Collaborative Transmission Planning: California's Renewable Energy Transmission Initiative

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***Abstract*—Transmission planning has been conducted primarily by utilities, in reactive fashion. Project approvals are increasingly litigated, when stakeholders later become engaged. Large Renewable Energy Standard (RES) targets present additional challenges for approval of generation and transmission projects and often require a proactive development approach. In response, California agencies formed a stakeholder-led planning process, the Renewable Energy Transmission Initiative (RETI) in 2007. RETI identified and ranked Renewable Energy Zones in California and neighboring regions, using both economic and environmental criteria, determined the transmission needed, based on least-regrets transmission planning principles, to access and deliver target renewable energy, and prepared a statewide conceptual transmission plan. RETI has been effective in identifying development priorities and in building stakeholder support for generation-transmission development for renewable energy. Its approach is applicable to other jurisdictions considering large-scale wind power-transmission construction.**

***Index Terms*—Collaboration, energy resources, environmental economics, power system planning, power transmission, technology social factors.**

I. Introduction

LARGE Renewable Energy Standard (RES) targets present new and significant challenges for planning and approval of generation and transmission projects. Competing proposals complicate agreement on development priority and identification of least-cost solutions. Transmission infrastructure may have to be proactively planned and fully or partially developed before renewable energy build-out is completely known. Opposition to infrastructure development requires project designs responsive to an increasing range of concerns.

Manuscript received August 29, 2011; revised January 27, 2012; accepted May 07, 2012.

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Digital Object Identifier 10.1109/TSTE.2012.2200111

To respond to these challenges, California agencies[1] formed the Renewable Energy Transmission Initiative (RETI) in 2007. RETI was a 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. It engaged interested stakeholders early in the planning process. The conceptual plan it produced was 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.

RETI was effective in identifying development priorities and in building stakeholder support for generation-transmission development. Its approach appears applicable to other jurisdictions considering large-scale renewable energy-transmission construction. RETI suspended its operation at the end of 2010 as a newly formed California Transmission Planning Group took broader responsibility for coordinating and developing statewide planning.

This paper examines major components of the RETI initiative: its structure and stakeholder collaborative process; identification, characterization, and ranking of Renewable Energy Zones in California and other regions of the western U.S. and Canada, using both economic and environmental criteria; determination of the transmission needed, based on least regrets transmission planning principles, to access and deliver target renewable energy; and development of an objective methodology for assessing the usefulness of transmission components in carrying renewable energy and meeting other planning goals. RETI utilized this methodology to prepare a statewide conceptual transmission plan now being used in detailed transmission planning in the state.

II. Stakeholder Collaboration Structure

A. Mission, Structure, and Participants

RETI's mission was to develop a statewide transmission plan capable of accessing and delivering sufficient renewable energy to meet state policy goals and able to win broad stakeholder support. Background information about the purpose and formation of RETI, its Mission Statement, Stakeholder Steering Committee members, and all RETI documents are available at www.energy.ca.gov/reti.

[1]California Public Utilities Commission, California Energy Commission, California Independent System Operator Corporation (CAISO), and municipal utilities joined together to form RETI.

The RETI collaborative had three elements: a Stakeholder Steering Committee, a Coordinating Committee, and a Plenary Stakeholder Group. A 29-member Stakeholder Steering Committee (SSC) directed RETI work. The SSC included representatives of California Load-Serving Entities (LSE) and Transmission Providers;[2] biomass, geothermal, solar, and wind generating companies; local, state and federal permitting agencies;[3] the military; tribes; consumers; and environmental groups. SSC members agreed to work in good faith to develop transmission solutions to support state policy goals. They were responsible for communicating details of RETI deliberations to the constituencies they represented, and for ensuring that the concerns of their constituencies were fully considered in RETI work. The SSC was responsible for producing the statewide plan in accordance with RETI's mission.

