the Dixieland to Bannister SS and Bannister SS to Ave 58 substation 230 kV transmission line.

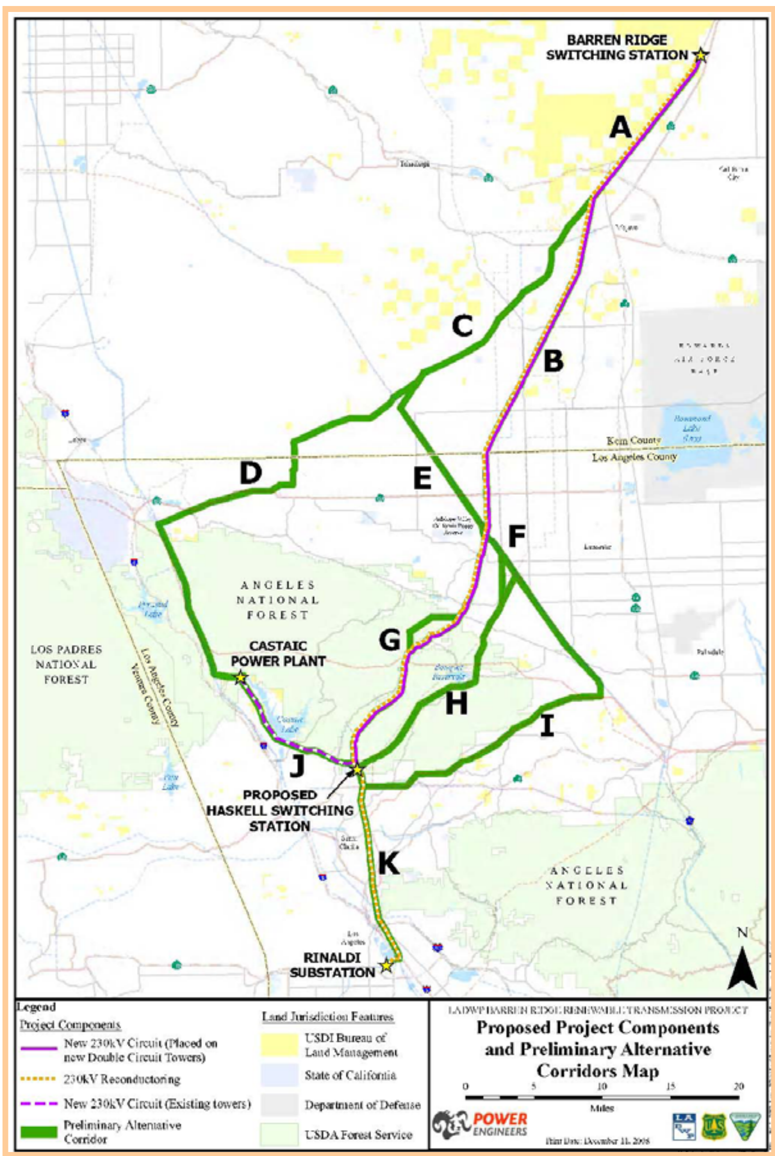
The following figure depicts projects 9 through 11



Los Angeles Department of Water and Power

Barren Ridge Renewable Transmission Project (BRRTP)

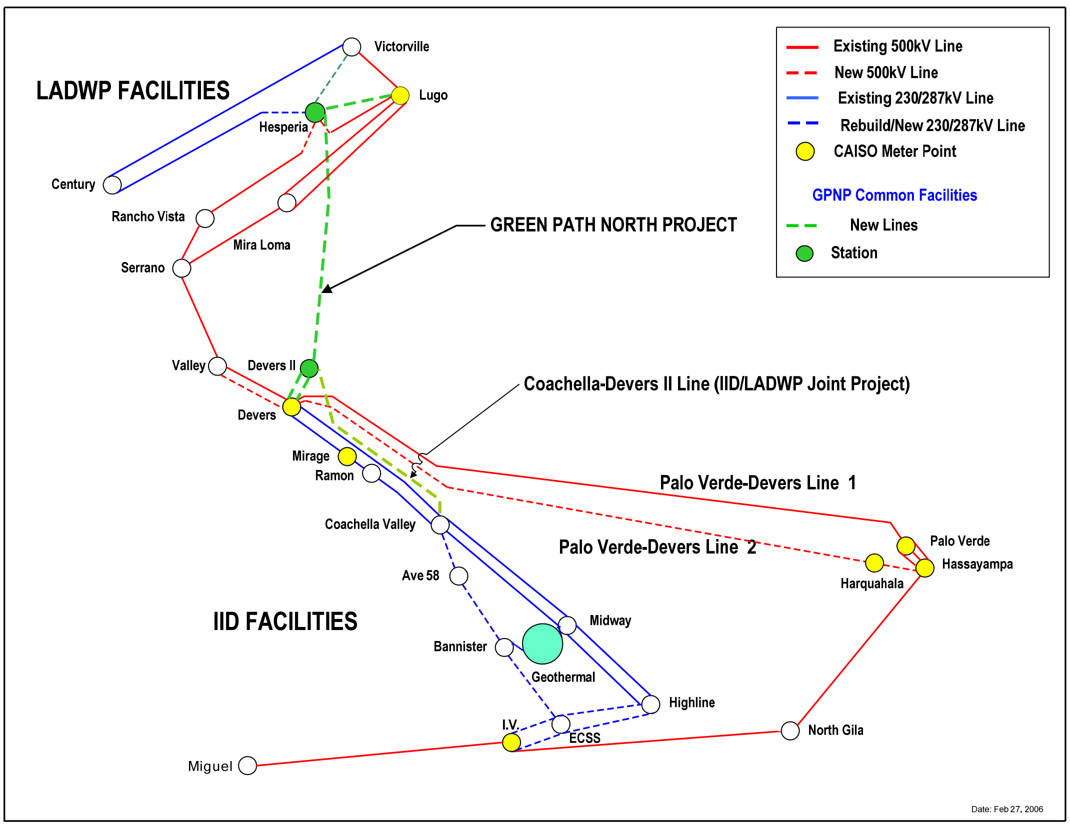
The BRRTP is a renewable resources project and consists of a construction of 61-mile double-circuit 230 kV transmission line between the Barren Ride Switching Station and a new Haskell Canyon Switching Station. The Barren Ridge Switching Station is a newly constructed station along the existing Inyo to Rinaldi line approximately 20 miles north of the City of Mojave. The project also consists of the reconductoring of the existing line from Barren Ridge to Haskell Canyon. With the construction of the new line and the reconductoring, the rating of the existing system, which is approximately 400 MW, will be increases to approximately 2200 MW. The project is presently in the environmental process and is expected to be in service by late 2013. The project map below shows the alternative routes now under environmental study.



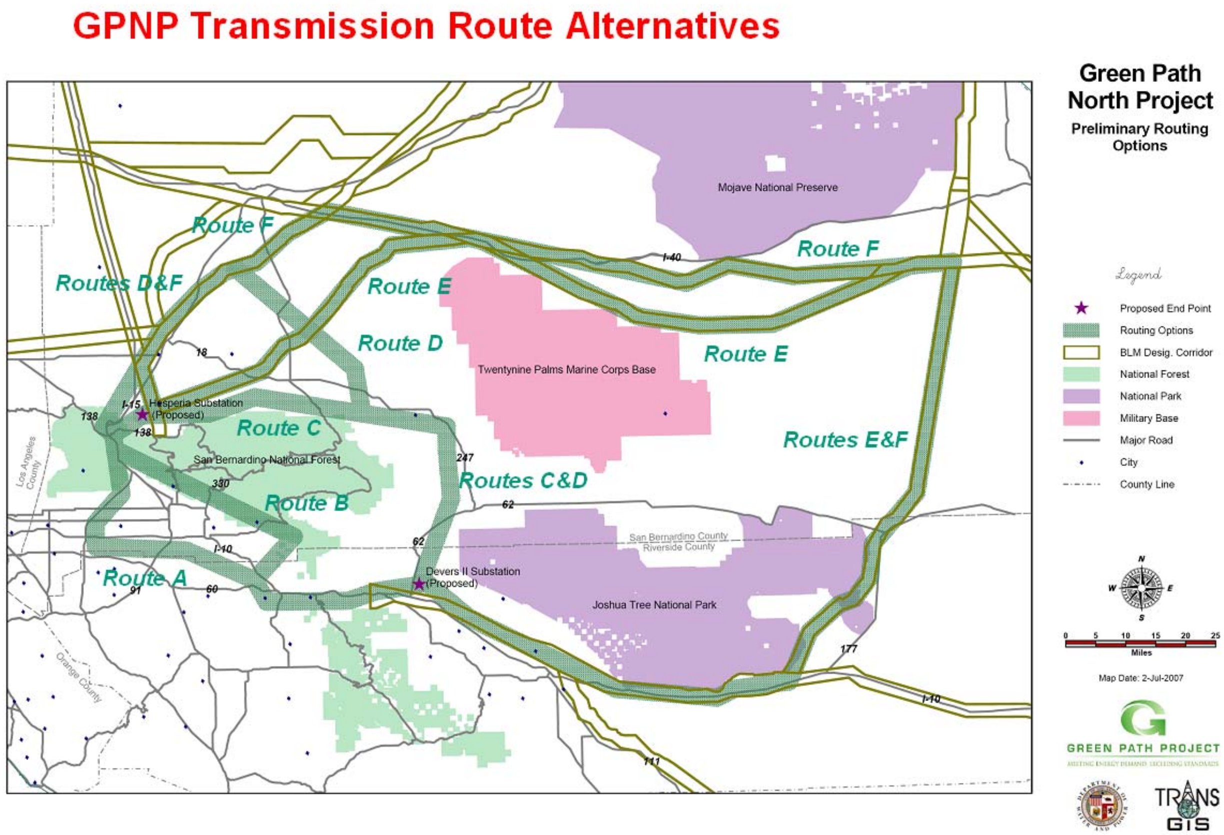
Green Path North Project (GPNP)

The GPNP is a renewable resource project with the purpose of transmitting a substantial level of Salton Sea geothermal and other renewable resources from the Imperial Valley area to the load centers in Southern California. This project is a joint project with Los Angeles Department of Water and Power (LADWP), Imperial Irrigation District (IID) and Southern California Public Power Authority (SCPPA) member cities. This project calls for construction of a double circuit 230 kVAC, 85-mile transmission line with an approximately 10-mile underground portion. This line is planned to originate at Devers substation near Palm Springs, California and terminate at Hesperia substation near the City of Hesperia, California. The projected completion date of this project is late 2014.

GPNP Transmission Project One-Line Diagram



This one-line diagram above shows the Green Path North Project in relation to other power system interconnections and geothermal resource in Imperial Valley. Several routing alternatives are under consideration for GPNP as shown in the attached map below. The transmission components that were evaluated with the RETI environmental screening process included transmission segments associated with the routing alternative A. In addition to the routing alternative A, five additional routings are being studied in the formal environmental review process for this project.



The GPNP 230 kV double-circuit AC transmission system will initially be rated at approximately 800 MW. The project plan is to design and configure the GPNP transmission system such that in could be converted to ±320 kV High-voltage DC (HVDC) system with potential transmission capacity rating of 3300 MW.

Mojave Desert Area Conceptual Segments

Foundation Group

1. BARS1_KRAM_1

This 40 mile single-circuit 500 kV transmission line connects the RETI conceptual plan Barstow 500/230/115 kV substation with SCE's upgraded Kramer 500/230/115 kV substation using existing corridor for the purpose of the integration and reliable transfer of renewable energy from the Pisgah, Mountain Pass, San Bernardino-Baker, Barstow, Iron Mountain, and Needles CREZs.

2. DEVR_MIRA_1

This 61 mile double-circuit 500 kV transmission line (circuit #1) connects Devers 500/230/115 kV substation to Mira Loma 500/230 kV substation using existing ROW for the purpose of allowing the integration and reliable transfer of renewable energy from the Imperial and Riverside counties and Baja CREZs.

3. DEVR_MIRA_2

This 61 mile double-circuit 500 kV transmission line (circuit #2) connects Devers 500/230/115 kV substation to Mira Loma 500/230 kV substation using existing ROW for the purpose of allowing the integration and reliable transfer of renewable energy from the Imperial and Riverside counties and Baja CREZs.

4. KRAM_LUGO_1

This 48 mile 500 kV transmission line (double-circuit tower, one side strung) connects SCE's upgraded Kramer 500/230/115 kV substation to Lugo 500/230 kV substation on existing corridor for the purpose of allowing the integration and reliable transfer of renewable energy from the Nevada, Owens Valley and Inyokern CREZs.

5. KRAM_WHUB_1

This 40 mile 500 kV transmission line (double-circuit tower, one side strung) connects SCE's upgraded Kramer 500/230/115 kV substation with Windhub 500/230 kV substation on existing corridor. The proposed line reliably serves the Los Angeles basin load centers by mutually sharing the Tehachapi line segments and line segments south of Kramer and west of Pisgah.

6. LUCV_LUGO_1

This 21 mile single-circuit 500 kV line connects the new Lucerne 500 kV substation to the existing Lugo 500/230 kV substation. This line is also part of the Pisgah-San Bernardino Lucerne-Lugo 500 kV lines network. The line is planned to integrate and transfer renewable power from the San Bernardino-Lucerne CREZ and also transfer renewable power from Pisgah, Mountain Pass, Iron Mountain, and Needles.

7. LUGO_VICT_2

This 15 mile single-circuit 500 kV transmission line connects SCE's existing Lugo 500/230 kV substation with LADWP's existing Victorville 500/230 kV substation on existing corridor for the purpose of providing a link between SCE and LADWP systems.

8. MIDW_KRAM_1

This 118 mile double-circuit 500 kV transmission line (circuit #1) connects PG&E's existing Midway 500/230 kV substation with SCE's upgraded Kramer 500/230/115 kV substation for transfer of renewable power between northern and southern California from multiple CREZs.

9. MIDW_KRAM_2

This 118 mile double-circuit 500 kV transmission line (circuit #2) connects PG&E's existing Midway 500/230 kV substation with SCE's upgraded Kramer 500/230/115 kV substation for transfer of renewable power between northern and southern California from multiple CREZs.

10. MIDW_WRLW_1

This 52.5 mile single-circuit 500 kV transmission line connects PG&E's existing Midway 500/230 kV substation with SCE's proposed TRTP Whirlwind 500/230 kV substation for the purpose of allowing the integration and reliable transfer of renewable energy from the Tehachapi CREZ and also delivers renewable power between northern and southern California to all load centers in California.

11. PISG_BARS1_1

This 30 mile single-circuit 500 kV transmission line connects the upgraded Pisgah 500/230 kV substation with the new Barstow 500/230 kV substation on existing corridor for the purpose of allowing the integration and reliable transfer of renewable energy from the Pisgah CREZ.

12. PISG_LUCV_1

This 47 mile single-circuit 500 kV line connects the upgraded Pisgah 500/230 kV substation to new Lucerne 500 kV substation. This line is also part of the Pisgah-San Bernardino Lucerne-Lugo 500 kV lines network. The line is planned to transfer power from CREZs at Pisgah, Mountain Pass, Iron Mountain, and Needles.

13. PISG_MIRA_1

This 97 mile single-circuit 500 kV line connects the upgraded Pisgah 500/230 kV substation to SCE's existing Mira Loma 500/230 kV substation. The line will utilize an existing corridor between Pisgah and Lugo substations for 67 miles and will also utilize 30 miles of new corridor between Lugo and Mira Loma substations.

14. VINC_MIRA_1

The 75 mile Vincent-Mira Loma 500 kV transmission line is created by building five line sections. Section 1 of this transmission line involves approximately 5 miles of tear down of the Rio Hondo-Vincent #2 220 kV line and replacement with 500 kV single-circuit construction from Vincent Substation to approximately 5 miles south of Vincent. Section 2 of this line involves approximately 23 miles of tear down of the Antelope-Mesa 220 kV transmission line and replacement with 500 kV single-circuit transmission line from approximately 5 miles south of Vincent to the Duarte Angeles National Forest area. Section 3 involves approximately 17 miles of tear down of the Antelope-Mesa 220 kV transmission line and replacement with 500 kV double-circuit construction from the Duarte Angeles National Forest area to Mesa substation. Section 4 involves 23 miles of tear down of idle Chino-Mesa 230 kV transmission and replacement with 500 kV double-circuit construction from Mesa substation to Chino substation. Section 5 involves approximately 7 miles of tear down of Chino-Mira Loma 220 kV transmission line and replacement with 500 kV double-circuit construction. The line will serve as a major link to deliver Tehachapi CREZ power to

SCE's eastern Los Angeles load centers and also serve to deliver power from CREZs in eastern counties to northern California.

Delivery Group

i. DEVR_VALL_2

This 40-mile single-circuit 500 kV line (circuit #2) connects Devers 500/230/115 kV substation to Valley 500/115 kV substation. This line segment is a component of the California portion of SCE's proposed DPV2 project. The line is planned to transfer power from CREZs at Riverside East, Imperial North, Imperial South, Imperial East, and Baja to Valley substation.

ii. DEVR_VALL_3

This 40 mile single-circuit 500 kV line (circuit #3) connects Devers 500/230/115 kV substation to Valley 500/115 kV substation. The line is planned to transfer power from CREZs at Riverside East, Imperial North, Imperial South, Imperial East, and Baja to Valley substation.

