WECC TEPPC 2007-08 Study Plan

Attachments

Work-in-Progress

April 17, 2007

WECC TEPPC 2007-08 Study Plan

I. Introduction

Because the 2007-8 WECC transmission expansion study program is a first effort, it will entail new thinking to delineate what Transmission Expansion Planning Policy Committee (TEPPC) is studying, why and for whom. As a first effort, the likelihood of success will be enhanced with a Study Plan describing a modest and focused study program. It is particularly important that we have a framework for the Study Plan that ties all TAS work group activities and study cases together in a plausible way. Above all else, TEPPC seeks to deliver a product in February, 2008 that is concise, coherent, technically sound, and useful. Additionally, we want to position ourselves to be able to 1) respond to major federal initiatives, 2) incorporate the work and needs of the sub-regional planning groups, state authorities, transmission providers and generators; and, 3) provide information that is of relevance and value to WECC Board and all member classes.

A key distinction between the Seams Steering Group-Western Interconnect (SSG-WI) Planning Work Group (PWG) and the present Study Plan challenge is that we are no longer in need of remedying the "empty plate problem", i.e. no proposed projects. While the PWG began with relatively few major proposed transmission projects, in the past 4 years major[1] and many minor projects have been approved and are under construction. In that time we have completed multiple interconnection and sub-region study efforts. A myriad of projects are on the drawing board and dozens are passing milestones in the WECC Regional Planning[2] and three phase rating processes. Many of these have emerged from the previous planning studies. An increasingly robust set of sub-regional planning groups (SPG) is emerging.[3]

These results present an intriguing dilemma for the TAS/TEPPC. What is it we are to do that can add value to what has already occurred? A blank-slate PWG-style study is clearly not needed or relevant. Many lessons have been learned in the PWG, Western Congestion Assessment Task Force (WCATF)[4] and Clean and Diverse Energy Advisory Committee (CDEAC)[5] processes. Adjustments can be made to improve on assumptions and approaches to reflect these lessons. Finally, unprecedented changes in federal oversight of reliability and transmission planning have occurred since the SSG-WI studies. A successful Study Plan and 2007 study program will reflect all of these dimensions.

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[1] TEPPC Major Projects link: http://www.wecc.biz/wrap.php?file=wrap/projects.html

[2] WECC's Planning Coordination Committee (PCC) has a detailed regional project planning and three-phase rating process that complements the TEPPC and sub-regional planning group economic expansion planning modeling. In the regional planning reviews, specific projects are defined and detailed power flow and other transmission system evaluations occur at the path level. If projects are successful, they emerge from the three-phase rating process with a path rating granted for the project when constructed.

[3] The TEPPC webpage has links to six sub-regional planning group websites (scroll down to bottom)

[4] The WCATF is the task force formed by WECC, SSG-WI and CREPC to perform the analyses and provide recommendations to the DOE for the western interconnection (WI) portion of the congestion study required by EPACT. This work was done in 2005-6 and the DOE study was provided to Congress in August, 2006.

[5] The CDEAC was a stakeholder committee of the Western Governors' Association (WGA) created to evaluate and recommend how to implement the Governors' goals related to efficiency and diverse and clean resources. These goals included achieving a 20% increase in energy efficiency by 2020 and development of 30,000 MW of new clean energy in the WGA footprint by 2015 [note the WGA footprint is not synonymous with the WI].

The thesis of this proposed SWG Study Plan is that the framework established by federal legislation and regulation, such as Federal Energy Regulatory Commission (FERC) Order 890, provide a reasonable starting point for organizing our first-time through 2007 TEPPC study program. Thus, this proposed Study Plan is organized around the federal framework activities, products and outcomes, including those described in Section II below. As described in Section III below, this approach can be refined and made more sophisticated after we complete one study cycle. The 2008-9 study cycle will be developed within the Western Planning Process developed to meet the requirements of Order No. 890. The 2007 study work will be foundational to future work, i.e., testing methodology and procedures from which successive improvements will be made.