The RETI Coordinating Committee ensured that the collaborative's work and products remain aligned with state policy goals. It was made up of the agencies which came together to form RETI.[4] A Plenary Stakeholder Group was made up of all interested and concerned individuals and groups; participation was open to all.

B. Operation of the Collaborative

As a state-initiated collaborative, the RETI planning process was open and public. All data and assumptions were transparent. Facilitators sponsored by the California Energy Commission led meetings and helped ensure respectful communication and even-handed consideration of all points of view. All RETI committees strived to reach decisions by consensus, defined as "all can live with." If consensus could not be reached, dissenting parties were able to file their own conclusions, which were published and incorporated in the RETI record.

The SSC met monthly, to agree on key assumptions and decide issues necessary to development of the conceptual plan. An engineering firm retained by the California Public Utilities Commission performed much of the technical and economic analysis required.[5] Most RETI work was done by working groups formed by the SSC to complete specific tasks. Working groups met weekly or more frequently as needed. Participation in working groups was open to all interested individuals. RETI's Environmental Working Group (EWG), for example, developed and applied methodologies for evaluating environmental concerns associated with generation and transmission development in specific regions. More than 50 participants representing a wide range of interests and perspectives—county planners, state and federal permitting agencies, the military, environmental NGOs and advocacy groups, geothermal, solar and wind development companies, and private citizens—regularly participated in EWG work.

The SSC reported its progress regularly to the Plenary Stakeholder Group and the public, in large public meetings in different areas of the state. These meetings allowed people concerned with aspects of generation and transmission development in those regions to provide suggestions and comments on issues such as the need for generation-transmission development and alternatives thereto.

RETI work was organized into two phases. In Phase 1 (September 2007–August 2009) participants achieved consensus on study methodology and detailed input assumptions, identified initial Competitive Renewable Energy Zones (CREZ) in California, and produced a preliminary economic and environmental ranking. Phase 2 (September 2009–January 2011) refined and adjusted CREZ boundaries in response to on-the-ground evaluation of potential resource development impacts in affected areas; included out-of-state resource areas in the evaluation, including transmission necessary to deliver such resources to California; and produced a statewide conceptual transmission plan. RETI work was summarized in four major reports: a Phase 1A, Phase 1B, Phase 2A, and Phase 2B report. Extensive public comments on drafts of these reports were incorporated into the final reports on each phase.

III. Identification and Ranking of Renewable Energy Zones

A. Renewable Energy Zone Development Approach

California law requires 33% of all electricity sold at retail to be supplied by renewable resources by 2020. This will require development of roughly 15 000 MW of new renewable generating capacity. Building transmission to access individual generating projects would be expensive and create major environmental impacts. Instead, the state will pursue utilization of its biomass, geothermal, solar, and wind resources using a zone development approach.

RETI was charged with identifying geographic regions, called Competitive Renewable Energy Zones or CREZ, having high densities of best-quality resources, and with minimizing the number of transmission facilities necessary to access and deliver sufficient renewable energy to meet state goals [1].[6] In 2007–2008, using criteria specified by the SSC, 37 CREZ were identified in the state [2]. Subsequent detailed evaluation of these initial CREZ, using GIS map information, land ownership data, and on-site evaluation of environmental factors and permitting feasibility led the SSC in 2009 to revise the boundaries and estimates of the energy resource potential of most CREZ [3]; the number of CREZ was also reduced to 35. Additional and more complete land use and environmental information about CREZ areas continued to become available throughout the RETI process. RETI did not, however, have resources to continuously update its characterization of CREZ.

B. California and Out-of-State Resources

RETI estimated the cost of developing renewable resources throughout California and other regions of the western U.S. and

[2]California Independent System Operator Corporation (CAISO); Imperial Irrigation District; Los Angeles Department of Water and Power; Northern California Power Agency (NCPA); Pacific Gas & Electric; Sacramento Municipal Utility District (SMUD); San Diego Gas & Electric; Southern California Edison; Southern California Public Power Authority (SCPPA); Western Independent Transmission Group.