Collector Group

1. Inyo Group

i. CONT_LPIN_1

This 45 mile single-circuit 500 kV line (initially operated at 230 kV) connects SCE's upgraded Control 500/230/115 kV substation to new Lone Pine 500/230 kV substation. The line is planned to access geothermal CREZs in northern and central Nevada which will be delivered to Control substation.

ii. LPIN_INYK_1

This 53 mile single-circuit 500 kV line (initially operated at 230 kV) connects new Lone Pine 500/230 kV substation to SCE's upgraded Inyokern 500/230/115 kV substation. The line is planned to access geothermal CREZs in northern and central Nevada which will be delivered to Control substation and also access renewable power from the Owens Valley CREZ.

iii. INYK_KRAM_1

This 66 mile single-circuit 500 kV line (initially operated at 230 kV) connects SCE's upgraded Inyokern 500/230/115 kV substation to SCE's upgraded Kramer 500/230/115 kV substation. The line is planned to access geothermal CREZs in northern and central Nevada which will be delivered to Control substation and also access renewable power from the Owens Valley and Inyokern CREZs.

2. MtPass Group

i. MTPS1_BAKR1_1

This 50 mile single-circuit 500 kV line connects SCE's upgraded Mountain Pass 500/115 kV substation to SCE's upgraded Baker 500/115 kV substation. The line is planned to access and deliver renewable power from the Mountain Pass CREZ.

ii. BAKR1_BARS1_1

This 50 mile single-circuit 500 kV line connects SCE's upgraded Baker 500/115 kV substation with SCE's upgraded Barstow 500 kV substation. The line is planned to access and deliver renewable power from the Mountain Pass and San Bernardino-Baker CREZs.

iii. BARS1_LUGO_1

This 51 mile single-circuit 500 kV line connects SCE's upgraded Barstow 500 kV substation with Lugo 500/230 kV substation. The line is planned to access and deliver renewable power from the Mountain Pass, San Bernardino-Baker, and Barstow CREZs.

iv. MTPS1_ELDO_1

This 32-mile single-circuit 500 kV line connects SCE's upgraded Mountain Pass 500/115 kV substation to Eldorado 500/230/115 kV substation. The line is planned to access and deliver renewable power from the Mountain Pass CREZ to California load centers via the existing SCE 500 kV Eldorado system. This line also provides a link to the Nevada transmission system.

3. IronMt Group

i. SCEJ_CAMI_1

This 10 mile single-circuit 500 kV line connects the new SCE Junction 500 kV substation to the upgraded Camino 500/230 kV substation. The line is planned to access the Needles CREZ and transfer the renewable power to SCE Junction substation.

ii. IRMT_SCEJ_1

This 39 mile double-circuit 500 kV line (circuit #1) connects Iron Mountain 500/230 kV substation to new SCE Junction 500 kV substation. The line is planned to access the Iron Mountain CREZ and transfer the renewable power to SCE Junction substation.

iii. IRMT_SCEJ_2

This 39-mile double-circuit 500 kV line (circuit #2) connects Iron Mountain 500/230 kV substation to new SCE Junction 500 kV substation. The line is planned to access the Iron Mountain CREZ and transfer the renewable power to SCE Junction substation.

iv. SCEJ_PISG_1

This 84 mile double-circuit 500 kV line (circuit #1) connects SCE Junction 500 kV substation to Pisgah 500/230 kV substation. The line is planned to transfer renewable power from Iron Mountain and Needles CREZs to Pisgah substation.

v. SCEJ_PISG_2

This 84 mile double-circuit 500 kV line (circuit #2) connects SCE Junction 500 kV substation to Pisgah 500/230 kV substation. The line is planned to transfer renewable power from Iron Mountain and Needles CREZs to Pisgah substation.

4. Riverside Group

i. MIDP_DESC_1

This 35-mile RETI single-circuit 500 kV line connects SCE's new Midpoint 500 kV substation with the new Desert Center 500/230 kV Substation (California portion of SCE's DPV2 project). The line is planned to access CREZs from the Riverside East area.

ii. DESC_DEVR_1

This 76-mile single-circuit 500 kV line connects the Desert Center 500/230 kV substation to the Devers 500/230/115 kV substation and represents the second 500 kV line in the Devers-Palo Verde corridor (California portion of SCE's DPV2 project), in addition to SCE's existing Palo Verde-Devers single-circuit 500 kV line #1 between the Desert Center and Devers substations. The line is planned to access renewable power from the Riverside East CREZ in the Eagle Mountain area and transfers power from both the Riverside East CREZs near Midpoint substation and Eagle Mountain area.

iii. DESC_DEVR_2

This 76-mile single-circuit 500 kV line connects the Desert Center 500/230 kV substation to the Devers 500/230/115 kV substation and represents the third single-circuit 500 kV line in the Devers-Palo Verde corridor, which already includes a portion of SCE's existing Palo Verde-Devers single-circuit 500 kV line #1 between the Desert Center and Devers substations and the Desert Center-Devers single-circuit 500 kV line #1 (California portion of SCE's DPV2 project) between the Desert Center and Devers substations. The line is planned to access renewable power from the Riverside East CREZ in the Eagle Mountain area and transfers power from both the Riverside East CREZ near Midpoint substation and Eagle Mountain area.

5. Imperial Group (Excluding IID proposed 230 kV line segments)

i. IMPV_BANN_1

This 51-mile single-circuit 500 kV line connects SDG&E's upgraded Imperial Valley 500/230 kV substation to IID's upgraded Bannister 500/230/161 kV substation. This 500 kV line is in addition to IID's multiple 230 kV line upgrades. The line is planned to access and transfer renewable power from the Imperial East, Imperial South, and Baja CREZs to SCE's Devers substation.

ii. BANN_DEVR_1

This 91.2-mile single-circuit 500 kV line connects IID's upgraded Bannister 500/230/161 kV substation with SCE's Devers 500/230/115 kV substation. This 500 kV line is in addition to IID's multiple 230 kV line upgrades. The line is planned to access and transfer renewable power from the Imperial North, Imperial East, Imperial South, and Baja CREZs to SCE's Devers substation.

6. Tehachapi Group

Tehachapi transmission project segments 1-3 (also known as the Antelope Transmission Project, or ATP) are under construction. These three segments, in combination with the remaining Tehachapi Renewable Transmission (TRTP) Project segments 4-11 result in a total of 15 RETI line segments in the Tehachapi region. All 15 Tehachapi RETI line segments access and deliver renewable power from the Tehachapi CREZ to multiple load centers in California and are described below.

1. ANTE_VINC_1 – Removal of the Antelope-Vincent #1 220 kV transmission line and conversion of the 21 mile Antelope-Vincent #2 220 kV single-circuit transmission line to 500 kV operation.

2. ANTE_VINC_2 – Removal of the Antelope-Mesa 220 kV transmission line and construction of a new 17.6 mile Antelope-Vincent #2 500 kV single-circuit transmission line on a different ROW than the Antelope-Vincent #1 500 kV transmission line.

3. CHNO_MIRA_1 – Replacement of two existing 220 kV lines with new double-circuit 220 kV towers creating the 6.7 mile Chino-Mira Loma #1 and #2 transmission lines.

4. CHNO_MIRA_2 – Replacement of two existing 220 kV lines with new double-circuit 220 kV towers creating the 6.7 mile Chino-Mira Loma #1 and #2 transmission lines.

5. CHNO_MIRA_3 – Addition of the 6.7 mile Chino-Mira Loma #3 transmission line to the open side of double-circuit 500 kV Vincent-Mira Loma towers that are created for the VINC_MIRA_1 transmission line. The Chino-Mira #3 transmission line will have 500 kV construction but will be operated at 220 kV.

6. GULD_EGLR_1 – The 9.4 mile Gould-Eagle Rock 220 kV transmission line is an existing line that is created as result of the construction of the Mesa-Vincent #2 220 kV transmission line.

7. MESA_VINC_2 – Formed by partial rebuild of the Eagle Rock-Pardee 220 kV transmission line. The total line length will be 36 miles, but 18 miles of the transmission line will have 500 kV construction and the remaining 18 miles will have 220 kV construction.

8. PRDE_VINC_2 – The 33.2-mile Pardee-Vincent #2 220 kV transmission line is an existing line created as a result of the Mesa-Vincent #2 220 kV line.

9. RIOH_VINC_2 – The 32.1 Rio Hondo-Vincent #2 220 kV line is composed of 4.2 miles of existing transmission line and 27.9 miles of new transmission line.

10. WHUB_ANTE_1 – The 25.6 mile Windhub-Antelope 500 kV transmission line was created during Tehachapi segments 1-3 with 500 kV construction with planned operation at 220 kV. This transmission line is changing its operating voltage from 220 kV to 500 kV.

11. WHUB_WRLW_1- Construction of a new 16.8 mile 500 kV single-circuit line on new ROW.

12. WRLW_ANTE_1 – New 15.6 mile 500 kV single-circuit line.

13. WRLW_VINC_1 - Create 33.2 mile Whirlwind-Vincent 500 kV single-circuit transmission line by looping in existing Midway-Vincent #3 500 kV transmission line into Whirlwind substation.

14. MIDW_WRLW_1 – Described in Foundation group.

15. VINC_MIRA_1 – Described in Foundation group.

II. Central and Northern California Segments

Carrizo Area Upgrades

The electric transmission system in the Los Padres area will require incremental upgrades to accommodate development of the Carrizo A, B and Santa Barbara CREZs. The following rough outline of needs will provide for development of up to 3000 MW from these CREZs.

-The first 1100 MW of renewables connected to the proposed Carrizo switching station on the Midway – Morro Bay 230 kV lines will require reconductoring of the Carrizo – Midway section of these 230 kV lines.

-Reconductoring the Morro Bay – Gates 230 kV lines will provide for the next 1000 MW of development in this area.

-A final 1000 MW of capacity will require a new line to the bulk system. A new Carrizo – Gates 230 kV line would meet this need.

South – to – North Bulk System Upgrades

The ability to transmit renewable power from southern California resources to the northern section of the state will require incremental upgrades to the WECC designated Paths 15 and 26 and connected lines. Current use of this pathway is limited by the Midway – Gates 500 kV line which is located between Paths 15 and 26. Incremental increases in south-to-north transfer capability are to be provided from the following upgrades:

-Construct a double circuit, 500 kV line between Midway and Gregg. This will add 1250 MW of south-to-north capacity by strengthening the limiting Midway – Gates section.

-Construct a double circuit, 500 kV line between Gregg and the Bay Area by connecting to the proposed Alpha 4 substation and modify TANC's Alpha Project 500 kV line from Tracy to Alpha 4 from single circuit tower line to a double circuit tower line. This line will strengthen the bulk system north of Path 15 and increase the south-to-north transfer capability north of Midway by an additional1250 MW.

- Reconductor the Midway – Vincent 500 kV #3 line.

- Construct a double circuit 500 kV line from Midway to Kramer, to connect the outer Southern California bulk system ring north to Midway. This would increase the South – North Capability over Path 26 by about another 1000 MW.

The British Columbia - California Project involves the construction of an approximate 1000 mile HVAC and HVDC transmission project from British Columbia to Northern California and interconnects with five or six existing and proposed substations (interconnection substations).

This Project is intended to meet three primary objectives:

1. Enhance access to significant incremental renewable resources in Canada and the Pacific Northwest.

2. Improve regional transmission reliability.

3. Provide market participants with beneficial opportunities to use the facilities.

Specifically the proposed project is as follows:

a) A series-compensated (up to 70%) 500 kV HVAC Double Circuit Tower Line (DCTL) from Selkirk Substation in the southeast British Columbia to Devil's Gap near Spokane, Washington and then to the proposed Northeast Oregon (NEO) Station and string 4-conductor bundled 666 kcmil ACSR. (Northern Segment)

b) A 3000 MVA, 500 kV HVAC to +/-500 kV HVDC Converter at the NEO Station.

c) A +/-500 kV HVDC line from the NEO Station to the proposed Collinsville Substation in the San Francisco Bay Area and string 3-conductor bundle 1272 kcmil ACSR. (Southern Segment)

d) A 3000 MVA, 500 kV HVAC to +/-500 kV HVDC Converter at Collinsville Substation.

e) +/- 600 MVAR Static VAR Compensators at each of the interconnection substations: Selkirk, Devil's Gap, Neo Station, Collinsville, Tracy and Cottonwood Area (if installed).

Potential Third Terminal

f) A third HVDC terminal may be installed in the Cottonwood area in northern California consisting of a 1000-1500 MVA, 500 kV HVAC to +/- 500 kV HVDC Converter. This potential terminal could be installed at the same time as or after part of or after the CNC Project is in operation.

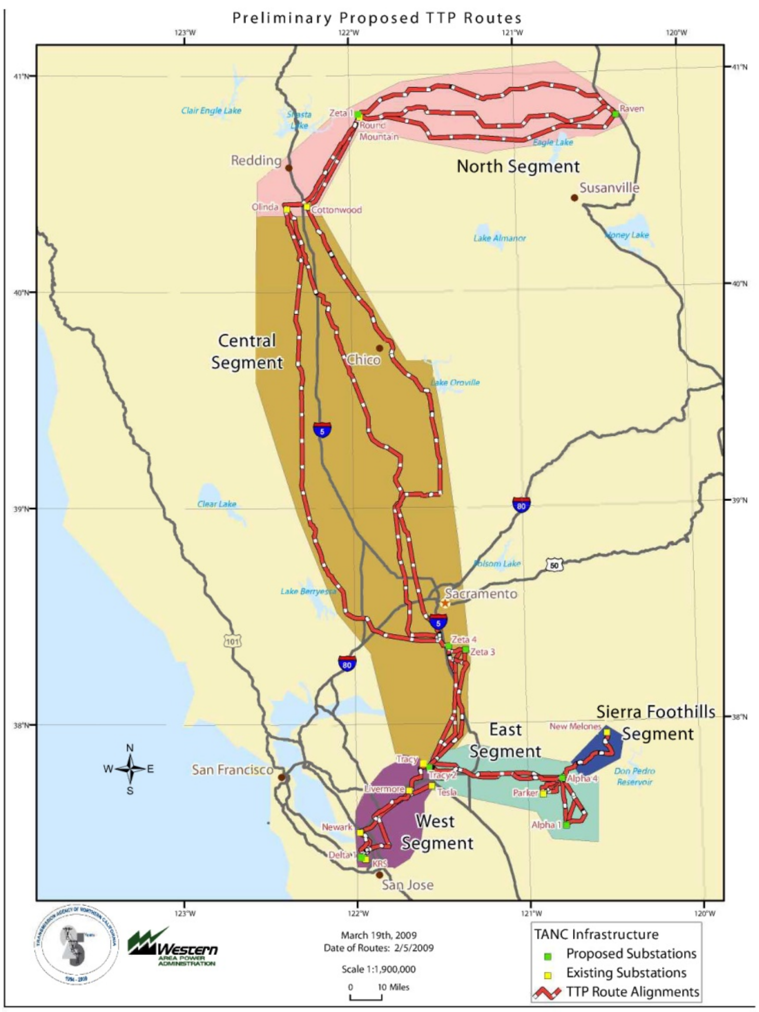
Transmission Agency of Northern California (TANC)

TANC Transmission Project (TTP)

Project Description: See Map 1

The TTP would include building and upgrading about 600 miles of 230-kilovolt (kV) and 500-kV transmission lines, substations, and related facilities. It would consist of five segments of transmission line corridor that extend from northeastern California through the Central Valley and split westward to the San Francisco Bay area and eastward to the Sierra Foothills. The proposed corridors have been identified to avoid, to the extent possible, residential and known environmentally-sensitive areas, and to take advantage of accessible competitive renewable energy zones, as recommended by the State of California's Renewable Energy Transmission Initiative. The proposed segments are further identified as: North Segment, Central Segment, West Segment, East Segment, and Sierra Foothills Segment.