II. Transmission Planning Framework

The context of WECC TEPPC's activities is a complex web of federal, regional, sub-regional, state and industry-level actions and requirements. The federal mandates contained in statutory and regulatory provisions established by Congress, FERC, DOE and NERC set the overall framework for all WI entities undertaking planning. Five major components of the national transmission planning framework include:

EPACT SEC. 1221 (a) (16 U.S.C. 824 Sec. 216 (a) (1) requires a study of electric transmission congestion;

EPACT SEC. 1221 (a) (16 U.S.C. 824 Sec. 216 (a) (2) requires a report designating national interest electric transmission corridors (NIETC);

EPACT SEC. 368 (b) provides for the designation of corridors for oil, gas and hydrogen pipelines and electricity transmission and distribution corridors on federal land in certain contiguous western states;

EPACT SEC. 1221 (b) establishes FERC backstop transmission siting authority over projects in designated NIETCs;

A FERC OATT Order 890 provision establish nine principles for transmission planning, and requires transmission providers to demonstrate compliance with the order by filing a Strawman proposal and Attachment K to Open Access Transmission Tariff (OATT).

The latter two components closely fall under TEPPC Charter Function 2 - *Providing policy and management of the planning process*. Progress is being made organizing a coordinated TEPPC and SPG effort to respond to Order 890 via the development of a Western Interconnect (WI) Strawman outlining an emerging Western Planning Process that will be a central driver in establishing a consensus transmission planning process. As it moves toward final implementation in OATT tariffs, Order 890 will clearly play a critical role in regional transmission planning in

2008 and beyond. States, independent developers, TP and others are actively participating in the FERC 1221 backstop siting regulation development process.[6]

The first three are most germane to the TEPPC Charter Function 3—*Guiding the analyses modeling for WI economic transmission planning*, the main function addressed by the Study Plan. The challenge to TAS and its workgroups is to organize all of its work group tasks and analyses into an integrated whole that begins to address requirements and conclusions of these components. The draft TEPPC/TAS work plan provides the first step, laying out the broad approach, including tasks and schedule. From this foundation, this Study Plan takes the next step by describing in more detail the specific studies and study cases that will be analyzed in the 2007-8 study cycle.

The TAS Studies Workgroup (SWG) has made progress in delineating timeframes and approaches for modeling cases. The SWG proposes three frameworks: an existing conditions case; a near term case; and multiple long term cases including one data test case and multiple transmission expansion cases. It has developed initial descriptions of the purposes of these cases, and has added the analyses of the TAS Historical Workgroup (HWG) and modeling Workgroup. Continuing work is needed to describe cases, their relationship to the TAS Study Report Outline and to identify linkages to the needs, expectations or results of the federal framework components. [Reviewer Note—the Study Report Outline contains references to "potential……needs…. problems….solutions…, non-wires solutions…transmission construction alternatives…."; we are not yet incorporating the same terminology in the purpose statements of the cases below.]

Section III below describes the TEPPC Study Cycle and outlines an initial "adaptive" approach that can provide a basis for a draft Study Plan that is directly integrated with the draft TEPPC Work Plan. Section IV provides an overview of the four main elements of the Study Plan and Section V contains a Strawman describing the proposed approach to conducting the long term (2017 +) modeling analyses.

The attachments to this proposed Study Plan address the development and documentation of assumptions needed to implement the Study Plan. **Attachment A** contains guidelines for developing assumptions; **Attachment B** provides a format for actual assumptions and documentation thereof; **Attachment C** contains the draft TEPPC Study Report Outline; and **Attachment D** contains a list of acronyms used in this Study Plan and other related products.