[3]Bureau of Land Management; California Energy Commission; California Public Utilities Commission; California State Association of Counties; Regional Council of Rural Counties; US Forest Service.

[4]California Energy Commission; CAISO; California Public Utilities Commission; NCPA; SMUD; SCPPA.

[5]Black & Veatch performed extensive technical and economic analysis and produced several reports throughout the course of the RETI collaborative.

[6]Reference [1, Ch. 3] describes the RETI study methodology, pp. 3-1–3-50.

Canada and transmitting the energy to California consumers, utilizing both existing and new transmission infrastructure. For purposes of conceptual transmission planning, resources in British Columbia, Oregon, Northern and Southern Nevada, and Baja California were treated as CREZ, with economic scores for those resources computed on the same basis as California CREZ. RETI Phase 1 also estimated the delivered cost to California users of biomass, geothermal, solar, and wind energy developed in other resource-rich areas across the West.

The Western Governors' Association, using RETI as a model, began a similar effort in 2009 to identify Western Renewable Energy Zones throughout the western 11 states, Alberta, Baja California, and British Columbia [4].[7] RETI considered resource and transmission cost data from WREZ analysis in its Phase 2 study. Power from out-of-state resources was grouped for delivery to major gateway substations along California borders [5].[8] Economic ranking found delivered power from some out-of-state areas to be less expensive than power from some California CREZ [6].[9] Detailed analysis of transmission costs from out-of-state areas, and cost and development uncertainties for all CREZ and out-of-state resources were also performed [7].[10] The least expensive California CREZ were found able to supply much more power than needed to meet the state's 33% renewable energy goal without calling on out-of-state resources.

Evaluation of renewable resource regions located out of state was limited by lack of environmental data comparable to that available for California. 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 CREZ were evaluated as parts of California CREZ.

C. *CREZ Economic Assessment and Ranking*

Stakeholders agreed on all assumptions used to calculate the Levelized Cost of Energy for generating projects in specific locations [8].[11] These assumptions included the capital and operating costs and performance characteristics of every generating technology, along with estimated site-specific development costs and transmission costs. RETI also estimated the value of the energy and capacity from resources within a CREZ by considering the production profile of those resources [9].[12] The difference between estimated cost and value provided the basis for CREZ economic ranking; the lower the figure, the better the economic value of the CREZ.

[7]WREZ Qualified Resource Areas are described in [4, p. 6-2].

[8]Out-of-state resources and corresponding gateway CREZ and gateway substations are shown in [5, p. 6-15].

[9]See [6, Table 7-2, p. 7-3] of this report, "Weighted Average Rank Cost—All CREZ and Resource Areas.". Fig. 7-1 on p. 7-5 displays this information as a supply curve.

[10]Reference [7, Fig. 7-3, p. 7-11] shows the supply curve of resources available with uncertainty bands indicating ranges of cost uncertainty for each resource area.

[11]Resource cost, technology cost, and performance and financial assumptions underlying RETI work are explained in [8, Chs. 4 and 5, pp. 4-1–5-50].

[12]Economic ranking methodology is described in [9, pp. 3-22–3-32].

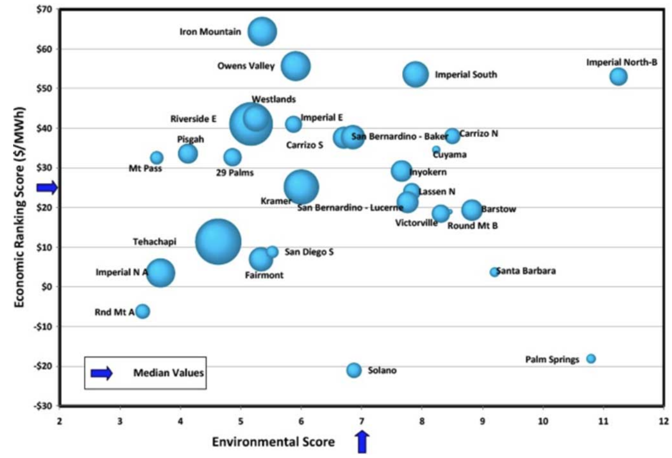

Fig. 1. Economic and Environmental Assessment of California CREZ, 2010.