Map 1

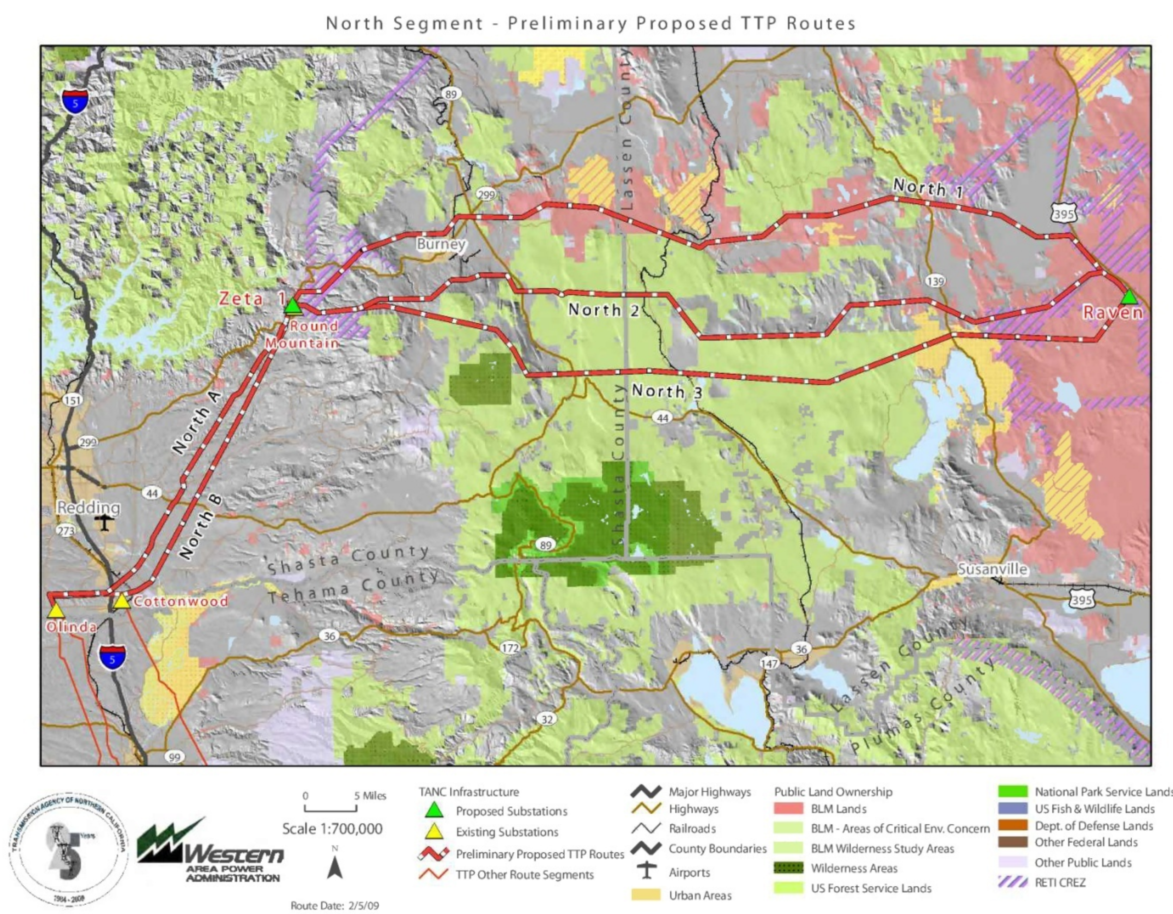


North Segment: See Map 2

The North Segment would include two, new, single-circuit, 500-kV transmission lines, each extending west from a proposed new substation near Ravendale to a proposed new substation near the Round Mountain Substation. Three corridor alternatives, each 80 to 100 miles long, have been preliminarily identified. The main purpose of these two lines in the North Segment is to connect the Lassen County North and South CREZ's to the bulk power system. The two lines are required for reliability so that the power system can withstand the loss of one of the lines without overloading the other line, or requiring the need for a remedial action scheme and generation dropping.

The North Segment would also include a new, 1-mile, single-circuit, 500-kV transmission line to interconnect the proposed new substation to the Round Mountain Substation. This new substation would serve as the connection point for the Round Mountain CREZ's. The North Segment would then continue with a new, double-circuit, 500-kV transmission line that would extend 40 to 45 miles southwest to Olinda Substation, south of the City of Redding. These lines connect the resources from the Lassen CREZ's to the Olinda Substation.

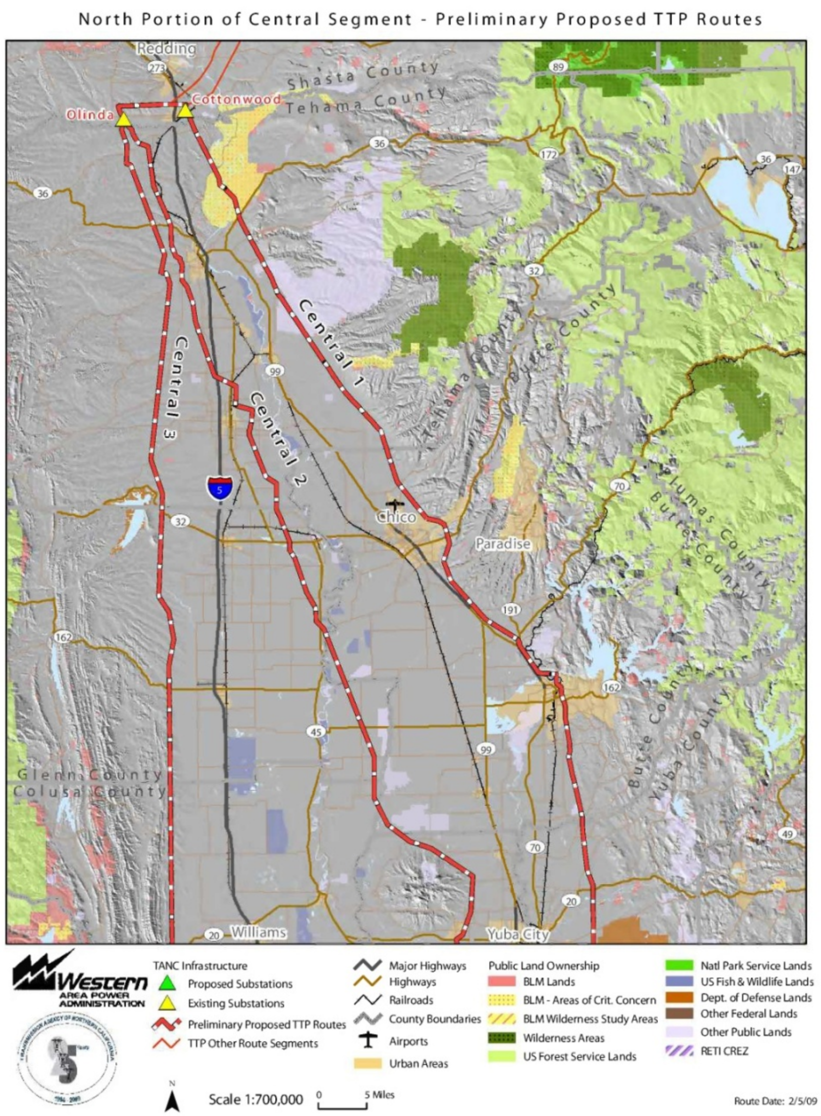
Map 2



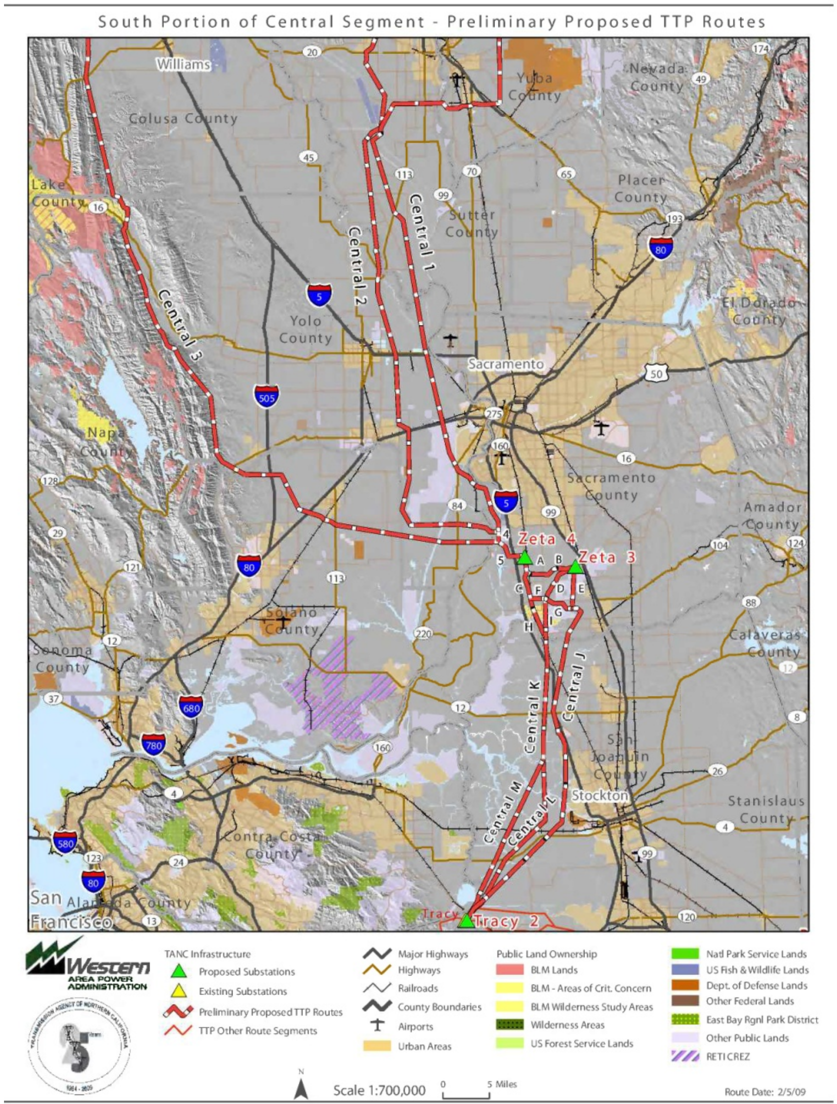
Central Segment: See Map 3 and Map 4

The Central Segment would begin at the Olinda Substation and extend south to Tracy. It would include a new, 160 to 180 mile, double-circuit, 500-kV transmission line through the Central Valley, with an interconnection to a new substation in southern Sacramento County. Three alternative corridors have been preliminarily identified for the Central Segment: the western, central, and eastern alternatives. From the proposed new substation in southern Sacramento County, each of three alternative corridors would continue 40 to 45 miles southwest to a proposed new substation near the Tracy Substation. The purpose of this line is to connect the bulk power system to the Sacramento service area to provide connection to the renewable energy in Lassen and Round Mountain. This will assist SMUD meet the green house gasses reduction and the renewable portfolio standards of 33-percent.

Map 3



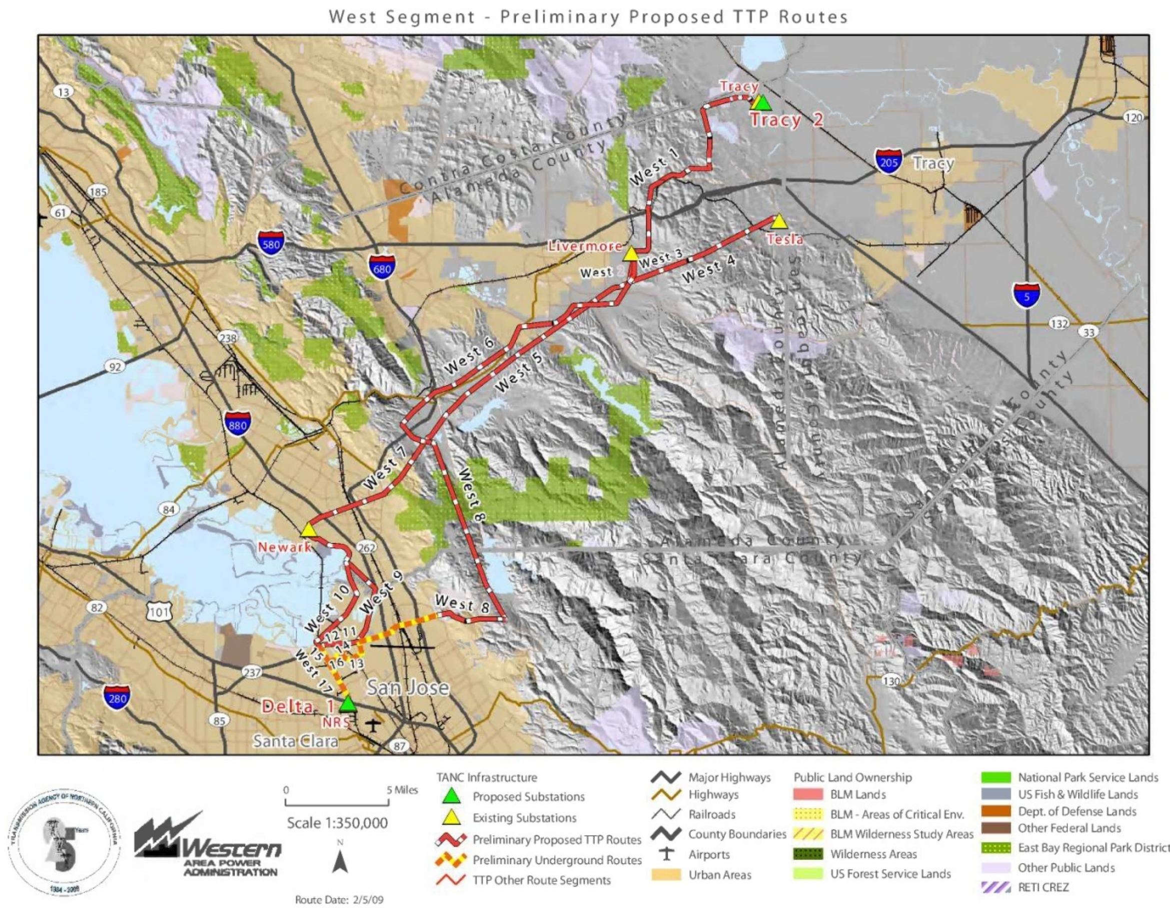
Map 4


South Portion of Central Segment - Preliminary Proposed TTP Routes
Williams
Colusa County
Yuba County
Nevada County
Placer County
Sutter County
Lake County
Central 1
Central 2
Central 3
Yolo County
El Dorado County
Sacramento
Napa County
Sacramento County
Amador County
Zeta 4
Zeta 3
Solano County
Calaveras County
Sonoma County
Central K
Central J
San Joaquin County
Stockton
Stanislaus County
Central M
Central L
Contra Costa County
San Francisco
Alameda County
Tracy
Tracy 2
Western Area Power Administration
TANC Infrastructure
Proposed Substations
Existing Substations
Preliminary Proposed TTP Routes
TTP Other Route Segments
Major Highways
Highways
Railroads
County Boundaries
Airports
Urban Areas
Public Land Ownership
BLM Lands
BLM - Areas of Crit. Concern
BLM Wilderness Study Areas
Wilderness Areas
US Forest Service Lands
Nat'l Park Service Lands
US Fish & Wildlife Lands
Dept. of Defense Lands
Other Federal Lands
East Bay Rgnl Park District
Other Public Lands
RETI CREZ
Scale 1:700,000
5 Miles
Route Date: 2/5/09

West Segment: See Map 5

The West Segment would include a double-circuit, 230-kV transmission line from the Tracy area to the South San Francisco Bay Area. The West Segment would include the rebuilding an existing single-circuit transmission line from Tracy to Livermore substation as a double-circuit line, where it would join a newly constructed single-circuit transmission line from the Tesla to the Livermore Substation area. The double-circuit transmission line would then run to the Newark substation area where one single-circuit line would terminate and the second single-circuit line would continue to a proposed new substation near the Kifer Receiving Station in Santa Clara. Two alternative corridors have been preliminary identified for this transmission line. These lines will allow delivery of renewable energy to the bay area.

Map 5



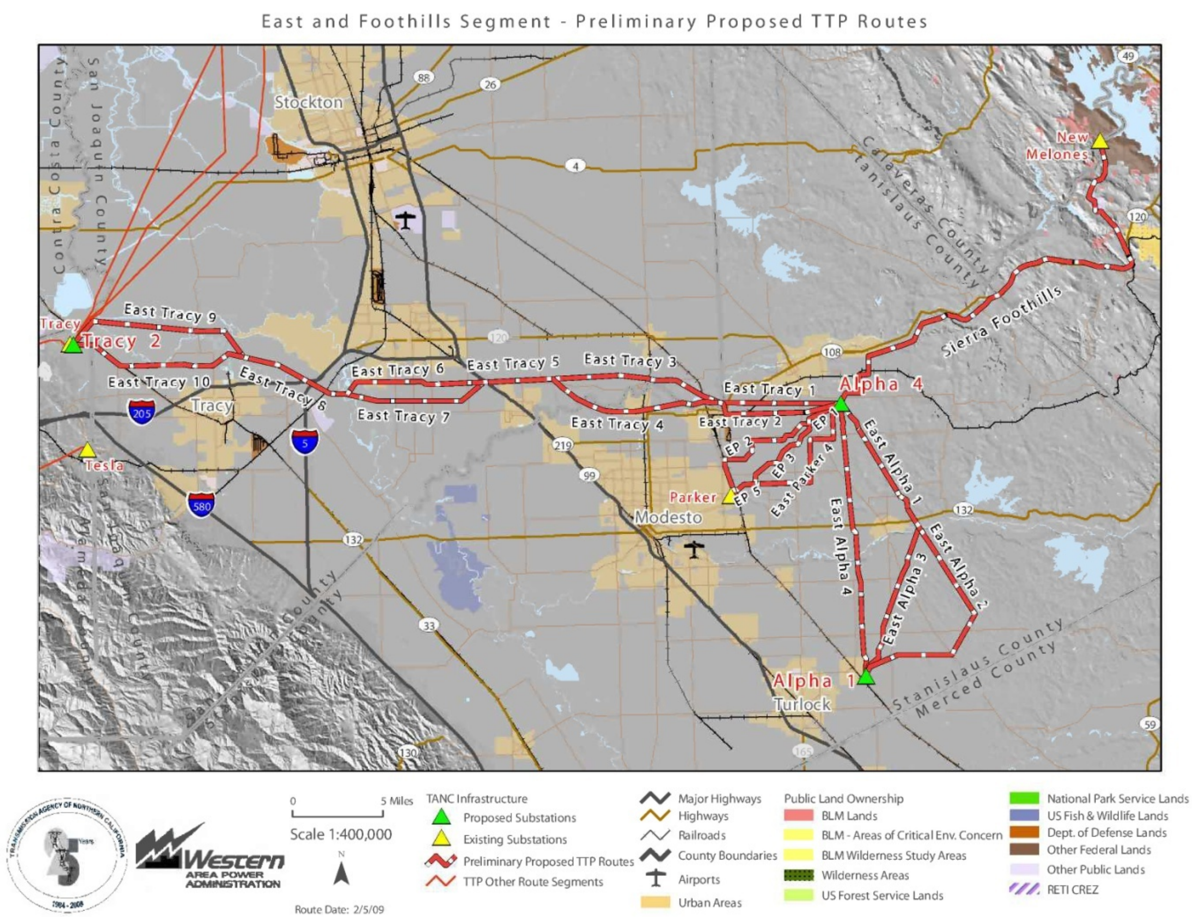
East Segment: See Map 6

The East segment would include building 40 to 45 miles of new, double-circuit, 500-kV transmission line east from the new substation near Tracy to a proposed substation located south of the Oakdale Airport. The primary purpose of this line is to deliver renewable energy from the Tracy area to the customer service areas of Modesto and Turlock. Two corridor alternatives have been preliminarily identified for the proposed 500-kV transmission line. From the new substation, the East Segment would split into two alignments: a 7 to 11 mile, double-circuit, 230-kV transmission line would run to the Parker Substation in Modesto, thus providing for deliveries of renewable energy to Modesto; and a 15 to 22 mile, double-circuit, 230-kV line would run to a proposed new substation located east of Turlock, thus providing for deliveries of renewable energy to Turlock. Three corridor alternatives have been preliminarily identified for each of the two, proposed, 230-kV transmission lines.