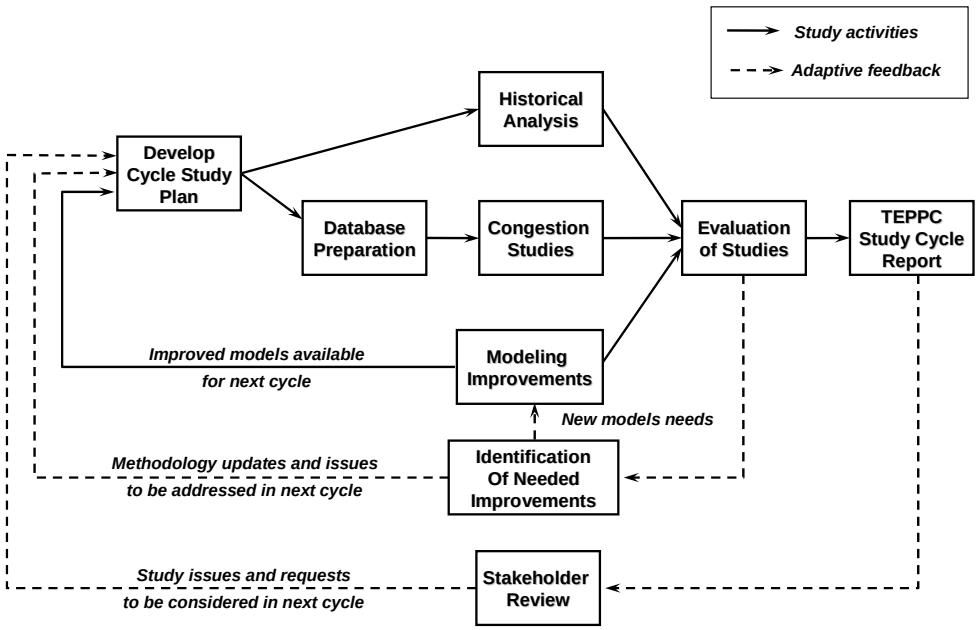
III. TEPPC's Study Cycle – An Adaptive Process

Figure No. 1 below, provides a graphic depiction of the TEPPC transmission expansion planning study cycle. Each cycle begins with the development of the Study Plan. The preparation of the Study Plan considers: (1) model improvement that have become available since the formation of the last study plan; (2) recommendation for issues to be considered and methodology improvements to be made as a result of evaluating the results of the last study program; and (3) study issues that stakeholders have requested be considered in the next study plan. During the study period, data is prepared as needed for the Study Plan, historical studies and congestion

[6] Though closely related and needing to be well-coordinated, these two components are not directly address in this draft Study Plan.

simulation studies are made. Improvements in modeling are ongoing. Information from these activities is evaluated in producing the TEPPC study report for this cycle.

Figure No. 1
The TEPPC Study Cycle
An Adaptive Process



In addition to producing transmission expansion studies, the TEPPC process includes adaptive feedback features. The evaluation of the studies made in preparation of the study report is also used to identify issues that should be addressed in the next cycle and to determine needed improvements in methodology. Feedback from stakeholders is invited along with requests for issues to be considered in developing the next study plan and in identifying needs for new models. Ongoing modeling studies produce new models which then become a part of the next study cycle as they are ready for implementation.

This adaptive study cycle is designed to provide a process that is responsive to changes in needs and which learns and improves with each study cycle.

IV. Study Plan Elements

This Study Plan proposes a study approach containing four main elements: historical analyses; WI system modeling; implementation of modeling enhancements; and review of federal corridor designations. Each of these is described briefly below.

A. Historical Analyses

Provide a historical perspective on congestion within the Western Interconnection.

- Collect and analyze historical data of line flows and other congestion related information.
- Archive actual flow and OTC data.

B. WI System Modeling Cases: Purposes and Timeframes

Three timeframes have been identified for modeling cases: existing, near term and long term. Preliminary descriptions of these are summarized below. The SWG has also developed a Strawman proposal for a 2017 data test case and multiple future transmission cases, as is summarized in Section V below.