D. *CREZ Environmental Ranking*

CREZ identification respected areas specified by RETI's EWG where energy development was prohibited or restricted as a result of law or policy. Within allowed development areas, the EWG assessed potential environmental concerns associated with CREZ, the renewable energy development areas within them, buffer zones around them, and the footprint of associated transmission facilities. Quantification of environmental concerns, using statewide datasets, allowed CREZ to be compared in a manner similar to economic ranking. Eight criteria were identified to support preliminary comparisons of the relative environmental sensitivity of California CREZ [10]. These rough assessments were in no way intended to substitute for detailed study of actual environmental impacts of development.

E. *Combined Economic-Environmental Ranking*

RETI next combined economic and environmental rankings to identify CREZ most likely to be developed (based on then-available data) and thus best able to justify transmission to those areas. This combined ranking is shown in Fig. 1. In this figure, bubbles represent each CREZ; the size of the bubble represents the estimated amount of energy (GWh) able to be generated in that CREZ. The x-axis represents increasing environmental concern; the y-axis represents increasing economic cost. The most attractive CREZ are thus in the lower left region of the graph. CREZ in that quadrant have relatively less environmental concern, and relatively low economic cost.

IV. Determining Required Transmission; Least-Regrets Planning

RETI stakeholders determined the aggregate capacity of new transmission to be planned by first estimating the amount of renewable energy needed to meet the state's 33% policy goal and subtracting the amount that could be supplied without new transmission infrastructure.[13] Renewable distributed generation connected to distribution circuits, and utilization of existing transmission freed up by displaced fossil power, both reduce

[13]RETI planning started from the California Energy Commission statewide load forecast prepared as part of its 2007 Integrated Energy Policy Report. This forecast projected total California load to grow 1.3% per year to 2020, to 335 644 GWh in that year.

the need for new transmission. Energy efficiency savings and customer demand resources reduce the total load forecast and thus the 33% share that must be provided by renewables. Many environmental stakeholders believe that the state can meet its renewable energy goals with a combination of energy efficiency programs and rooftop photovoltaic installations, eliminating the need for new transmission. By assembling consistent data and facilitating public discussion of this issue, RETI achieved stakeholder consensus on the estimated amounts of energy efficiency savings and distributed generation that could be in place in the state by 2020 [11]. After these factors were taken into account, and considering the amount of existing renewable energy in operation in the state, stakeholder consensus found approximately 57 000 GWh of new large-scale renewable generation to be needed to meet the state's 33% target in 2020. The RETI transmission plan thus had to be capable of accessing and delivering that amount of energy (referred to as the "Net Short") to California customers.

RETI used principles of least-regrets planning to guide its work. This identifies transmission facilities likely to be found needed and fully utilized under a number of development scenarios. Considerations include the potential of planned transmission to increase network reliability, reduce anticipated congestion, or increase statewide bulk power transfer capacity, in addition to accessing renewable energy under a variety of future resource development scenarios. Incorporating least-regrets considerations increased the robustness of the statewide plan and helped minimize the risk of creating stranded assets—the risk to transmission owners and consumers that facilities will not be adequately utilized.

V. Conceptual Plan Assessment Methodology

A. *Objective Methodology for Prioritizing Line Segments*

To develop its initial conceptual plan, the SSC formed a Conceptual Planning Work Group (CPWG). This work group started with the set of revised CREZ, including those representing out-of-state resources. It considered alternative network connections for accessing them, and compiled a comprehensive list of conceptual transmission components for this purpose. Using the evaluation methodology described below, it then grouped the line segments into three categories of transmission facilities: Renewable Foundation lines, Renewable Delivery lines, and Renewable Collector lines [12]. Some lines serve two or three of these functions.