Sierra Foothills Segment: See Map 6

The Sierra Foothills Segment would include a new, double-circuit, 230-kV transmission line, approximately 28 miles long. It would originate at the proposed substation near the Oakdale Airport and extend through the Sierra Foothills to Western's existing substation at the New Melones Dam. Alternative corridors for this segment have not been identified at this time.

Map 6



Appendix H. Line Segment Data

Segment ID#	Line Segment Short Name	Length (Miles)	Cost ($Million)	On-line Date	Enviro Score
1	ALPH4_ALPH1_1	22	34.38	2014	80
2	ALPH4_ALPH1_2	22	34.38	2014	1
3	ALPH4_PARK_1	11	17.19	2014	80
4	ALPH4_PARK_2	11	17.19	2014	1
5	ANTE_VINC_1	21	16.28	2013	2
6	ANTE_VINC_2	17.6	68.20	2013	2
7	AV58_CHCV_1	17.5	32.81	2014	4
8	BAKR1_BARS1_1	50	193.75	2015	48
9	BANN_AV58_1	61	107.41	2014	36
10	BANN_CHCV_1	56.2	140.22	2014	36
11	BANN_DEVR_1	91.2	296.40	2020	216
12	BANN_ELCN_1	27.5	51.56	2013	16
13	BANN_GEO_1	16	25.00	2013	120
14	BANN_GEO_2	16	25.00	2013	1
15	BARS1_KRAM_1	40	130.00	2015	72
16	BARS1_LUGO_1	51	286.88	2015	108
17	BRNR_HASC_1	60	40.50	2013	72
18	BRNR_HASC_2	60	150.00	2013	3
19	CAST_HASC_2	12	7.50	2013	1
20	CHCV_DVR2_1	35	54.69	2014	72
21	CHCV_DVR2_2	35	54.69	2014	2
22	CHCV_MIRG_1	20	13.50	2013	3
23	CHCV_MIRG_2	20	13.50	2013	3
24	CHNO_MIRA_1	6.7	14.66	2013	8
25	CHNO_MIRA_2	6.7	14.66	2013	1
26	CHNO_MIRA_3	6.7	30.53	2013	1
27	CMPL_ECND_1	37	24.98	2013	2
28	CMPL_ECND_2	37	23.13	2013	2
29	CMPL_TALG_1	10	6.75	2013	1
30	CMPL_TALG_2	10	6.25	2013	1
31	COLL_PITT_1	1	1.56	2020	40
32	COLL_PITT_2	1	1.56	2020	1
33	COLL_TRCY2_1	40	130.00	2020	96
34	CONT_LPIN_1	45	202.50	2015	4
35	DESC_DEVR_1	76	247.00	2013	72
36	DESC_DEVR_2	76	247.00	2020	3
37	DEVR_DVR2_1	0.3	0.98	2014	12

Segment ID#	Line Segment Short Name	Length (Miles)	Cost ($Million)	On-line Date	Enviro Score
38	DEVR_MIRA_1	61	190.63	2015	24
39	DEVR_MIRA_2	61	190.63	2017	3
40	DEVR_VALL_2	40	130.00	2013	48
41	DEVR_VALL_3	40	130.00	2020	12
42	DILL_TRCY2_1	43	139.75	2014	144
43	DIXL_BANN_1	43	51.56	2013	8
44	DVR2_CENT_1	175	308.19	2014	288
45	DVR2_VICT_1	133	279.84	2014	150
46	ELCN_HILN_1	19	35.63	2013	4
47	ELCN_HILN_2	19	35.63	2013	1
48	ELCN_IMPV2_2	18	33.75	2013	4
49	GATE_MBAY_1	70	47.25	2012	12
50	GREG_ALPH4_1	100	312.50	2016	144
51	GREG_ALPH4_2	100	312.50	2016	3
52	GULD_EGLR_1	9.4	3.53	2013	1
53	HASC_RNLD_1	15	10.13	2013	1
54	IMPV_BANN_1	51	165.75	2020	216
55	IMPV_XFMR_2	0.0246	51.25	2011	0
56	IMPV_XFMR_3	0.0246	51.25	2012	0
57	INYK_KRAM_1	66	214.50	2015	72
58	IRMT_SCEJ_1	39	134.06	2015	12
59	IRMT_SCEJ_2	39	134.06	2020	2
60	KRAM_LUGO_1	48	270.00	2015	48
61	KRAM_WHUB_1	40	225.00	2015	80
62	LELK_CMPL_1	31	100.75	2013	240
63	LIVR_DELT_1	17	31.88	2014	144
64	LPIN_INYK_1	53	238.50	2015	12
65	LUCV_LUGO_1	21	65.63	2015	36
66	LUGO_VICT_2	15	48.75	2015	8
67	MESA_VINC_2	36	126.00	2013	6
68	MIDP_DESC_1	35	113.75	2013	48
69	MIDW_CARZ_1	46	31.05	2011	8
70	MIDW_GEO_1	16	25.00	2012	80
71	MIDW_GEO_2	16	25.00	2012	1
72	MIDW_GREG_1	141	440.63	2016	192
73	MIDW_GREG_2	141	440.63	2016	4
74	MIDW_KRAM_1	118	368.75	2015	144
75	MIDW_KRAM_2	118	368.75	2015	4
76	MIDW_WRLW_1	72.8	28.21	2013	36
77	MIRG_DEVR_1	15	10.13	2013	1

Segment ID#	Line Segment Short Name	Length (Miles)	Cost ($Million)	On-line Date	Enviro Score
78	MIRG_DEVR_2	15	10.13	2013	1
79	MTPS1_BAKR1_1	50	193.75	2015	48
80	MTPS1_ELDO_1	32	124.00	2012	48
81	NEO_COLL_1	640	2080.00	2020	180
82	OLND_DILL_1	183	594.75	2014	480
83	PISG_BARS1_1	30	97.50	2015	72
84	PISG_LUCV_1	47	146.88	2015	216
85	PISG_MIRA_1	97	375.63	2014	144
86	PRDE_VINC_2	33.2	16.60	2013	2
87	RIOH_VINC_2	32.1	124.39	2013	16
88	SCEJ_CAMI_1	10	38.75	2015	6
89	SCEJ_PISG_1	84	262.50	2015	108
90	SCEJ_PISG_2	84	262.50	2020	3
91	SELK_NEO_1	270	843.75	2020	120
92	SELK_NEO_2	270	843.75	2020	5
93	TESL_NEWK_1	29	54.38	2014	32
94	TRCY2_ALPH4_1	45	140.63	2014	160
95	TRCY2_ALPH4_2	45	140.63	2016	2
96	TRCY2_LIVR_1	13	24.38	2014	4
97	TRCY2_TRCY_1	1	3.25	2014	8
98	VINC_MIRA_1	75	414.03125	2013	12
99	WHUB_ANTE_1	25.6	16.64	2013	2
100	WHUB_WRLW_1	16.8	54.6	2013	12
101	WRLW_ANTE_1	15.6	50.7	2013	24
102	WRLW_VINC_1	33.2	10.79	2013	2
103	ZETA1_OLND_1	42	136.5	2014	96
104	ZETA1_RDMT_1	1	3.25	2014	24

Appendix I. List of Component Facilities

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Build new 230 kV Alpha 4-Alpha 1 #1 line (22 miles)	Alpha4-Alpha1_1	ALPH4_ALPH1_1
Build new 230 kV Alpha 4-Alpha 1 #2 line (22 miles)	Alpha4-Alpha1_2	ALPH4_ALPH1_2
Build new 230 kV Alpha 4-Parker #1 line (11 miles)	Alpha4-Parker_1	ALPH4_PARK_1
Build new 230 kV Alpha 4-Parker #2 line (11 miles)	Alpha4-Parker_2	ALPH4_PARK_2
Removal of existing Antelope-Vincent No.1 220 kV T/L and conversion of 21 mile Antelope-Vincent No.2 220 T/L, which was previously constructed at 500 kV and operated at 220 kV, to 500 kV operation. Costs are for 220 kV line tear down and Voltage change (termination cost used). (21 miles)	Antelope-Vincent_1_replace	ANTE_VINC_1
Tear down Antelope-Mesa 220 kV line and construct new 500 kV Antelope-Vincent #2 line (17.6 miles)	Antelope-Vincent_2	ANTE_VINC_2
Rebuild existing Avenue 58-Coachella Valley 161 kV line from Avenue 58 substation to Coachella Valley substation with double-circuit 230 kV towers to create a 230 kV Avenue 58-Coachella Valley #1 line (17.5 miles)	Ave58-CoachellaValley_1_rebuild	AV58_CHCV_1
Replace existing Coolwater-Black Mountain lines with new 500 kV Baker1-Barstow1 #1 line (50 miles) between Baker and Barstow.	Baker1-Barstow1_replace	BAKR1_BARS1_1
Rebuild existing El Centro-Avenue 58 161 kV line from Avenue 58 substation south as far as Bannister with double-circuit 230 kV towers and connect rebuilt line to Bannister substation creating a 230 kV Bannister-Avenue 58 #1 line (61 miles)	Bannister-Ave58_1_rebuild	BANN_AV58_1
Add 230 kV Bannister-Coachella Valley #1 line on open side of new 230 kV structures between (i) Bannister and Ave 58 substation area, and (ii) Ave 58 substation area and Coachella Valley substation (56.2 miles)	Bannister-CoachellaValley_1	BANN_CHCV_1
Add 500 kV Bannister-Devers #1 line (91.2 miles)	Bannister-Devers_1	BANN_DEVR_1
Add 230 kV Bannister-El Centro #1 line on open side of new towers (27.5 miles)	Bannister-ElCentro_1	BANN_ELCN_1
Add 230 kV Bannister-Geo #1 line (16 miles)	Bannister-Geo_1	BANN_GEO_1
Add 230 kV Bannister-Geo #2 line (16 miles)	Bannister-Geo_2	BANN_GEO_2
Build new 500 kV Barstow1-Kramer #1 line, 40 miles using single-circuit towers	Barstow1-Kramer_1	BARS1_KRAM_1
Build new 500 kV Barstow1-Lugo #1 line with double circuit towers (51 miles)	Barstow1-Lugo_1	BARS1_LUGO_1
Upgrade existing 230 kV Owens Gorge-Rinaldi line from Barren Ridge Switching Station to Haskell Canyon switching station (60 miles)	BarrenRidge-HaskellCanyon_upgrade	BRNR_HASC_1
Build 230 kV Barren Ridge Switching Station-Haskell Canyon #2 line with double circuit towers (60 miles)	BarrenRidge-HaskellCanyon_2	BRNR_HASC_2
Add 230 kV Castaic Power Plant-Haskell Canyon #2 line on open side of towers (12 miles)	Castaic_HaskellCanyon_2	CAST_HASC_2
Add Coachella Valley-DeversII 230 kV line #1 (35 miles)	CoachellaValley-DeversII_1	CHCV_DVR2_1
Add Coachella Valley-DeversII 230 kV line #2 (35 miles)	CoachellaValley-DeversII_2	CHCV_DVR2_2
Upgrade existing 230 kV Coachella Valley-Mirage #1 (20 miles)	CoachellaValley-Mirage_1_upgrade	CHCV_MIRG_1
Upgrade existing 230 kV Coachella Valley-Mirage #2 (20 miles)	CoachellaValley-Mirage_2_upgrade	CHCV_MIRG_2

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Replace two existing single-circuit 220 kV lines with new double-circuit 220 kV towers creating new 220 kV Chino-Mira Loma #1 line. Requires relocating several existing 66 kV lines near Chino substation. (6.7 miles) (segment 8B)	Chino-MiraLoma_1_replace	CHNO_MIRA_1
Add new 230 kV Chino-Mira Loma #2 line on open side of new double-circuit 230 kV towers. (6.7 miles) (segment 8A)	Chino-MiraLoma_2	CHNO_MIRA_2
Add new 220 kV Chino-Mira Loma #3 line on open side of new 500 kV towers. (6.7 miles) (segment 8B)	Chino-MiraLoma_3	CHNO_MIRA_3
Reconductor existing 230 kV Talega-Escondido #1 line between Escondido and new Camp Pendleton substation (37 miles)	CampPendleton-Escondido_upgrade	CMPL_ECND_1
Add new 230 kV Camp Pendleton-Escondido #2 line on open side of existing towers (37 miles)	CampPendleton-Escondido_2	CMPL_ECND_2
Reconductor existing 230 kV Talega-Escondido #1 line between Talega and new Camp Pendleton substation (10 miles)	CampPendleton-Talega_upgrade	CMPL_TALG_1
Add new 230 kV Camp Pendleton-Talega #2 line on open side of existing towers (10 miles)	CampPendleton-Talega_2	CMPL_TALG_2
Build Collinsville-Pittsburgh 230 kV line #1 (1 mile)	Collinsville-Pittsburgh_1	COLL_PITT_1
Build Collinsville-Pittsburgh 230 kV line #2 (1 mile)	Collinsville-Pittsburgh_2	COLL_PITT_2
Build new Collinsville-Tracy2 area 500 kV line (40 miles)	Collinsville-Tracy2_1	COLL_TRCY2_1
Replace two existing 115 kV Control-Inyokern lines between Control and new Lone Pine substation with a new 230 kV Control-Lone Pine #1 line built to 500 kV specifications (45 miles)	Control-LonePine_1_rebuild	CONT_LPIN_1
Build 500 kV Desert Center-Devers #1 line (76 miles) on single-circuit towers (one segment of the recently modified California portion of the Palo Verde-Devers #2 project)	DesertCenter-Devers_1	DESC_DEVR_1
Build 500 kV Desert Center-Devers #2 line (76 miles) on single-circuit towers for the RETI proposed new line west of Devers Center.	DesertCenter-Devers_2	DESC_DEVR_2
Connect Devers and DeversII substations with a 500 kV tie (0.3 miles)	Devers-DeversII_1	DEVR_DVR2_1
Build new 500 kV Devers-Mira Loma #1 line with double-circuit towers (61 miles)	Devers-MiraLoma_1	DEVR_MIRA_1
Add new 500 kV Devers-Mira Loma #2 line on open-side of towers (61 miles)	Devers-MiraLoma_2	DEVR_MIRA_2
Add new 500 kV Devers-Valley #2 line on single-circuit towers (40 miles)	Devers_Valley_2	DEVR_VALL_2
Add a 500 kV Devers-Valley #3 line using single-circuit towers (40 miles) for the RETI proposed new line west of Devers.	Devers-Valley_3	DEVR_VALL_3
Build new 500 kV Dillard Road-Tracy2 #1 line (43 miles)	DillardRoad-Tracy2_1	DILL_TRCY2_1
Disconnect Dixieland-El Centro 230 kV line from El Centro substation and (i) rebuild existing El Centro-Avenue 58 161 kV line north as far as Bannister with double-circuit 230 kV towers, and (ii) connect rebuilt line to Bannister substation creating a Dixieland-Bannister 230 kV line (43 miles)	Dixieland-Bannister_rebuild	DIXL_BANN_1
Build new 230 kV Green Path North #2 line from DeversII to Century 230 kV bus (175 miles) (Includes (a) 95 miles of circuit on open side of new double circuit towers, (b) 10 miles of new underground construction in the Upland area, and (c) removing and restringing 70 miles of an existing 287 kV Victorville-Century #2 line and operating restrung line at 230 kV)	DeversII-Century_1	DVR2_CENT_1