1. Existing Conditions Test Case (2007)

   a. Purpose – A benchmark for current conditions and model verification, which can be used by transmission providers and others for evaluation of existing congestion.
   b. Case preparation will use:
      - Existing generation and transmission resources.
      - Recent historical hydro data.
      - Historical load data to avoid confidentiality issues.
      - Network of operating power case flow for heavy summer 2007 - 07HS3A

2. Near-Term Case (2010-11)

a. Purpose – A near term case to be used for evaluation of future congestion occurring before most transmission expansion alternatives can be implemented by considering sensitivity of congestion to hydro conditions, fuel costs and other major parameters.
b. Case preparation will use:
   - Committed new resources & transmission (3 years out), as identified by Loads and Resources Subcommittee for in-service date.
   - Load Forecasts for 2010 (first non-confidential year).
   - Network of a 5 year power flow case (2012 heavy winter case) with adjustments as required to remove lines not in service in 2010 - 2012HS2.

3. Long-Term Cases (2017)

a. Purpose – A long term case used for study of congestion and transmission expansion alternatives, through evaluation of a set of Expansion Study Cases. These cases will consider the effect on future transmission needs based on differences in resource mix and location including demand side alternatives. (See Section V for further discussion.)
b. Case preparation will use:
   - Resource types and quantities held constant to maintain reserve margins and meet energy requirements of load.
   - Generation plant locations varied to test different transmission configurations.
   - Forecasted load for 2017.
   - 10-year power flow case (2017 heavy winter case) - 2016-17HW1
c. Scenarios with alternative generation portfolio with supporting transmission.

- Resource technologies and quantities changed to reflect potential policy changes increasing RPS levels and new carbon restrictions.
- Transmission adjusted to support specific generation assumptions.
- Transmission contained in the sub-regional biennial plans.
- Generation resources scaled to meet load with appropriate margin.
- 10-year power flow case (2017 heavy winter case) - 2016-17HW1.

C. Modeling Enhancement Implementation

As described in the TEPPC Work Plan, the TAS Modeling Workgroup is tasked to periodically review the analytic methodology and modeling tools and recommend improvement tools used for economic transmission planning expansion. The Modeling Workgroup has prioritized the modeling improvements needed to determine which can be done now and which improvements will be studied later. In each study cycle, the improvements available at the time will be included in that study cycle. For this 2007 study plan, only those model improvements available when the data-base is released will be used.

The areas being considered for model improvements are:

- Hydro modeling
- Constraint modeling
- Wind modeling
- Phase angle regulator modeling
- Losses modeling issues
- DC line modeling issues
- Must-run generation modeling issues
- Thermal unit commitment and ramp modeling
- Load modeling
- Analysis of pricing issues

D. Overlay of Federal Corridor Designations

The DOE is scheduled to release its final draft Environmental Impact Statement identifying electric transmission corridors on federal lands in western states in spring 2007. Over the course of the remainder of 2007, it is expected that corridors will be designated through the process of federal land management agencies releasing Records of Decisions that amend their land management plans. A final element of the 2007-08 Study Plan will include an overlay of federally designated corridors onto maps of congested paths and congestion constraints that emerge from TEPPC modeling. This will not reflect any desire to affect or change designations, but will inform review of how closely the corridors emerging in the western U.S. match those on federal lands.

E. Summary

As noted in Section III, this Study Plan proposes a methodology that may be viewed as a test for 2007. It will certainly evolve in future cycles. Overall it seeks to integrate the multiple aspects of TEPPC and TAS activities into a framework that is responsive to national, regional and sub-

regional needs and requirements. Table 1 provides an illustrative summary of how the Study Plan activities could inform such assessments.

While the analyses and resulting *2008 Study Report* may not identify or prioritize specific areas of "critical, concerning or conditional" congestion, it will seek to provide information to provide a basis for assessment of congestion.