Renewable Foundation lines increase the capacity of the California transmission network across the state, and especially between Palm Springs and Sacramento, allowing energy to flow north or south as needed. They allow energy from almost all identified CREZ to reach load centers throughout the state. There are 14 key transmission components in the Foundation Group. 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.

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

Renewable Collector lines carry power from various CREZ to Foundation and Delivery lines. These transmission components are grouped geographically into projects capable of accessing adjacent CREZ. There are 12 groupings of collector lines. Several of these transmission components form portions of or connect to major intertie lines connecting California to the rest of the western regional grid, and therefore, provide access to out-of-state resources. RETI's Conceptual Planning Work Group sorted these groups of transmission components by the amount of renewable energy they could transport, their environmental ratings, and estimates of their capital cost.

RETI then developed an assessment methodology for estimating the relative usefulness of proposed transmission components in each grouping for carrying renewable energy. This assessment methodology uses shift factors or distribution factors and metrics for estimating the amount of renewable energy that various transmission components could access and deliver. 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 [13]. The percentages flowing in each of the line segments included in the RETI conceptual statewide plan were tabulated in a matrix. Since more than 100 new transmission components were considered to provide access to 35 CREZ, more than 3500 shift factors were computed in the evaluation.

RETI also developed four CREZ energy metrics, or rating criteria, to incorporate different dimensions of renewable energy availability [14]. These four criteria are: A) Total CREZ energy potential; B) Total CREZ energy weighted by CREZ economic scores; C) Total CREZ energy weighted by CREZ environmental scores; and D) CREZ energy having known commercial interest, measured in terms of Power Purchase Agreements and interconnection requests. The intent was to develop an adjusted energy score that reasonably reflected the considerations represented by each of these four criteria.

The renewable energy access provided by each transmission component in the conceptual plan was estimated by multiplying the absolute values of the shift factors for the line by each of the four energy metrics for every CREZ, and summing the result. This produced a single "combined energy score" which provided a kind of average energy score for each line segment. This was used to compare the energy access provided by individual transmission components.

A short extract of the line segment scoring results is shown in Table I. The first row of this table shows results for the second circuit of the Pardee-Vincent transmission line, from the Pardee substation to the Vincent substation in the Tehachapi region of Southern California. The first column shows the GWh of CREZ energy estimated to flow on that segment. The second column shows the economic rating of the CREZ energy accessed by that line segment; the third column, the environmental rating of the CREZ accessed; and the fourth column, the commercial interest rating of the CREZ energy accessed. The fifth column combines

TABLE I
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 values from the other four columns into one number.[14] The SSC used this Combined CREZ Energy Score in identifying the final set of lines it recommended in its conceptual plan.[15]

To recap, RETI's conceptual plan assessment methodology follows a five-step process [15]:

1) Transmission system modeling—In the first step, all proposed new transmission components 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—Shift factors tying the new transmission components to various CREZ were calculated.
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, the energy output of each CREZ, and commercial interest, represented by the amount of energy able to be provided by projects in each CREZ having Power Purchase Agreements or queue positions in the state's interconnection process.
4) The transmission components were then combined into functional groups (Renewable Foundation Lines, Renewable Delivery Lines, Renewable Collector Lines), 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, along with group energy ratings.

The steps in this methodology are shown as a flowchart in Fig. 2.

Taken together, this combination of weighted economic and environmental considerations, adjusted by shift factors, provides a transparent and objective methodology for evaluating the usefulness of lines to carry renewable energy.

The type of generation transported by new transmission projects is important to many stakeholders and portions of the public concerned about the effects of electricity generation on climate breakdown. Their support for transmission development depends in large part on evaluation of the extent to which proposed projects will access and deliver renewables. Many understand that electricity flows on the transmission network according to the laws of physics, and that flows attributable to any generator cannot be accurately tracked. Given this reality, the ability to estimate renewable energy flows provides pertinent information for decision-makers and the public as they evaluate proposed transmission projects.