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Build new 230 kV Green Path North #1 line from DeversII to Victorville 230 kV bus (133 miles) (Includes (a) 95 miles of new double circuit towers, (b) 10 miles of new underground construction in the Upland area, and (c) removing and restringing 28 miles of an existing 287 kV Victorville-Century #2 line and operating restrung line at 230 kV)	DeversII-Victorville_1	DVR2_VICT_1
Rebuild existing El Centro-Pilot Knob 161 kV line east as far as Highline substation with double-circuit 230 kV towers and connect to Highline substation creating 230 kV El Centro-Highline #1 line (19 miles)	ElCentro-Highline_1_upgrade	ELCN_HILN_1
Add 230 kV El Centro-Highline #2 line on open side of new towers (19 miles)	ElCentro-Highline_2	ELCN_HILN_2
Add 230 kV El Centro-Imperial ValleyII #2 line (18 miles)	ElCentro-ImperialValleyII_2	ELCN_IMPV2_2
Reconductor existing Morro Bay-Gates 230 kV line (will accommodate the next 1000 MW of development in this area) (70 miles)	Gates-MorroBay_1_upgrade	GATE_MBAY_1
Build new 500 kV Gregg-Alpha 4 line #1 (100 miles, two 2300 kcmil AAL bundled conductors)	Gregg-Alpha4_1	GREG_ALPH4_1
Build new 500 kV Gregg-Alpha 4 line #2 on the opposite side of the towers (100 miles, two 2300 kcmil AAL bundled conductors)	Gregg-Alpha4_2	GREG_ALPH4_2
Add new 220 kV Gould-Eagle Rock #1 line created from reconfiguration of existing line (Termination Cost only, 9.4 miles, $3.5)	Gould-EagleRock_1	GULD_EGLR_1
Upgrade existing 230 kV Owens Gorge-Rinaldi line from Haskell Canyon switching station to Rinaldi (15 miles)	HaskellCanyon_Rinaldi_upgrade	HASC_RNLD_1
Add 500 kV Imperial Valley-Bannister #1 line (51 miles)	ImperialValley-Bannister_1	IMPV_BANN_1
Replace existing 500/230 kV 600 MVA Imperial Valley transformer with a new 1120 MVA transformer	ImperialValley_xfmr_2_upgrade	IMPV_XFMR_2
Add third 500/230 kV Imperial Valley transformer (1120 MVA)	ImperialValley_xfmr_3	IMPV_XFMR_3
Build new 500 kV Inyokern-Kramer #1 line (66 miles)	Inyokern-Kramer_1	INYK_KRAM_1
Rebuild existing 230 kV Iron Mountain-Camino line with new double circuit 500 kV towers (39 miles) between Iron Mountain and Edison Junction creating a 500 kV Iron Mountain-Edison Junction #1 line	IronMountain-EdisonJunction_1_rebuild	IRMT_SCEJ_1
Add 500 kV Iron Mountain-Edison Junction #2 line on open side of towers (39 miles)	IronMountain-EdisonJunction_2	IRMT_SCEJ_2
Build new 500 kV Kramer-Lugo #1 line with double circuit towers (48 miles)	Kramer-Lugo_1	KRAM_LUGO_1
Build new 500 kV Kramer-Windhub #1 line with double circuit towers (38 miles)	Kramer-Windhub_1	KRAM_WHUB_1
Build new Talega-Escondido/Valley-Serrano 500 kV line (31 miles)	LeeLake-CampPendleton_1	LELK_CMPL_1
Build new 230 kV Livermore-Delta #1 line (17 miles)	Livermore-Delta_1	LIVR_DELT_1
Replace two existing 115 kV Control-Inyokern lines between new Lone Pine substation and Inyokern with a new 230 kV Lone Pine-Inyokern #1 line built to 500 kV specifications (53 miles)	LonePine-Inyokern_1_rebuild	LPIN_INYK_1
Build new 500 kV Lucerne Valley-Lugo #1 line with double circuit towers (21 miles) (Scored as double circuit 500 kV/2)	LucerneValley-Lugo_1	LUCV_LUGO_1
Build Lugo-Victorville 500 kV #2 (24 miles)	Lugo-Victorville_2	LUGO_VICT_2
Partial rebuild of Eagle Rock-Pardee from Vincent to Gould and partial stringing of new conducter on vacant tower positions from Gould to Mesa. 18 miles 230 kV construction and 18 miles 500 kV construction.	Mesa_Vincent_2	MESA_VINC_2

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Build 500 kV SCE Midpoint-Desert Center #1 line (35 miles) on single-circuit towers (one segment of the recently modified California portion of Palo Verde-Devers #2 project. Desert Center was relocated to reduce gen-tie lengths from Eagle Mountain renewable area resources under Riverside East CREZ).	Midpoint-DesertCenter_1	MIDP_DESC_1
Reconductor Carrizo-Midway section of existing 230 kV line (will accommodate first 1100 MW of renewables connected to Carrizo switching station) (46 miles)	Midway-Carrizo_1_upgrade	MIDW_CARZ_1
Build new 230 kV Midway-Geo #1 line with double-circuit 230 kV towers (16 miles)	Midway-Geo_1	MIDW_GEO_1
Add 230 kV Midway-Geo #2 line on open side of new 230 kV towers (16 miles)	Midway-Geo_2	MIDW_GEO_2
Construct new 500 kV Midway-Gregg #1 line (141 miles, two 2300 kcmil AAL bundled conductors)	Midway-Gregg_1	MIDW_GREG_1
Construct new 500 kV Midway-Gregg #2 line on the opposite of the towers (141 miles, two 2300 kcmil AAL bundled conductors)	Midway-Gregg_2	MIDW_GREG_2
Build new 500 kV Midway-Kramer #1 line with double circuit towers (118 miles)	Midway-Kramer_1	MIDW_KRAM_1
Add new 500 kV Midway-Kramer #2 line on open side of towers (118 miles)	Midway-Kramer_2	MIDW_KRAM_2
Construct approximately 2 miles of new 500kV single-circuit T/L to loop the existing Midway-Vincent No.3 500kV T/L in-an-out of the new Whirlwind 500kV Substation (total line length is 70.8 mi).	Midway-Whirlwind_1_upgrade	MIDW_WRLW_1
Upgrade existing 230 kV Mirage-Devers #1 (15 miles)	Mirage-Devers_1_upgrade	MIRG_DEVR_1
Upgrade existing 230 kV Mirage-Devers #2 (15 miles)	Mirage-Devers_2_upgrade	MIRG_DEVR_2
Replace existing 115 kV Coolwater-El Dorado line with new 500 kV Mountain Pass1-Baker1 #1 line (50 miles) between Mountain Pass and Baker.	MountainPass1-Baker1_replace	MTPS1_BAKR1_1
Replace existing 115 kV Coolwater-El Dorado line with new 500 kV Mountain Pass1-El Dorado # 1 line between Mountain Pass and El Dorado (32 miles).	MountainPass1-ElDorado_1_replace	MTPS1_ELDO_1
Build a new +/- 500 kV DC NEO-Collinsville line (3-conductor bundle 1272 kcmil ACSR (640 miles)	NEO-Collinsville_1	NEO_COLL_1
Build new 500 kV Olinda-Dillard Road #1 line (183 miles)	Olinda-DillardRoad_1	OLND_DILL_1
Build new 500 kV Pisgah-Barstow1 #1 line, 30 miles using single-circuit towers	Pisgah-Barstow1_1	PISG_BARS1_1
Build new 500 kV Pisgah-Lucerne Valley #1 line with double circuit towers (47 miles) (Scored as double circuit 500 kV/2)	Pisgah-LucerneValley_1	PISG_LUCV_1
Build new 500 kV Pisgah-Mira Loma #1 line using open side of new towers between (i) Pisgah and Lucerne Valley substation area, and (ii) Lucerne Valley substation area and Lugo substation area (bypassing both Lucerne Valley and Lugo substations) and (iii) on new 500 kV double circuit towers between Lugo substation area and Mira Loma (97 miles) (Scored as double circuit 500 kV/2 between Pisgah and Lugo + double circuit 500 kV with open side between Lugo and Mira Loma)	Pisgah-MiraLoma_1	PISG_MIRA_1
33.2 mile portion of existing Eagle Rock-Pardee 230 kV line between Pardee and Vincent. (Termination costs only)	Pardee_Vincent_2	PRDE_VINC_2
27.9 mi rebuild of Antelope-Mesa 230 kV plus 4.2 miles of existing line (32.1 miles total)	Rio Hondo_Vincent_2	RIOH_VINC_2

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Rebuild existing 230 kV Iron Mountain-Camino line with new 500 kV towers between Edison Junction and Camino (10 miles) creating a 500 kV Camino-Edison Junction #1 line	EdisonJunction-Camino_1_rebuild	SCEJ_CAMI_1
Build 500 kV SCE Junction-Pisgah #1 line with double circuit towers (84 miles)	EdisonJunction-Pisgah_1	SCEJ_PISG_1
Add 500 kV Edison Junction-Pisgah #2 line on open side of towers (84 miles)	EdisonJunction-Pisgah_2	SCEJ_PISG_2
Build a new series compensated (up to 70%) 500 kV Selkirk-Devil's Gap-NEO line #1 (4-conductor bundled 666 kcmil ACSR) (270 miles)	Selkirk-NEO_1	SELK_NEO_1
Build a new series compensated (up to 70%) 500 kV Selkirk-Devil's Gap-NEO line #2 (4-conductor bundled 666 kcmil ACSR) (270 miles)	Selkirk-NEO_2	SELK_NEO_2
Build new 230 kV Tesla-Newark #1 line (29 miles)	Tesla-Newark_1	TESL_NEWK_1
Build new 500 kV Tracy2-Alpha 4 #1 line (45 miles)	Tracy2-Alpha4_1	TRCY2_ALPH4_1
Modify towers to accommodate a second 500 kV line and add 500 kV Tracy2-Alpha 4 #2 line on opposite side of towers (45 miles)	Tracy2-Alpha4_2	TRCY2_ALPH4_2
Build new 230 kV Tracy2-Livermore #1 line (13 miles)	Tracy2-Livermore_1	TRCY2_LIVR_1
Connect new Tracy2 substation and existing Tracy substation with a short 500 kV line (1 mile)	Tracy2-Tracy_1	TRCY2_TRCY_1
Section 1 = From Vincent to 5 miles south of Vincent (5 miles, Replace Rio Hondo-Vincent No.2 230kV with 500kV single-circuit construction). Section 2 = 5 miles south of Vincent to Duarte (ANF) (23 miles, Replace Antelope-Mesa 230kV with 500kV single-circuit construction). Section 3 = Duarte (ANF) to Mesa (17 miles, Replace Antelope-Mesa 230kV with 500kV double-circuit construction). Section 4 = Mesa to Chino (23 miles, Replace idle Chino-Mesa 230kV with 500kV double-circuit construction). Section 5 = Chino to Mira Loma (7 miles, Replace Chino-Mira Loma 230 kV with 500kV double-circuit construction).	Vincent-MiraLoma_1_replace	VINC_MIRA_1
Existing line with 500kV construction changing voltage operation from 220 to 500kV. Using termination cost (25.6 mi). -Kevin Richardson (SCE) 626-302-0366	Windhub_Antelope_1	WHUB_ANTE_1
Build new 500 kV Windhub-Whirlwind #1 line (16.8 miles) (segment 10)	Windhub_Whirlwind_1	WHUB_WRLW_1
Build new 500 kV Whirlwind-Antelope #1 line (15.6 miles) (segment 4)	Whirlwind-Antelope_1	WRLW_ANTE_1
Termination cost (Whirlwind side only) for looping in existing Midway-Vincent #3 line into Whirlwind (33.2 miles) -Kevin Richardson (SCE) 626-302-0366	Whirlwind_Vincent_1	WRLW_VINC_1
Build new 500 kV Zeta 1-Olinda #1 line (42 miles)	Zeta1-Olinda_1	ZETA1_OLND_1
Connect new Zeta 1 substation and existing Round Mountain substation with a short 500 kV line (1 mile)	Zeta1-RoundMountain_1	ZETA1_RDMT_1
Construct new 230/500 kV Desert Center substation looping-in existing Devers-Palo Verde #1 right-of-way due south of Julian Hinds substation. This substation will terminate the new 500 kV Midpoint-Desert Center #1 line (which is one segment of the recently modified Palo Verde-Devers #2 project), the new Desert Center-Devers #1 line (which is one segment of the recently modified Palo Verde-Devers #2 project), and the new 500 kV Desert Center-Devers #2 project. (Generation from the Riverside East CREZ that is located in the Eagle Mountain area is assumed to be connected to the new DesertCenter_sub with a trunk line.)	DesertCenter_sub	

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Construct new 500 kV Midpoint substation looping in existing 500 kV Palo Verde-Devers #1 line creating 500 kV Palo Verde-SCE Midpoint #1 and 500 kV SCE Midpoint-Devers #1 lines. Also terminates new 500 kV Midpoint-Desert Center #1 line (which is one segment of the recently modified Palo Verde-Devers #2 project).	Midpoint_loop-in	
Expand Devers substation to terminate 500 kV Devers-DeverII #1 line, 500 kV Devers-Valley #3, 500 kV Bannister-Devers #1 line, 500 kV Desert Center-Devers #1 line (one segment of the recently modified Palo Verde-Devers #2 project), 500 kV Desert Center-Devers #2 line, and 500 kV Devers-Mira Loma #1 and #2 lines. (The 500 kV Eagle Mountain2-Devers #1 line and 500 kV Eagle Mountain2-Devers #2 line will also terminate at Devers substation but are considered trunk lines for RETI purposes.)	Devers_sub_expand	
Expand Valley substation to terminate 500 kV Devers-Valley #3 line and 500 kV Devers-Valley #2 line	Valley_sub_expand	
Upgrade Camino substation with 500 kV capability	Camino_sub_upgrade	
Upgrade Iron Mountain substation with 500 kV capability	IronMountain_sub_upgrade	
Construct -100/+500 MVAR SVC at Iron Mountain	IronMountain_SVC	
Construct new 500 kV EdisonJunction switching station between Iron Mountain and Camino substations in the existing Iron Mountain-Camino right-of-way	EdisonJunction_sub	
Construct new Baker1 substation looping in 500 kV rebuild of existing 115 kV Coolwater-El Dorado line	Baker1_sub	
Construct new Baker2 substation looping in existing 500 kV Adelanto-Marketplace #1 line	Baker2_sub	
Construct new 500 kV Mountain Pass1 substation looping in 500 kV rebuild of 115 kV Coolwater-El Dorado line	MountainPass1_sub	
Construct new 287 kV Mountain Pass2 substation looping in LADWP's existing 287 kV Victorville-Mead line.	MountainPass2_sub	
Build new 500 kV Barstow1 substation connecting 500 kV rebuild of 115 kV Coolwater-El Dorado line. Also terminates new 500 kV Barstow1-Lugo #1 line, new 500 kV Pisgah-Barstow1 #1 line, and new 500 kV Barstow1-Kramer_1 line.	Barstow1_sub	
Build new 500 kV Barstow2 substation looping in existing 500 kV Adelanto-Marketplace #1 line	Barstow2_sub	
Expand Lugo substation to terminate 500 kV Barstow1-Lugo #1, 500 kV Lucerne Valley-Lugo #1, 500 kV Kramer-Lugo #1, and 500 kV Lugo-Victorville #2 lines	Lugo_sub_expand	
Connect Twentynine Palms CREZ to new Lucerne Valley substation with a trunk line.		
Construct new 500 kV Pisgah substation looping in existing 500 kV Eldorado-Lugo and Mohave-Lugo lines. New substation also terminates new 500 kV Edison Junction-Pisgah #1 and #2 lines, new 500 kV Pisgah-Barstow1 #1 line, new 500 kV Pisgah-Lucerne Valley #1 line and new 500 kV Pisgah-Mira Loma #1 line.	Pisgah_sub	
Construct new 500 kV Lucerne Valley substation that connects the new 500 kV Pisgah-Lucerne Valley and new 500 kV Lucerne Valley-Lugo lines.	LucerneValley_sub	