Metrics that may be used to quantify the significance of congestion and its potential value will be similar to those used by WCATF and DOE, subject to revisions that result from the congestion metrics workshop TEPPC has planned for spring 2007. These include: binding hours (% of time annually or number of total hours); U90 (% of time annually or number of total hours) a constrained path is loaded above 90% of limit; shadow price (price averaged over all hours in a year); binding hours shadow price; and congestion rent (shadow price x flow summed over all hours constraint is binding). [Note—these are DOE's definitions and may differ from those used in the WI studies.]

Table 1. Summary of Study Plan Activities and Congestion Categories

	EXISTING CONGESTION	EMERGING CONGESTION	CONDITIONAL CONGESTION	FEDERAL CORRIDOR DESIGNATIONS
Historical Data and Analyses	XX	XX		X
Existing Conditions Case	XX	XX		X
3-5 Year Case	?	XX		X
10 Year Data Test Case			?	
10 year Transmission Expansion Cases			XX	XX
Modeling Enhancements Overlay Congested Paths on Federal Corridor Maps	X	X	X	X

V. Strawman Proposal - 2017 Data Test Case and Transmission Expansion Cases

This Strawman proposal for 2017 long-term cases avoids the presumption that it is possible to create one reference case against which all scenario cases are measured. In large measure, it is the assumed future generation resources and their location that drives the modeling results, including the costs of congestion and the benefits of transmission to address it.[7] This is true for a reference case just as it is, albeit to a larger degree, for the scenario cases.[8] The approach proposed here is to identify multiple future transmission expansion cases. The important point is that no judgment would be involved as to which of the future cases is more likely, preferred or the most appropriate to judge other cases against. Results of all the cases would be reported in comparable fashion.

Another central feature of the proposed approach is that it would rely on L and R data, IRPs, RPS and other policies to quantify increments of resources by fuel type. This would constitute a proxy, hypothetical "WI Resource Plan." These quantities and types of resources, *but not their specific locations or the associated transmission*, would be held constant and applied consistently across the 2017 transmission expansion cases.

This proposed approach for 2007 could include seven activities: A) Specifying the foundation information that would be the same in all cases; B) Constructing and running the 2017 Data Test Case; C) Specifying Proxy WI Resource Categories and Increments; D) Selecting themes of, and constructing the future transmission expansion cases; E) Identifying sensitivities useful to perform on all or selected cases; and, F) Conducting comparisons of case results; and; G) Initiating 2008 analyses extending the 2007 work to test more extreme "scenario" cases, or new cases identified by DOE for their Congestion Study update.[9] The following sections provide an overview of the seven activity areas involved in implementing the approach described in this Strawman proposal.[10]

<u>A. Specifying Foundation Assumptions.</u> The foundation assumptions for all of the expansion cases would be the same. To the maximum extent feasible these assumptions would rely on consensus work already completed by the SSG-WI Planning Work Group (subject to data/error corrections documented in the Promod database transfer process). More recent information provided by the Load and Resources Committee (LRS) for the 2007 Power Supply Assessment (PSA) would also be used. Attachment A describes a draft approach to developing assumptions for the modeling cases. Steps for this activity to build all cases would include: Input reasonably known information; and, Quantify Gap between loads and 2008 resources and 2016 loads.

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[7] This is one reason DOE defined categories of congestion that focused on 1) the near term with actual operations or known resources and 2) mid-to longer term that identified "conditional" congestion that was dependent on what (and where) resources were added in the future.

[8] In addition to the false certainty, creation of one reference case leads to perverse incentives for project developers to get their project into the reference case, in hopes of somehow benefiting from being there.

[9] Scenarios changing generation increments developed from what is learned in the 2007 cases would be analyzed in 2008—see activity 7 on page 9.

[10] A more detailed description of steps to implement each activity area has been developed in a draft proposal available on the SWG page of the WECC website.[Grace still needs to update this and provide to Robert for review and posting].