B. *Environmental Framework of the Conceptual Plan*

Conceptual planning usually considers only potential electrical connections between substations, without regard to geographic and routing 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 [16]. RETI Phase 1 work referred to these as Category 1 and Category 2 lands, respectively. These steps are normally overlooked in traditional transmission planning.

RETI review of environmental concerns associated with generation and transmission projects was necessarily limited to high-level screening. Nevertheless, the SSC believed that even preliminary assessments of environmental concerns associated with new transmission facilities could help evaluate project developability and avoid consideration of those unlikely to be able to obtain required permits.

In 2009, RETI work groups including the CPWG, CREZ Revision Work Group (CRWG), and Environmental Work Group

[14]The relative line segment scores for each of the four CREZ energy metrics (columns 2–5 in Table I—energy potential, economics, environmental concern, and commercial interest) were first normalized by dividing the line segment score in each category by the maximum value for all lines. The relative combined score for each line segment was found by averaging the normalized scores for all four criteria, after weighting the economic and environmental scores by a factor of 0.5. This factor was chosen to give more weight to the quantity of energy accessed, and to commercial interest in developing the line segment, relative to CREZ economic and environmental considerations; different weighting factors could be selected to fit requirements of other planning processes. The combined score was then divided by the relative normalized line energy score to obtain an adjustment factor, which was multiplied by the line segment CREZ energy score (Column 2 in Table I) to obtain the Combined CREZ Energy Score for each line segment (Column 6 in Table I). For additional explanation, see: Renewable Energy Transmission Initiative, "Phase 2A Final Report," August 2009, pp. 3-59–3-61; and in online Appendix A, Phase 2A Data Workbook, the spreadsheet titled, "Data Rating Master."

[15]The Combined Energy Scores of all line segments accessing each CREZ were added to produce the total amount of energy flowing from each CREZ. CREZ having the largest Combined CREZ Energy (in GWh) have the potential to supply the most renewable energy while developing the fewest number of CREZ. However, groups of line segments accessing each CREZ were also ranked by their combined Environmental Scores, and by their estimated capital costs. CREZ and corresponding groups of line segments supplying the largest amount of energy with the lowest group environmental score and at the lowest cost for the amount of transmission required are preferred.