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Expand Mira Loma substation to terminate 500 kV Pisgah-Mira Loma #1 line, 500 kV Vincent-Mira Loma #1 line, 230 kV Chino-Mira Loma #1 and #2 lines, 500 kV Chino-Mira Loma #3 line and 500 kV Devers-Mira Loma #1 and #2 lines.	MiraLoma_sub_expand	
(i) on open side of new 500 kV towers between Pisgah and Lucerne Valley substation area		
(ii) on open side of towers between Lucerne Valley substation area and Lugo substation area		
(iii) on new 500 kV double circuit towers between Lugo substation area and Mira Loma		
Construct new 230 kV Lone Pine substation with capability to expand to 500 kV	LonePine_sub	
Upgrade Inyokern substation to 500 kV	Inyokern_sub_upgrade	
Upgrade Kramer substation with 500 kV capability. Terminates new 500 kV Barstow1-Kramer #1 line.	Kramer_sub_upgrade	
Construct new 500/230 kV High Desert substation looping in existing 500 kV Victorville-McCullough #1 and #2 lines	HighDesert_sub	
Expand Victorville substation to terminate 500 kV Lugo-Victorville #2 line	Victorville_sub_expand	
Construct new 500/230 kV Fairmont substation looping in existing 500 kV Adelanto-Rinaldi #1 and Victorville-Rinaldi #1 lines	Fairmont_sub	
Construct new Eco 500/230/69 kV substation looping in existing 500 kV Imperial Valley-Miguel #1 line	Eco_sub	
Expand Imperial Valley substation to terminate 500 kV Imperial Valley-Bannister #1 and #2 lines.	ImperialValley_sub_expand	
(i) between Bannister substation and Ave 58 area (38.7 miles)		
(ii) between Ave 58 area and Coachella Valley substation area (17.5 miles)		
(iii) between Coachella Valley substation area and Devers substation (35 miles)		
Upgrade Bannister substation with 500 kV capability. Terminates new 500 kV Imperial Valley-Bannister #1 line, new 500 kV Bannister-Devers #1 line, and new 230 kV Bannister-Geo #1 and #2 lines, rebuilt 230 kV Bannister-Coachella Valley #1 line and rebuilt 230 kV Bannister-Ave58 #1 line.	Bannister_sub_upgrade	
Implement Eco-Miguel generation SPS	Eco_Miguel_SPS	
Construct new Solano 500/230 kV substation looping in existing 500 kV Vaca Dixon-Tesla #1 line	Solano_sub	
Construct new West Gila substation looping in existing 500 kV North Gila-Imperial Valley #1 line	WestGila_sub	
Expand Midway substation to terminate 500 kV Midway-Kramer #1 and #2 lines	Midway_sub_expand	
Build 230 kV Carrizo switching station looping in existing Midway-Morro Bay 230 kV lines creating Morro Bay-Carrizo and Carrizo-Midway 230 kV lines	Carrizo_sub	
Build new 500 kV bus at existing Gregg substation and add two 500/230 kV transformers	Gregg_sub_upgrade	
Build a new 500 kV Northeast Oregon (NEO) substation including a +/- 500 kV AC-DC convertor with 3000 MVA thermal capability	NEO_sub_invertor	

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Build a new 500 kV Collinsville substation including a +/- 500 kV AC-DC convertor with 3000 MVA thermal capability.	Collinsville_sub_invertor	
Add +/- 600 MVAR Static VAR Compensators (SVCs) at Selkirk, Devil's Gap, NEO Station, Collinsville, Tracy substation and near Cottonwood substation	PNW_SVCs	
Possibly construct a third +/- 500 kV AC-DC convertor station with 1500 MVA thermal capability near Cottonwood substation		
Install two 500/230 kV transformers at new Collinsville substation	Collinsville_sub_xfmrs	
Install needed reactive power reinforcement at new Collinsville substation	Collinsville_sub_caps	
Loop existing Tesla-Vaca Dixon 500 kV line into new Collinsville substation	Collinsville_sub_loopin	
Termination costs for the loop in at Whirlwind based on the total mileage of 70.8 (PG&E portion is 52 & SCE portion is 18.8). Termination cost is 1/2 of 25% since termination cost only applies to Whirlwind.		
Construct approximately 2 miles of new 500kV single-circuit T/L to loop the existing Midway-Vincent No.3 500kV T/L in-an-out of the new Whirlwind 500kV Substation.		
Construct new 500 kV Zeta 1 substation	Zeta1_sub	
Construct new Mid-Point compensation station	Mid-Point_comp	
Construct new 500 kV Dillard Road substation (SMUD interconnection)	DillardRoad_sub	
Construct new 500 kV Tracy2 substation	Tracy2_sub	
Construct new Alpha 4 substation with 500/230 kV transformation capability	Alpha4_sub	
Construct new 230 kV Alpha 1 substation	Alpha1_sub	
Break existing 230 kV New Melones #1 and #2 taps to the Wilson-Belotta 230 kV line and reconnect to the Alpha 4 substation creating 230 kV New Melones-Alpha 4 #1 and #2 lines	NewMelones_tap_reconfig	
Construct new 230 kV Delta 1 substation	Delta1_sub	
Construct Barren Ridge Switching Station looping in existing 230 kV Owens Gorge-Rinaldi line	BarrenRidge_sub	
Construct new Haskell Canyon switching station looping in upgraded 230 kV Owens Gorge-Rinaldi line and existing 230 kV Castaic Power Plant-Olive #1 line creating a 230 kV Castaic-Haskell Canyon #1 line and a 230 kV Haskell Canyon-Olive #1 line.	HaskellCanyon_sub	
Construct DeversII 500/230 kV substation	DeversII_sub	
Construct new Imperial ValleyII substation looping in existing El Centro-Imperial Valley 230 kV line and Dixieland-Imperial Valley 230 kV line	ImperialValleyII_sub	
(i) Bannister and Ave 58 substation area		
(ii) Ave 58 substation area and Coachella Valley substation		
(i) rebuild existing El Centro-Avenue 58 161 kV line north as far as Bannister with double-circuit 230 kV towers		
Add 230 kV transformation capability at Avenue 58 substation	Ave58_sub_upgrade	
Add 230/287 kV transformation capability at Victorville substation (one transformer)		

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Add 230/230 kV phase shifting transformer at Victorville substation (one transformer)		
Add 230/287 kV transformation capability at Century substation (two transformers)		
Add 230/230 kV phase shifting transformer at Century (one transformer)		
(a) 95 miles of new double circuit towers		
(b) 10 miles of new underground construction in the Upland area		
(c) removing and restringing 28 miles of an existing 287 kV Victorville-Century #2 line		
(a) 95 miles of circuit on open side of new double circuit towers		
(b) 10 miles of new underground construction in the Upland area		
(c) removing and restringing 70 miles of an existing 287 kV Victorville-Century #2 line and operating restrung line at 230 kV)		
Build new Camp Pendleton 500/230 kV substation looping-in reconductored 230 kV Talega-Escondido #1 line	CampPendleton_sub	
Build new Lee Lake 500 kV switching station looping-in existing 500 kV Valley-Serrano #1 line	LeeLake_sub	
Construct Whirlwind 500/220 kV substation looping in existing 500 kV Midway-Vincent #3 line (creating 500 kV Midway-Whirlwind #1 line and Whirlwind-Vincent #1 line.) (segment 4) (Also terminates new 500 kV Windhub-Whirlwind #1 line, new 500 kV Whirlwind-Antelope #1 line and new 500 kV Whirlwind-Vincent #1 line.)	Whirlwind_sub	
Upgrade Windhub substation to 500 kV capability; initially operated at 220 kV (segment 9) (terminates new 500 kV Windhub-Whirlwind #1 line, new 500 kV Windhub-Antelope #1 line, and new 500 kV Kramer-Windhub #1 line)	Windhub_sub	
Build new 220 kV Whirlwind-Cottonwood #1 line with double-circuit towers (4 miles) (segment 4) [This is a TRUNK LINE]		
Build new 220 kV Whirlwind-Cottonwood #2 line on open side of towers (4 miles) (segment 4) [This is a TRUNK LINE]		
Add capacitor banks at Windhub and Whirlwind 200/55 kV substation (segment 9)		
Upgrade Antelope substation with switch rack, two transformers, new capacitor banks and a Static VAR Compensator (SVC) (segment 9) (Also terminates new 500 kV Antelope-Vincent #1 and #2 lines, new 500 kV Windhub-Antelope #1 line and new 500 kV Antelope-Whirlwind #1 line.)	Antelope_sub_upgrade	
Upgrade Vincent substation by replacing existing transformer bank, expanding existing switch rack, adding two new capacitor banks and new circuit breakers. (segment 9) (Also terminates new 500 kV Antelope-Vincent #1 and #2 lines, new 500 kV Whirlwind-Vincent #1 line, new 500 kV Vincent-Mira Loma #1 line, new 230 kV Vincent-Gould #1 line, and new 230 kV Vincent-Rio Hondo #1 line.)	Vincent_sub_upgrade	
Section 1 (Starting from Vincent)= 5 mile tear down of 230kV and new 500kV single-circuit construction.		
Section 2 = 23 mile tear down of 230kV and new 500kV construction.		
Section 3 = 17 mile of tear down of 230kV and 500kV double-circuit construction.		
Section 4 = 23 mile tear down of 230kV and new 500kV double-circuit construction.		

New Substations and Network Upgrades	Upgrade Identification Name	Short Name
Section 5 = 7 mile tear down of 230 kV and new 500kV double-circuit construction.		
Expand Mesa substation. (Terminates new 230 kV Gould-Mesa #1 line.)	Mesa_sub_expand	
Expand Eagle Rock substation. (Terminates new 230 kV Gould-Eagle Rock #1 line.)	EagleRock_sub_expand	
Expand Gould substation (Terminates new 230 kV Vincent-Gould #1 line, new 230 kV Gould-Mesa #1 line and new 230 kV Gould-Eagle Rock #1 line.)	Gould_sub_upgrade	
Expand Chino substation (Terminates new 230 kV Chino-Mira Loma #1 line, new 230 kV Chino-Mira Loma #2 line and new 230 kV Chino-Mira Loma #3 line.)	Chino_sub_upgrade	
18 miles of 230kV construction		
18 miles of 500kV construction		

Appendix J. CREZ Injection Points and New Substations

	Injection Point(s) for Renewable Energy from Each CREZ		
CREZs and Out-of-State Locations	**Connection Point(s) for CREZs and Out-of-State Locations**	**Line Configuration within Substations/Switching Stations**	**Planned New Substation**
British Columbia	Existing Selkirk substation	Renewable generation modeled as injecting at the existing Selkirk 500 kV bus	**NEO substation** **Collinsville substation**
Oregon	Planned NEO substation	Renewable generation modeled as injecting at the NEO 500 kV bus.	
Round Mountain-A	New Zeta1 substation	Renewable generation modeled as injected at the Zeta1 500 kV bus	**Zeta1** **Tracy2** **Dillard Road** **Alpha 1** **Alpha 4** **Delta 1**
Nevada N	New Zeta1 substation		
Round Mountain-B	New Zeta1 substation		
Lassen South	New Zeta1 substation		
Lassen North	New Zeta1 substation		
Solano	New Solano substation	New Solana substation loops in existing 500 kV Vaca Dixon-Tesla #1 line. Renewable generation modeled as injected at the Solana 500 kV bus	**Solano**
Carrizo North	New Carrizo switching station	New Carrizo switching station loops in existing 230 kV Midway-Morro Bay line. Renewable generation modeled as injected at the Carrizo switching station on the 230 kV Midway-Morro Bay line.	**Carrizo switching station**
Cuyama	New Carrizo switching station		
Carrizo South	New Carrizo switching station		
Santa Barbara	PG&E's existing Mesa substation	Renewable generation modeled as injecting at PG&E's existing Mesa 230 kV bus	None
Riverside East	SCE's planned Midpoint substation and the new Desert Center substation	SCE's planned Midpoint substation configured to loop-in existing Palo Verde-Devers #1 line. New Desert Center substation configured to loop-in existing Palo Verde-Devers #1 line. 67% of renewable generation modeled as injected at 500 kV bus of SCE's planned Midpoint substation. 33% modeled as injected at the 500 kV bus of new Desert Center substation.	**SCE's Midpoint substation** **Desert Center substation**
Palm Springs	Existing Devers substation	Renewable generation modeled as injected at existing Devers 500 kV bus	None
Iron Mountain	Upgraded Iron Mountain substation	Renewable generation modeled as injected at Iron Mountain new 500 kV bus	**Existing Iron Mountain substation upgraded with 500/230 kV transformation capability**
Needles	Upgraded Camino substation	Renewable generation modeled as injected at Camino new 500 kV bus	**Existing Camino substation upgraded with 500/230 kV transformation capability**
Pisgah	New Pisgah substation	New Pisgah substation configured to loop-in existing 500 kV El Dorado-Lugo and Mohave-Lugo lines Renewable generation modeled as injected at the Pisgah 500 kV bus	**Pisgah substation**
San Bernardino-Lucerne	New Lucerne Valley substation	Renewable generation modeled as injected at new Lucerne Valley 500 kV bus	**Lucerne Valley substation**
Twentynine Palms	New Lucerne Valley substation		

CREZs and Out-of-State Locations	Connection Point(s) for CREZs and Out-of-State Locations	Line Configuration within Substations/Switching Stations	Planned New Substation
Nevada C	Existing Dixie Valley substation	Renewable generation modeled as injected at existing Dixie Valley 230 kV bus	None
Owens Valley	New Lone Pine substation	Renewable generation modeled as injected at Lone Pine 230 kV bus	**Lone Pine substation**
Inyokern	Upgraded Inyokern substation	Renewable generation modeled as injected at Inyokern 230 kV bus	**Existing Inyokern substation upgraded to 230 kV**
Tehachapi	New Barren Ridge substation and upgraded Antelope substation	New Barren Ridge substation configured to loop in upgraded 230 kV Gorge-Rinaldi line. 20% of renewable generation modeled as injected at Barren Ridge 230 kV bus. 80% of renewable generation modeled as injected at Antelope 500 kV bus.	**Whirlwind substation** **Windhub substation** **Barren Ridge substation**
Kramer	Upgraded Kramer substation and new Barren Ridge substation	92% of renewable generation modeled as injected at Kramer 500 kV bus. 8% of renewable generation modeled as injected at Barren Ridge 230 kV bus.	**Existing Kramer substation upgraded with 500/230 kV transformation capability**
Mountain Pass	New Mountain Pass1 and new Mountain Pass2 substations	New Mountain Pass2 substation looped into existing 287 kV Victorville-Mead #1 line 50% of renewable generation modeled as injected at Mountain Pass1 500 kV bus. 50% of renewable generation modeled as injected at Mountain Pass2 287 kV bus.	**Mountain Pass1 substation** **Mountain Pass 2 substation**
San Bernardino-Baker	New Baker1 and new Baker2 substations	New Baker2 substation loops in existing 500 kV Adelanto-Marketplace #1 line 50% of renewable generation modeled as injected at Baker1 500 kV bus. 50% of renewable generation modeled as injected at Baker2 500 kV bus.	**Baker1 substation** **Baker2 substation**
Barstow	New Barstow1 and new Barstow2 substations	New Barstow2 substation loops in existing 500 kV Adelanto-Marketplace #1 line 50% of renewable generation modeled as injected at Barstow1 500 kV bus. 50% of renewable generation modeled as injected at Barstow2 500 kV bus.	**Barstow1 substation** **Barstow2 substation**
Victorville	New High Desert substation	New High Desert substation loops in existing 500 kV Victorville-McCullough #1 and #2 lines. Renewable generation modeled as injected at High Desert 500 kV bus.	**High Desert substation**
Fairmont	New Fairmont substation	New Fairmont substation loops in existing 500 kV Adelanto-Rinaldi #1 line and existing Victorville-Rinaldi #1 line. Renewable generation modeled as injected at Fairmont 500 kV bus.	**Fairmont substation**
Imperial East	New West Gila substation	New West Gila substation loops in existing 500 kV North Gila-Imperial Valley line Renewable generation modeled as injected at West Gila 500 kV bus.	**West Gila substation**

<table>
<tr><th>CREZs and Out-of-State Locations</th><th>Connection Point(s) for CREZs and Out-of-State Locations</th><th>Line Configuration within Substations/Switching Stations</th><th>Planned New Substation</th></tr>
<tr><td>Imperial North-A</td><td>Existing IID Midway substation</td><td rowspan="2">Renewable generation modeled as injected at IID Midway 230 kV bus.</td><td rowspan="3">Geo substation

Existing Bannister substation upgraded with 230 kV capability and 500/230 kV transformation capability

DeversII substation

Imperial ValleyII substation</td></tr>
<tr><td>Imperial North-B</td><td>Existing IID Midway substation</td></tr>
<tr><td>Imperial South</td><td>Existing Imperial Valley substation</td><td>Renewable generation modeled as injected at Imperial Valley 230 kV bus</td></tr>
<tr><td>San Diego South</td><td>New Eco substation</td><td rowspan="2">New Eco substation loops in existing 500 kV Imperial Valley-Miguel line.

Renewable generation modeled as injected at Eco 500 kV bus.</td><td rowspan="2">Eco substation</td></tr>
<tr><td>Baja – La Rumorosa</td><td>New Eco substation</td></tr>
<tr><td>Baja – Santa Catarina</td><td>Existing Imperial Valley substation</td><td>Renewable generation modeled as injected at Imperial Valley 230 kV bus</td><td>None</td></tr>
<tr><td>San Diego North Central</td><td>Existing Sycamore Canyon substation</td><td>Renewable generation modeled as injected at Sycamore Canyon 230 kV bus</td><td>None</td></tr>
</table>

Appendix K. About Shift Factors

RETI conceptual transmission planning employed shift factors, sometimes also called power transfer distribution factors, to explore the relative usefulness of potential line segments in distributing new renewable generation. This Appendix provides background information on shift factors and the significant limitations involved in using them.

The power grid is a network of elements including transmission lines, transformers, generators, loads, and related electrical facilities. There are both Direct Current and Alternating Current (AC) elements within this network; most of the WECC network is operated with Alternating Current. Many of the grid elements have control parameters that are set by grid operators. These include, among other things, voltage control settings, phase angle regulators and capacitor bank switching.

Powerflows on the AC grid can be modeled mathematically as a set of non-linear equations. For example, flow on a line is a trigonometric function of the voltages at the two ends of that line which represents a non-linear relationship between the main variables defining the operation of the system.