B. Constructing and Running the 2017 Data Test Case. The 2017 Data Test Case would include all existing resources as described in the foundation assumptions above. It would also include planned incremental generation that is complete or under construction and scheduled for completion by December 2010. If there is insufficient generation to meet projected load and required operating reserves during some hours the model will provide for these shortages either by using the model's capability to track un-served demand or by using expensive fictitious generation near the load centers. Reports will include an accounting of locations and amounts of these additional needed resources. These reports provide an indication of needs that is not met by existing or likely incremental generation and the location of that need.

C. Specifying Proxy WI Resource Categories and Increments for 2017 Cases. The purpose of this step would be to address the challenge of future generation uncertainty by creating proxy, hypothetical WI resource technology/fuel increments to be used for all 2017 transmission expansion cases. Holding resource quantities constant is needed to allow focus of the comparative analyses to be on transmission rather than future generation. This would only be used for the purposes of simulations in 2007 and would be changed every year to reflect updated resource development, regulatory/policy direction or paradigm shifts due to dramatic fuel or technology cost changes, etc. It would have no WECC or state "approval" for any policy or other regulatory purpose.

There is consensus (thus far) that this simplifying assumption of holding generation types and quantities constant is acceptable for 2007. However, it has been noted that this artificial but necessary vision of the future embeds a narrow view of possible outcomes. It is important that this be expressly acknowledged in the *Study Report* and with appropriate caveats on study conclusions. Additionally, the need to evaluate scenarios changing generation increments (developed from what is learned in the 2007 cases) has been emphasized (see Activity G on page 12).

D. Constructing and Running 2017 Transmission Expansion Cases. Based on input from sub-regional planning studies and mega-project analyses, and using the foundation assumptions and resource category quantities, future cases would be constructed. The focus of the case themes would be on illuminating possible transmission development. While each case would use the same total quantity and total amounts of each category of resources, the *locations of less certain project resources would be varied.* This in turn would result in *differing congestion results and the new transmission required to deliver the resources varying* among the cases. It would seek to highlight different export/import relationships among sub-regions without the "over-building" for the WI overall that results when exports are assume and analyzed at the sub-regional planning level. It is important to note that although the overall WI reserve margin target would be adhered to, different future cases would by definition vary sub-region margins as a result of varying export assumptions.

In moving the proxy WI resource plan to different locations, it may be necessary to make some substitutions to achieve the same intended capacity and energy margins. Even though total renewable energy increments would be constant (as needed to meet RPS and other requirements), the specific fuel types to accomplish this would vary as the spatial distribution changes among the cases. Changes in types of renewables could also vary estimates of energy (gigawatt hour(s)-GWh) margins; this would be tracked and adjustments made as appropriate.

Illustrative descriptions of possible 2017 case variations could be:

1. West Coast load centers seek self-sufficiency with indigenous west coast resources.

2. West coast load centers pursue diversity of fuels/location for 1/2 of incremental need, assuming resources meet greenhouse gas (GHG) performance standard (GPS) requirements; RPS can be met using renewable credits (except where prohibited by state requirement) and
   a. Wyoming/Montana wind and coal develops and Nevada develops transmission and coal by rail w/geothermal plus wind.
   b. Canada develops resources and transmission for export via inland or off-coast corridors.
   c. Southwest renewable resources are delivered to load centers

3. The WI states and Load Serving Entities (LSEs) achieve the WGA clean and diverse energy initiative (CDEi) efficiency goals (20% by 2020).

Significant deliberation will be required to make progress specifying these 2017 transmission expansion cases. This will occur through a collaborative effort led by a SWG team of volunteers targeted around the May timeframe.

E. Designing and Running Sensitivities. Load forecast uncertainty ranges (due to economic conditions or extreme weather) would be evaluated as sensitivity. Gas price sensitivities could be run for one case and the results applied qualitatively to other cases. Critical hydro could be treated the same way. Variations of carbon adder values could be used. At this time it is suggested that energy efficiency be treated as a stand-alone future expansion case and not as sensitivity. Further discussions of the TAS work groups will allow for specification of sensitivities.