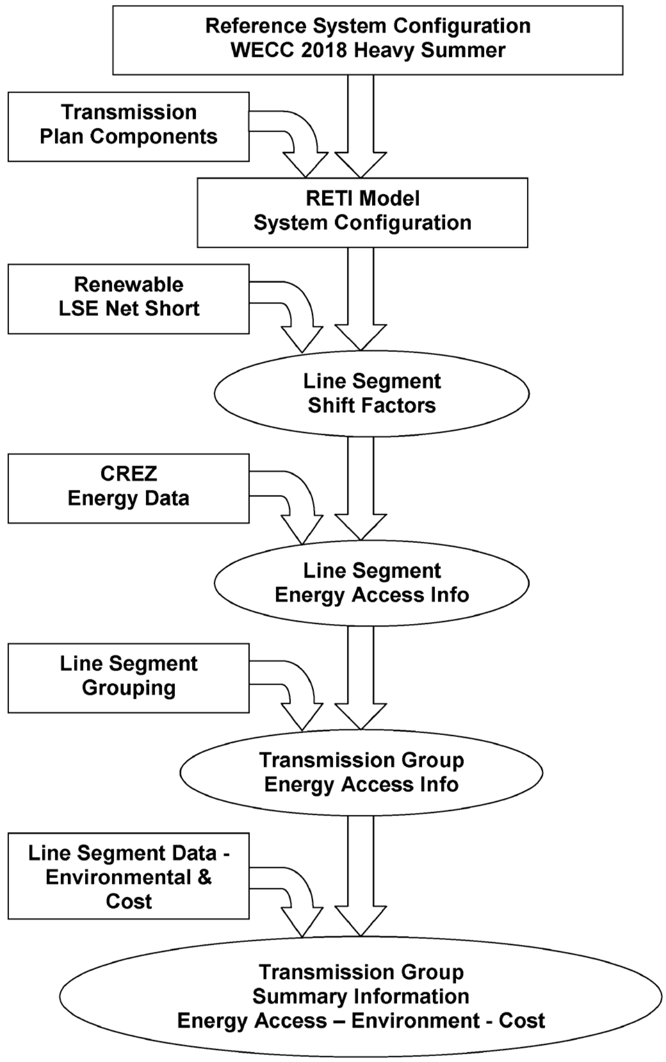

Fig. 2. Flowchart for RETI Conceptual Plan Assessment.

collaborated to modify 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.

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 these new facilities. In addition to these objective considerations, the CRWG convened panels of environmental experts to provide their collective professional opinion on environmental concerns and the extent to which these concerns could be mitigated [17].

VI. Controversial Issues

With hard work and intense interaction, RETI Stakeholder Steering Committee members found ways to agree on almost all of the detailed planning assumptions required by the study. Given the diverse interests and perspectives represented, this required both compromise and willingness to proceed with less than adequate data on some issues. Several issues proved especially difficult and controversial. These included:

Net Short. This is the amount of renewable energy, in GWh, estimated to be needed to meet the state's 33% target, after considering adjustments to demand created by energy efficiency savings, distributed generation, combined heat and power, electric vehicle charging, and other such factors. Inadequate objective information made estimates of the contributions of these resources in 2020 highly uncertain. This in turn made it difficult for SSC members to agree how much bulk renewable energy and transmission was likely to be needed by that year [18].

Environmental Scoring. As a screening level study, RETI did not have time or resources to perform detailed evaluations of potential environmental impacts of resource and transmission development in CREZ or out-of-state areas. The categories of impacts and the scoring process used to estimate environmental concern were admittedly subjective, and were intended to allow assessment only of the relative environmental concern associated with development in CREZ and out-of-state areas. The SSC did, however, agree to use such scoring to ensure that at least rough indications of environmental concern were included in the earliest stages of planning transmission to access renewables.

Environmental Ranking of Wind Projects. The wind industry, following precedents established by the U.S. Department of Energy, held that the impacts of wind projects should be calculated only for the area disturbed by turbine foundations, access roads, and associated substations, a footprint typically about 5% of the total land area required by a project. State and federal agencies, in contrast, maintained that 100% of project area should be considered as affected, in view of impacts on habitat and to birds, even though only a small percentage is actually disturbed. This was the one issue on which the SSC could not achieve consensus, and the wind industry filed a formal dissent. RETI Phase 2A and 2B reports calculated CREZ environmental rankings using wind industry formulas (5% of wind project area considered disturbed), and included these alongside the majority-agreed rankings [19].

Shift Factors. Also called Distribution Factors, these are a standard utility planning tool. RETI, however, marked the first time that shift factors were used to estimate the relative usefulness of line segments in carrying renewable energy. Shift factor analysis has the significant limitations explained in the RETI reports, and some engineers were uncomfortable using shift factors for this purpose [20].[16] In view of the increased scrutiny being applied to transmission projects intended primarily to provide access to renewable energy, RETI's approach to use of shift factors may be of interest to transmission planning processes in many jurisdictions.

VII. Purpose and Use of the Conceptual Plan

The purpose of conceptual planning is to identify potential transmission alternatives—in this case, those most effective in supporting the state's 33% renewable energy goal—for detailed study. Power flow modeling and production cost simulations performed by the CAISO and California Publicly Owned Utilities (POUs) then determine which projects are needed and meet economic metrics, and how they must be configured electrically.

[16]See [20, Sec. 3.4], Limitations of the RETI Rating Methodology, p. 3-61, and Appendix K, "About Shift Factors."