The non-linear equations can be solved to determine how power produced by all electric generators connected to the grid distributes across the network to meet power demand at all load nodes on the grid, accounting as well for the losses incurred in transmitting the power. This process involves solving many simultaneous non-linear equations employing iterative algorithms based on the Newton–Rhapson method. This is computationally intensive and can be very time consuming. It requires identifying and fine tuning the settings on hundreds of operator-controlled elements throughout the AC power grid in order to obtain a solution which precisely balances generation with load and losses.

To speed up the solution process, the power industry often uses a simpler mathematical model. This model uses a series of assumptions that result in a set of linear simultaneous equations that, when solved, approximate real power flows across individual network line segments in the transmission grid. This “DC” model produces solutions that are satisfactory for many purposes. For example, all ISOs and RTOs, including the CAISO, have employed shift factors for many years in the operation of their markets.

The linear DC power flow approach involves use of a matrix of numbers called shift factors. The shift factor matrix is not particularly complex to derive. The only data needed is the admittance matrix for the grid. Admittance measures the relative ease with which power flows in each network line segment. Most commercial power flow analysis tools have a built-in feature to evaluate the shift factor matrix.

Shift factors for RETI were developed starting from a grid configuration consisting of all lines expected to be in place in the WECC in the summer of the year 2018. This WECC "Heavy Summer" case was modified to incorporate the transmission additions included in RETI's conceptual transmission expansion plan. This modified grid configuration was imported into a simulation model called GridView. GridView produces a set of shift factors for the existing and conceptual new network elements in the WECC grid. Each set of shift factors is calculated relative to a specific node generally called a "reference" node. Together, the sets of shift factors form a matrix.

Shift factor (j,k) is equal to the fraction of a power injection that will flow on network element (j) if an increment of power is injected at node (k) and withdrawn at the reference node. Although the shift factor matrix is normally determined relative to a single reference node, it is possible to calculate the shift factor matrix to reflect a distributed reference node (multiple nodes). With this calculation, shift factor (j,k) is equal to the change in flow on line (j) if an increment of power is injected at node (k) and withdrawn at a number of nodes in some pre-determined proportion.

For purposes of developing the shift factors used in the prioritization process for each proposed new network element (j) included in the RETI conceptual transmission plan,[30] the injection nodes (k) were determined by the electrical proximity of each of the RETI Phase 1 Competitive Renewable Energy Zones (CREZs) or out of state development areas to a nearby existing or new substation on the California grid. For example, the injection node for the Palm Springs CREZ is assumed to be the nearby existing Devers substation 230 kV bus.

For purposes of developing the CREZ shift factors used in evaluating each network element (j), RETI used a distributed reference bus to represent the power withdrawals. The distributed reference bus is comprised of multiple buses within predefined load serving areas.[31] For each predefined load serving area, a calculation was made to estimate that load serving area's fractional share of the RETI net short.[32] The fractional share was then assumed to be equally distributed across each of the buses within the predefined load serving area. For example, if a load serving area was determined to have 10% of the statewide net short, and if there were five withdrawal buses within this load serving area, then each withdrawal bus within this load serving area would be modeled as consuming 2% (fractionally 0.020) of the incremental injection at each injection node. Defining injection nodes based on CREZ locations, and defining withdrawal nodes reflective of the RETI net short distributed across the state results

[30] Although GridView calculates shift factors for every network element in the WECC, the prioritization process used only shift factors applicable to the network elements included in the RETI conceptual transmission plan.
[31] Buses were selected to represent, very roughly, the distribution of loads within each predefined load serving area.
[32] The RETI net short is the amount of additional renewable energy needed by each LSE to meet its 33% RPS goal.

in shift factors that may roughly represent the usefulness of the network elements analyzed in transmitting renewable energy to meet California policy goals.

The following table depicts a hypothetical shift factor matrix for a few CREZ injection points and a few network elements contained in the RETI conceptual transmission plan. The data is interpreted as follows: for the Baja CREZ in the first row, 0.0037 in the column headed MDPT_DESC_1 (Midpoint-Desert Center) means that 0.37% of the power injected into the grid from the Baja development area flows on transmission line segment MDPT_DESC_1. Similarly, in the second column, 0.83% of the power injected into the grid from the Baja development area flows on transmission line segment DESC_DEVR_1. For power injected into the grid from the Barstow CREZ, 0.0044 or 0.44% flows on the MDPT_DESC_1 transmission line segment (second row, first column), 0.47% flows on the DESC_DEVR_1 transmission line segment (second row, second column), and so on.

Illustrative Shift Factor Matrix

Segment ID → CREZ Name↓	MDPT_DESC_1	DESC_DEVR_1	JULH_EGMT_1	JULH_EGMT_2
Baja-La Rumorosa	0.0037	0.0083	0.0071	0.0071
Barstow	0.0044	0.0047	0.0017	0.0017
British Columbia	0.0062	0.0057	0.0013	0.0013
Carrizo North	0.0004	0.0016	0.0019	0.0019
Carrizo South	0.0004	0.0016	0.0019	0.0019
Cuyama	0.0004	0.0016	0.0019	0.0019
Fairmont	0.0003	0.0008	0.0015	0.0015
Imperial East	0.0390	0.0235	0.0062	0.0062

Based on the scoring mechanism adopted for RETI Phase 2A analysis, a network element that exhibits relatively high shift factors for many CREZs will receive a higher ranking score than a network element the exhibits relatively lower shift factors for most CREZs. The basic idea is that shift factors provide some measure of the relative usefulness of each network element in accommodating delivery of renewable power from each of the identified CREZs to specified withdrawal (load) nodes.

Limitations Associated with Use of Shift Factors

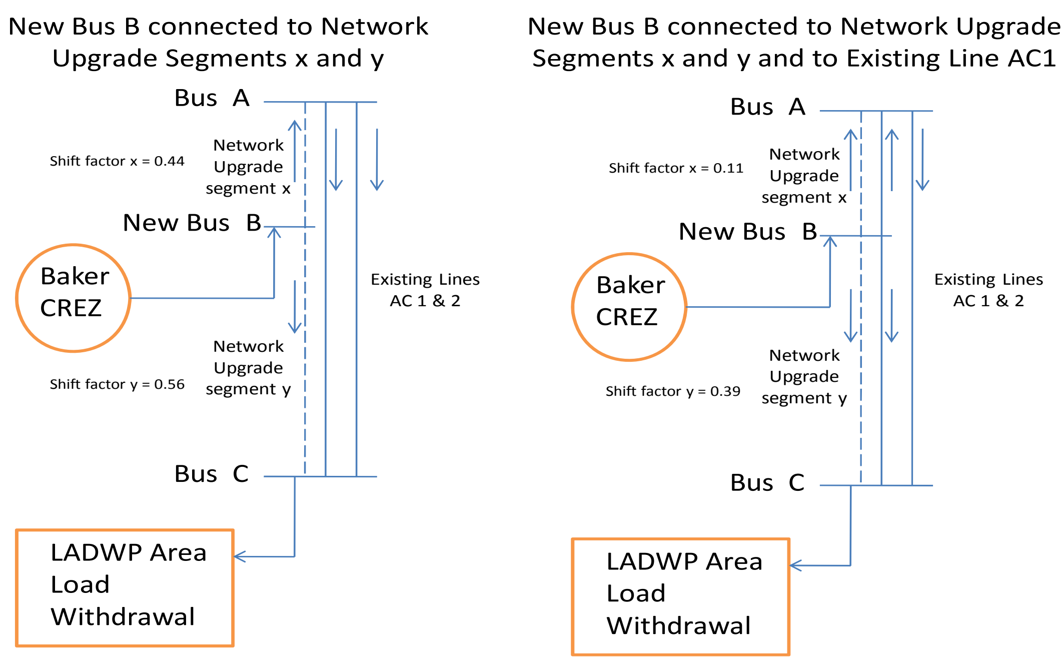
A shift factor matrix is determined directly from the parameters of the elements (primarily transmission lines and transformers) comprising the grid in an assumed grid configuration; the MW size of loads or generation have no effect on the magnitude of shift factors. By itself, a shift factor matrix cannot tell us how much power flows on individual lines; rather, it indicates what fraction of an injection or withdrawal at a particular node will flow on particular transmission line segments and across particular transformers. Multiplying the shift factor matrix by the amount of generation injected at a particular location (or the negative of the shift factors by the loads at particular withdrawal locations) will tell us how much power flows on each grid element. If this process is applied to every injection (or withdrawal) location, one-at-a-time, and the resulting power flows on each grid element summed for each injection (or withdrawal) iteration, the sum represents the total power flow for each grid element.[33] Collectively, for all grid elements, shift factors can—if used in this manner—provide a picture of total power flow on lines, under normal operating conditions.

RETI has calculated its shift factor matrix based on a "distributed" reference node. When the shift factor is multiplied by the energy from a CREZ, the product is the fraction of the energy that would flow on each grid line from that CREZ to the distributed reference node. By modifying the reference node to represent a distribution of the RETI net short to LSE areas in proportion to the LSE short, RETI is able to approximate the flow of CREZ energy on the conceptual line segments, assuming physical delivery of the renewable energy to each LSE rather than to a single reference node. Since RETI is interested in scoring each line for its utilization in delivering energy from all of the CREZs to all load centers based on their net short, the line segment rank scoring multiplies each line segment shift factor and CREZ pair by the energy associated with that CREZ and sums across all CREZs for that line segment to determine the energy flow on each conceptual new line. This approach does not capture the effect of CREZ energy flow on non-conceptual plan line segments, nor does it capture the effect of non-CREZ energy flow on conceptual line segments. In fact, by using energy rather than power, RETI is expressly not trying to solve the same problem as a power flow simulation. Thus, the use of Shift Factors in RETI is not to identify expected total power flow on existing or conceptual line segments. The purpose of using shift factors is to provide information on relative effectiveness of various proposed line segments to integrate the assumed energy development in CREZs sufficient to meet a 33% RPS goal by 2020. Additional studies will be necessary to optimize the plan in consideration of the interactions of existing and new renewable generation on power flow on the entire grid, taking into account contingencies and dispatch limitations as is routinely done to develop a detailed transmission plan of service.

As noted above, shift factors are calculated for a specified set of injection and withdrawal locations using the physical characteristics of the assumed network of existing and planned line segments. Because power injected at a particular point flows on every element of the grid, in varying amounts, shift factor magnitudes can be significantly affected by the way in which the injections are configured. If power is injected at a bus that connects only to two new line segments, the calculated shift factors for these new line segments will be different than if the bus connects to the two new line segments and other new and/or existing lines. Subsequent

[33] This summation process is sometimes referred to as "superposition."

phases of RETI may propose different grid configurations.[34] This would change the shift factors, and therefore may lead to changes in prioritization or even elimination of segments. For example, consider the following two grid configurations:



This example shows that a decision to connect New Bus B to (a) network upgrade segments x and y, rather than (b) to both network upgrade segments x and y and existing line AC1, has a significant effect on the magnitude of the shift factors for network upgrade segments x and y. In other words, the priority of a network upgrade in the RETI conceptual transmission plan would be significantly changed simply by limiting the number of lines to which the CREZ energy is assumed to be injected.

In addition to limitations associated with the choice of grid configuration upon which shift factors are calculated, there are technical considerations which may cause shift factor-based line flow estimates to deviate from actual flows. These considerations are as follows:

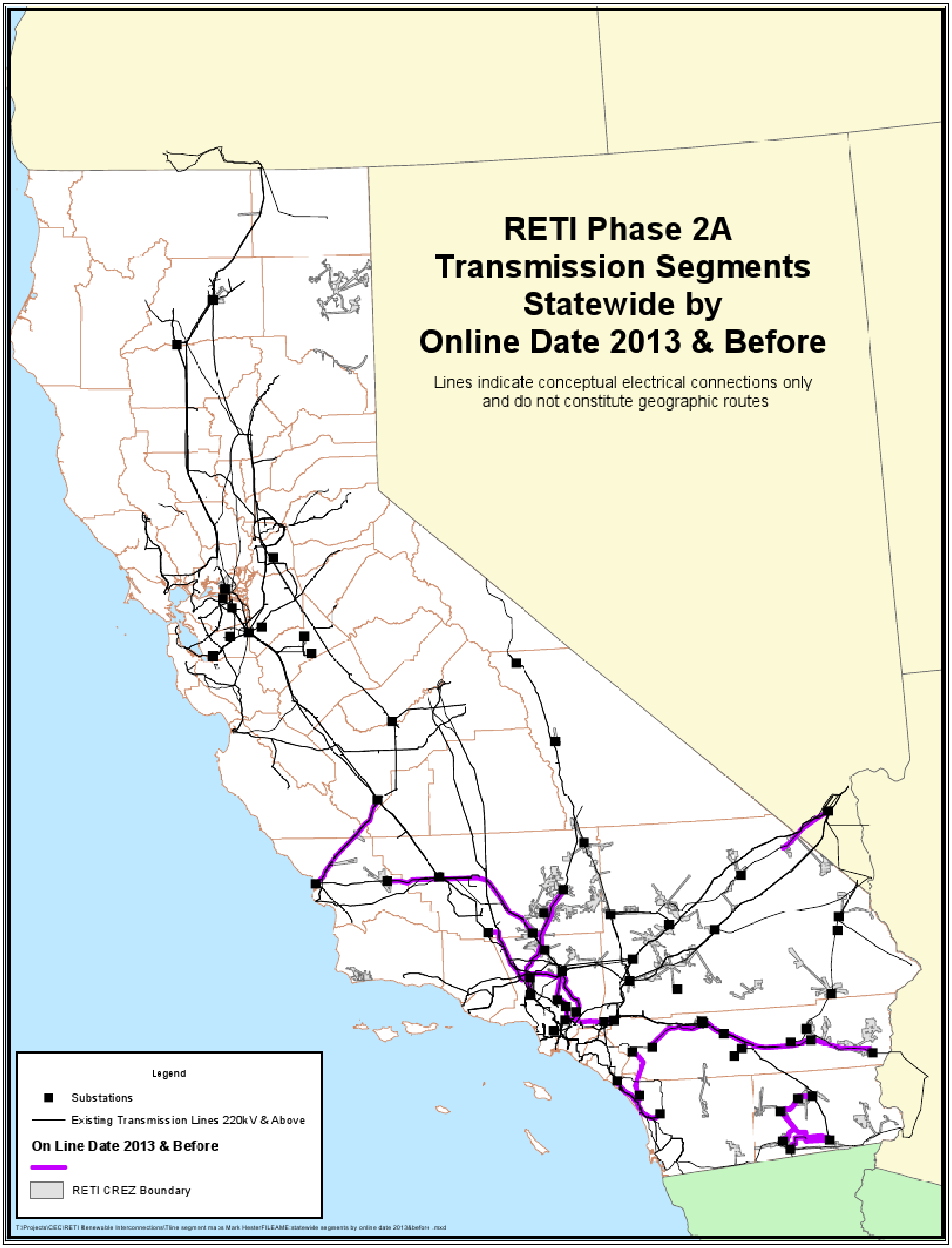
1. The relationship between generation of power at one bus, absorption of power at another bus and power flow on the interconnecting grid lines is nonlinear. Shift factor calculation assumes a linear relationship and as such the calculation of power flow in a DC model will be more approximate then other simulation techniques for solving the load flow

[34] The benefits and costs associated with different injection configurations were not evaluated in RETI Phase 2A work.

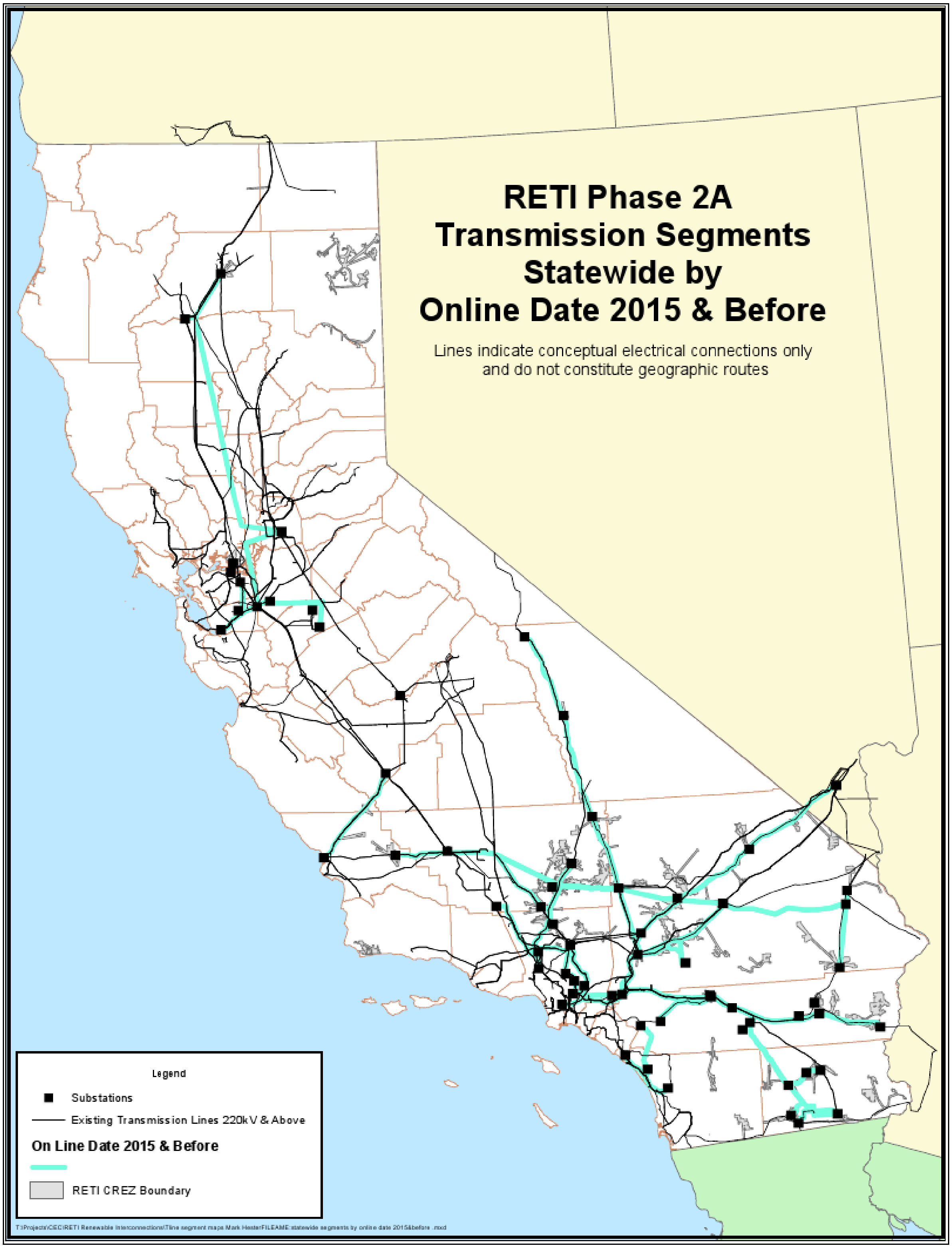
problem. The degree of error introduced due to this difference is generally low. It is considered acceptable by the industry for a variety of purposes, and is more than adequate for the kind of screening and comparison undertaken by RETI.