F. Comparing Case Results. Summarizing the results of the simulations has proven to be a challenging task in past transmission expansion-planning exercises. Presentation of results need be tailored to the questions our "clients" are asking. The results of transmission expansion case simulations could be compared amongst themselves; to the 2007 and 2010 cases; to sub-regional studies or to the 2017 Data Test Case.

G. Development of Scenarios. Building on what is learned in 2007, scenarios that would test changes to the kinds of resources added (really high or low gas prices, high carbon adders, technology breakthroughs in performance/cost, etc.) would be pursued when practicable. It is also possible that DOE will request additional cases to be run to inform their August 2008 update of the EPAct Congestion Study.

Attachment A

Guidelines for Developing Expansion Study Cases

[Note—Continuing update needed as appropriate to reflect emerging 2007 LRS schedule and process.]

A. Principles to Be Applied When Developing Modeling Cases

1. The modeling cases will reflect compliance with existing state, provincial and federal law including Resource Adequacy Requirements, Renewable Portfolio Standards and carbon emission standards.

2. Cases will comply with any state mandated reserve requirements and any non-mandatory, but documented reserve targets, such as those in the Pacific Northwest. [11]

3. Where no documented reserve margin requirement exists, the Studies Work Group will work with WECC Loads and Resources Subcommittee to specify an assumed reserve margin.

4. Load forecasts will be documented and publicly reviewable. The starting point will be the L&R data submitted and publicly available in accordance with "Exhibit B - Collection and Review of Loads and Resources Data."

5. The load forecasts proposed for use will be posted on the WECC web site and an opportunity for states/provinces and others will be provided to adjust the proposed load forecast information. Changes to the proposed load forecast data will be documented.

6. A methodology for dealing with demand-side management resources will be developed.

7. The Modeling Work Group will provide a recommendation regarding backing out losses and efficiencies.

8. The specification of generation resources in the modeling cases will be in the following order:
   - Existing generation based on the existing TEPPC database, adjusted for updated information from the 2006 L&R data submittal.
   - Minus Class 1 and 2 generation retirements in the most recent Power Supply Assessment (PSA).
   - Plus Class 1 and 2 generation additions in the most recent PSA.

[11] The Pacific Northwest (PNW) is an energy-constrained area that has a voluntary energy adequacy standard in addition to a capacity adequacy standard. A methodology needs to be developed to translate the PNW resource adequacy standards to a resource adequacy measure that the PROMOD model can use, either as some type of quasi-reserve margin, or perhaps as an explicit energy metric.

- Transmission facilities used in the modeling cases shall be added as appropriate to the case:
  - Existing transmission facilities less any committed retirements.
  - Transmission facilities under construction and expected to be in operation by the date of the case.
  - Permitted but not-yet-under construction transmission facilities.

B. Data sources and documentation

1. Load forecast data from L&R submission which are governed by the confidentiality provisions of Exhibit B adjusted by:
   - Publicly-available state or provincial load forecasts; and
   - Publicly available LSE load forecasts.

2. Resource data from:
   - The generation resources used in the PSA.
   - State/provincially-approved or "acknowledged" LSE resource plans with any further definition on location of such presumed generation documented.
   - Generation resource data, which did not satisfy the certainty threshold, in the PSA, provided that the rationale for selecting proposed generation from this generation pool is documented.

C. Process for Developing the Modeling Cases

1. Regulatory Policies: WECC staff, with assistance from the Western Interstate Energy Board and Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory, will document state/provincial policies on Resource Adequacy Requirements, Renewable Portfolio Standards and carbon limitations.

2. Reserve Requirements: WECC staff will consult with the California PUC on reserve margin requirements for California IOUs and with the Northwest Power and Conservation Council on the possible translation of resource adequacy-driven standards in the Pacific Northwest to one-hour peak reserve margins. WECC staff will ask LSEs if they have any documented reserve margin requirements or targets.