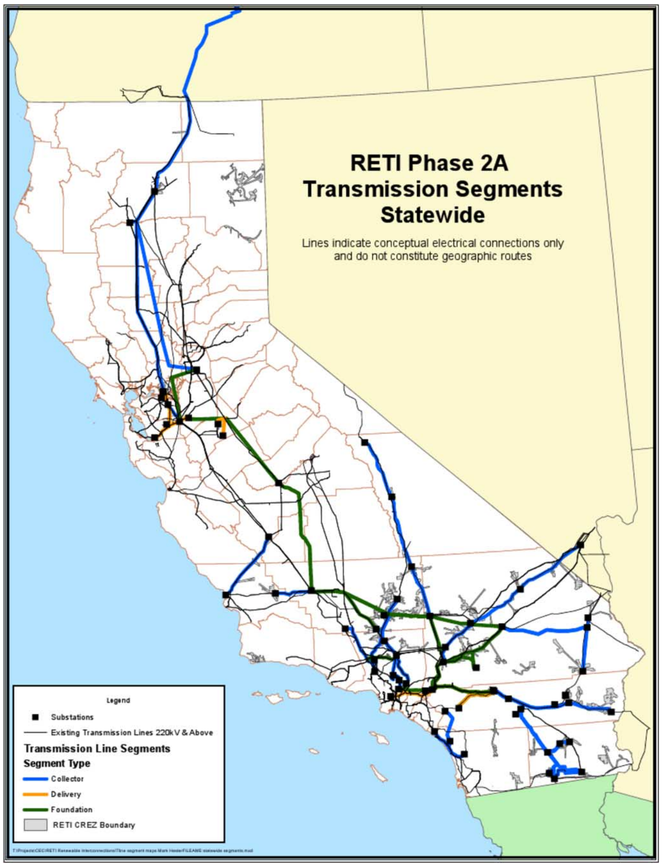

Fig. 3. Conceptual Plan Line Segments.

A plan capable of being implemented can be developed only after such detailed study.

The purpose and limitations of RETI's initial conceptual transmission plan are summarized below.

The RETI Conceptual Transmission Plan:

- Identified additional transmission capacity to access and deliver renewable energy to meet state goals in 2020.
- Evaluated relative usefulness of potential lines for accessing and delivering renewable energy.
- Identified potential transmission network lines for further detailed study by CAISO or POUs.
- Located most conceptual lines in existing rights of way or designated utility corridors.
- Incorporated environmental considerations from the beginning; included high-level environmental screening of conceptual transmission lines.
- Incorporated a wide range of stakeholder perspective.

The Conceptual Plan did not:

- Include precise routing of lines.
- Preclude study of other areas having 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 or for designation of development zones.

Key line segments identified in the RETI conceptual plan are shown in Fig. 3.

The many transmission components identified in the preliminary conceptual plan are in different stages of development. Some, like Tehachapi and Imperial Irrigation District (IID) transmission projects, 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 segments, in 2013. Lines in the Foundation Group were estimated to be able to be placed in service in the 2014–2016 time frame. Several larger projects are not expected to be built until 2020.

Priority line segments in the RETI plan are now being studied by the California Transmission Planning Group (CTPG). The CTPG was formed in late 2009 to enable California POUs to plan jointly with the CAISO, which operates the grid owned by the state's investor-owned utilities. Scarce transmission rights-of-way and financial and environmental pressures now effectively require shared utilization of transmission facilities in the state. The CTPG has taken RETI's prioritized transmission facilities and is performing detailed power flow, stability, and economic studies. Study results will be used in the CAISO Transmission Planning Process approved by the Federal Energy Regulatory Commission, and in the transmission planning processes of California POUs.

VIII. Conclusion

New transmission lines are understandably controversial, especially those which require new rights-of-way. The California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) require that the public be given the opportunity to comment on proposed transmission lines and alternatives. 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 likely impossible to avoid all opposition to new lines.

The RETI plan was 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 significant limitations [21]. But at a time when national and regional transmission planning is increasingly being tied to renewable energy development, stakeholder involvement in planning can help build public acceptance of the required infrastructure. Development of this ranking methodology is a significant outcome of the RETI process.

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