2. The flow of power on a transmission line due to injection of power at a bus may involve a variety of control operations in the system, including tap changes, local network configuration changes, and static and dynamic VAR supply changes. Shift factor calculation ignores all such system control operations, and since the shift factor matrix is entirely dependent on and would change with any change in system configuration (topology), such changes are also omitted from consideration. Here again the degree of error introduced due to this limitation is generally low and, as noted above, is considered acceptable.

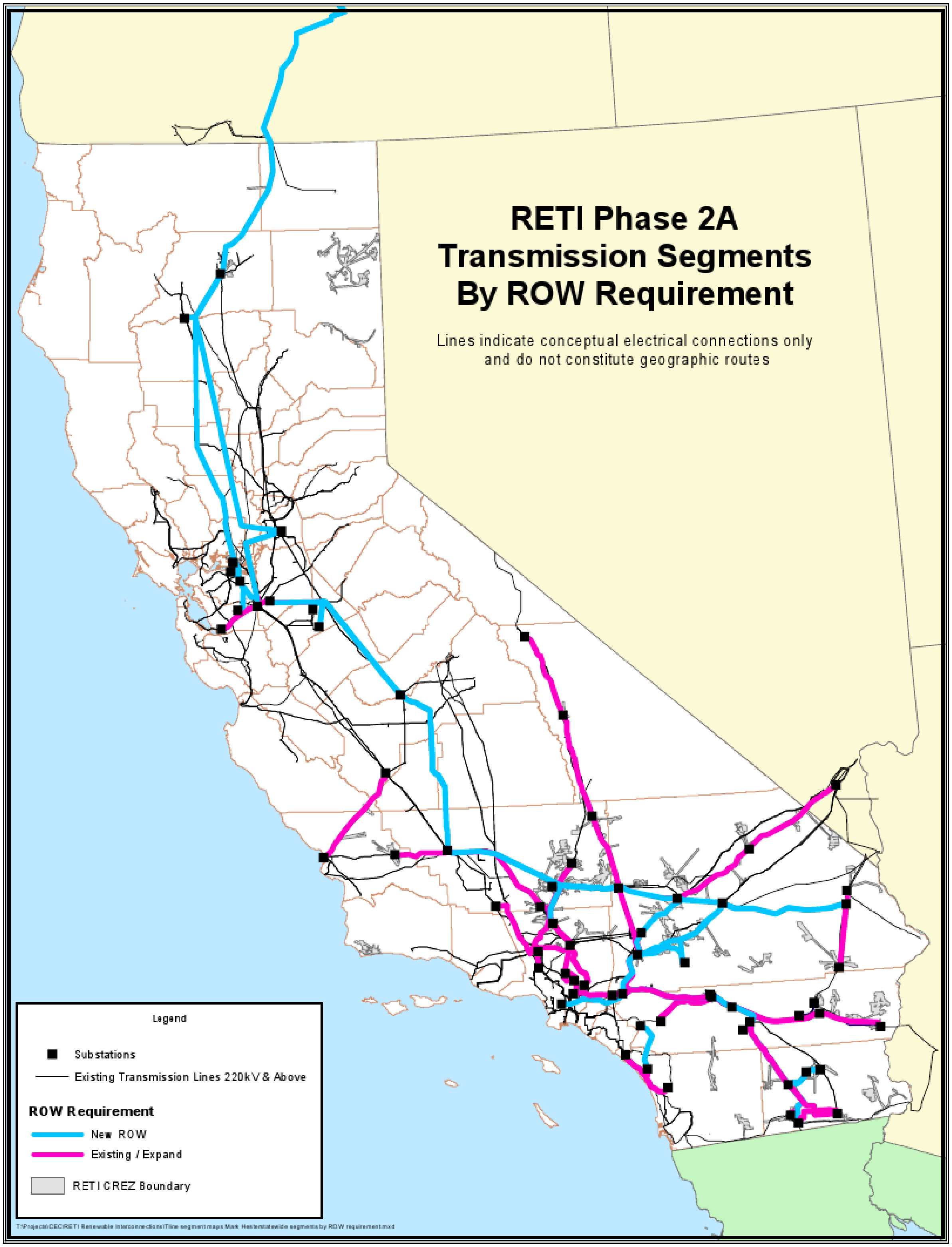
Appendix L. Maps



Statewide segments by online date – 2013 and before.



Statewide segments by online date – 2015 and before.



Statewide Segments by ROW requirements.

Appendix M. Glossary

AB 32	California legislation, Global Warming Solutions Act of 2006, requiring greenhouse gas reductions.
ACE	Area Control Error
ACEC	Area of Critical Environmental Concern
BLM	US Bureau of Land Management
CAISO	California Independent System Operator
CBD	Center for Biological Diversity
CEC	California Energy Commission
CEERT	Center for Energy Efficiency and Renewable Technologies
CEQA	California Environmental Quality Act
CFE	Comision Federal de Electricidad (Mexico)
COI	California-Oregon Interconnection
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
CPWG	RETI Conceptual Planning Work Group
CREZ	Competitive Renewable Energy Zone
CRWG	RETI CREZ Revision Work Group
CTPG	California Transmission Planning Group
Definitive Plan	Transmission facilities specified in sufficient detail to be able to be approved by regulatory agencies for ratemaking and construction, versus a Conceptual Plan.
DFG	California Department of Fish and Game
DOE	US Department of Energy
DRECP	Desert Renewable Energy Conservation Plan
DWMA	Desert Wildlife Management Area
EIR	Environmental Impact Report
EJ	Environmental Justice. Addresses issues regarding disproportionate impacts of generation-transmission projects on low-income/communities of color.
EWG	RETI Environmental Working Group
FERC	Federal Energy Regulatory Commission
FS	Facility Study
Gen-tie	Transmission line connecting a generator to the grid
GWh	Gigawatt-hour. 1 GWh = 1 million kWh
HCP	Habitat Conservation Plan
IID	Imperial Irrigation District
IOU	Investor Owned Utility
IVSG	Imperial Valley Study Group
kWh	Kilowatt-hour
LADWP	Los Angeles Department of Water and Power
LEAPS	Lake Elsinore Advanced Pumped Storage project
LGIP	Large Generator Interconnection Process. FERC-mandated process for studying requests to connect a generator to the grid.

Looping	Connecting a new third point between two existing points already connected.
LSE	Load-Serving Entity
MW	Megawatt
MWD	Metropolitan Water District
NCCP	Natural Communities Conservation Plan
NCPA	Northern California Power Agency
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Council
NP15	North of Path 15
NRDC	Natural Resources Defense Council
PACT	Planning Alternative Corridors for Transmission
PEA	Proponent's Environmental Assessment
PG&E	Pacific Gas & Electric Company
POU	Publicly-Owned Utility
PPA	Power Purchase Agreement
RAS	Remedial Action Scheme
RETAAC	Nevada Renewable Energy Transmission Access Advisory Committee
RETI	California Renewable Energy Transmission Initiative
RMR	Reliability Must Run
ROW	Right Of Way
RPS	Renewable Portfolio Standard
SCE	Southern California Edison Company
SCPPA	Southern California Public Power Authority
SDG&E	San Diego Gas & Electric Company
Sec 399.25	Section of California Public Utilities Code
SIS	System Impact Study
SMUD	Sacramento Municipal Utility District
SPS	Special Protection System
SSC	RETI Stakeholder Steering Committee
TANC	Transmission Agency of Northern California
TCSG	Tehachapi Collaborative Study Group
TRTP	Tehachapi Renewable Transmission Project
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
WECC	Western Electricity Coordinating Council
WREZ	Western Renewable Energy Zone Initiative. Joint effort of Western Governors Association and US DOE to identify renewable energy zones across the western 11 states, British Columbia, Alberta and Baja California.

Appendix N. CREZ Environmental Ranking Results Using Wind Industry Formulas

As noted in the RETI Phase 1B Report and explained in Section 2.4 of the RETI Phase 2A Report, there was no consensus regarding how project footprint for wind projects should be defined and applied in assessing potential environmental concern. EWG formulas should not be considered to establish a precedent for evaluating wind project impacts. This is first instance in which the environmental effect of wind projects has been characterized as proportional to the entire project lease area, and the wind industry takes strong exception to such formulas, pointing to the lack of data and systematic study of such impacts. The U.S. Department of Energy 20% Wind Vision report (May 2008) found that wind projects in the U.S. directly disturb on average 2.5%-5% of total project lease area for turbine foundations, access roads and substations.

The following CREZ rankings are based on calculations based on a wind project footprint of 3.5% of the lease area for Criterion #1 (Project Area), Criterion #3 (Sensitive Areas in CREZ), Criterion #4 (Sensitive Buffer Areas) and Criterion #6 (wildlife corridors). The EWG formulas used 3.5% of project lease area for Criterion #1.

Table N-1 compares the CREZ environmental rankings using the wind industry formulas with the EWG formulas.

Figure N-1 charts the CREZ environmental rankings using the wind industry formulas with the CREZ economic rankings, in comparison to **Figure 2-4**.

All of the calculations and results reported in Appendix N have been made independently by the wind industry.

Table N-1. CREZ Environmental Ranking Results Using Wind Industry Formulas.

CREZ Name	Annual Energy (GWh/yr)	Score Using Wind Formulas	Score Using EWG Formulas
Mountain Pass	4,336	2.1	3.5
San Diego South	1,926	2.9	5.5
Palm Springs	2,595	3.9	8.0
Pisgah	6,281	4.8	4.0
Tehachapi	29,473	5.0	4.6
Santa Barbara	1,180	5.3	9.2
Iron Mountain	11,611	6.1	5.2
Round Mountain-B	742	6.2	8.4
Solano	2,865	6.4	7.6
Lassen North	3,784	6.6	7.8
Victorville	4,270	7.3	8.2
Riverside East	25,473	7.4	5.1
Twentynine Palms	4,616	7.9	4.8
Barstow	5,856	8.2	8.7
Imperial North-A	10,626	8.2	3.7
Baja-A (La Rumorosa)	8,035	8.5	7.6
Baja-B (Santa Catarina)	8,931	8.5	7.6
British Columbia	1,849	8.5	7.6
Nevada C	2,624	8.5	7.6
Nevada N	822	8.5	7.6
Oregon	3,062	8.5	7.6
San Bernardino - Lucerne	8,143	8.7	7.7
Imperial East	3,959	8.9	5.7
Carrizo South	8,323	9.2	6.6
Cuyama	1,784	9.2	6.6
Inyokern	6,322	10.2	7.6
Lassen South	1,106	10.3	19.4
Owens Valley	3,613	10.3	5.5
Round Mountain-A	2,691	10.6	3.4
Fairmont	10,355	11.2	10.6
Needles	1,187	11.2	10.0
Kramer	16,553	11.6	5.9
Carrizo North	3,395	13.0	8.4
Imperial South	9,167	13.1	7.8
San Diego North Central	739	13.2	22.2
San Bernardino - Baker	8,707	15.6	6.7
Imperial North-B	4,507	20.7	11.1

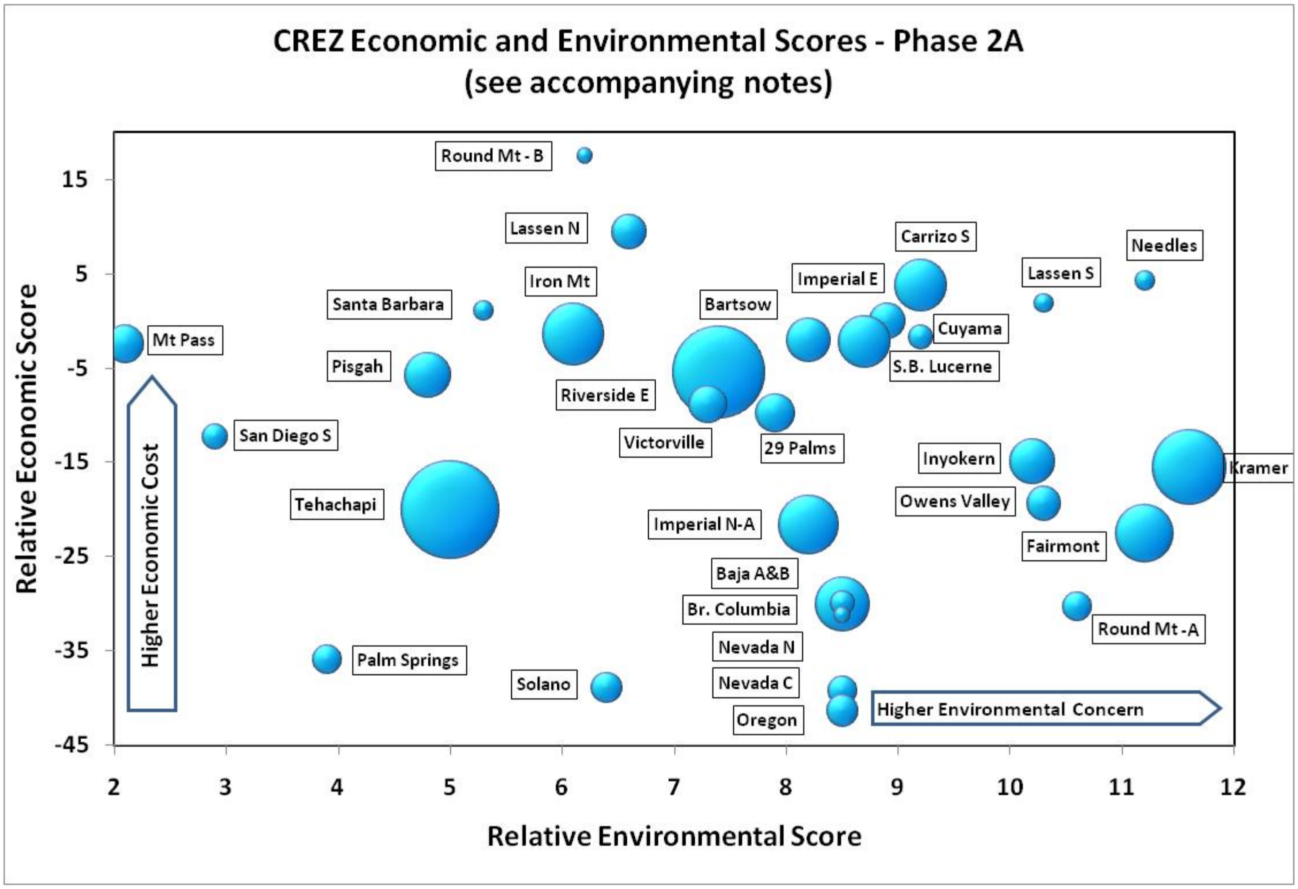


Figure N-1. CREZ Economic and Environmental Scores Phase 2A, Bubble Chart, Using Wind Industry Environmental Formulas.

Notes:
Areas of the bubbles are proportional to CREZ energy.
Out of state CREZ economic scores include proxy costs for delivering energy to the California border.
Carrizo North CREZ is off the right side of the chart.
Economic Score = 0.95 Environmental Score = 13.0 Energy = 3,395 GWh
Imperial South CREZ is off the right side of the chart.
Economic Score = 1.84 Environmental Score = 13.1 Energy = 9,167 GWh
San Diego North Central CREZ is off the right side of the chart.
Economic Score = -0.32 Environmental Score = 13.2 Energy = 739 GWh

San Bernardino - Baker CREZ is off the right side of the chart.
Economic Score = 1.23 Environmental Score = 15.6 Energy = 8,707 GWh
Imperial North-B CREZ is off the right side of the chart.
Economic Score = 0.44 Environmental Score = 20.7 Energy = 4,507 GWh