3. Load Forecasts: Following receipt of L&R load forecast data, WECC staff will post the information on the WECC web site and request alternative forecasts from the California Energy Commission, Northwest Power and Conservation Council and another other parties by May 1. By May 15, WECC staff will assemble a documented load forecast for the Cases.

4. Resource Assumptions: Following receipt of L&R resource forecast data, WECC staff will post the resource additions for various certainty classifications on the WECC web site and request comments. Lawrence Berkeley National Laboratory would identify approved and potential resource additions contained in state/provincial approved/acknowledged LSE resource plans.

5. Transmission Assumptions:
   a. *Topology:* The topology to be used will be recommended by the TAS Data and Modeling Work Groups.[12]
   b. *Transmission Wheeling Charges*.[13]
   c. *Power Flow Case (s):* The SSG-WI data base has a WECC 2004 Heavy Summer case for network definition, providing one season's distribution factor definition. A decision need to be made with regards to updating, reading four power flow cases to reflect network operation in all seasons.

[12] It has been noted the SSG-WI database may be too detailed in the Rocky Mountain Power Authority (RMPA) (influenced by RMATS). It is challenging to update loads in the existing database because of the WECC L&R report does not have granular loads for RMPA. The number of bubbles helps to capture load shape diversity in sub-areas. In addition, the number of bubbles also allows for modeling different reserves held in different regions.

[13] We learned wheeling charges penalizes power exchange between regions/areas, hence impacts the dispatch. In SSG-WI we spent little time on this because of the disagreement on how to capture the operation version of wheeling rates.

Attachment B

Expansion Study Cases: Assumptions and Documentation

[Illustrative—to be Updated as SWG and TAS/TEPPC Approve Assumptions]

The 2007 TEPPC Study Plan modeling cases includes both production cost modeling (using Promod) and economic analysis (outside the model). Assumptions used in both are documented in this matrix and an associated set of attachments to be prepared.

	Key Assumptions [assumptions used in SSG-WI 2015 case]
Load Forecast	• The WECC's 2005 L&R load forecast is used for the 2015 studies, with three large exceptions: (Peak loads are based on one in two, monthly non-simultaneous peaks) (1) For Oregon, Washington and parts of Idaho, the Northwest Power Planning Council supplied data from GENESYS/HELM models. The models rely on historical load shapes for the Northwest and a historic relationship between load and temperature for each month. The net result is hourly demand for 2015 given 2002 temperatures (2002 is considered medium water year) (2) For Colorado, parts of Idaho, Montana, Utah, Wyoming, and northern Nevada the load forecast in the RMATS study (Sept 2004) is used, escalated from 2008 to 2015 using rates provided by regional representatives (3) For California, the latest CEC load forecast is used (Sept, 2005). • The topology adopted for this planning process is more detailed in some sub-regions than the WECC topology: two bubbles instead of one for NW, and multiple additional bubbles for Rocky Mountain states and California. The load forecast is disaggregated for the SSG-WI topology to create monthly peak and energy loads for each SSG-WI topology bubble. These monthly peak and energy load amounts are then distributed to the bus bars using the WECC power flow case. *The methodology for disaggregating the total load forecast for SSG-WI topology is an area requiring improvement.* • The monthly peak and energy loads are converted to hourly shapes developed using FERC Form 714. Hourly load shapes are an important factor in modeling transmission congestion. Load shapes are determined for each bubble (all buses within a bubble use the same hourly shape). With two exceptions, hourly shapes for each bubble are "normalized" using 2002 actual loads as the sample year. Exceptions: (1) hourly shapes developed in RMATS are used for Colorado, parts of Idaho, Montana, Utah, Wyoming, and northern Nevada; (2) hourly shapes produced by the NWPCC/BPA's HELMS model are used for Oregon, Washington and parts of Idaho. • California loads and mapping to buses are adjusted to capture the unique characteristics of pumping plants in California. • Transmission losses are included in the load forecast. Currently, WECC does not have information to separate loss

Load Forecast as Modeled in Gridview

AREA	ANNUAL ENERGY MWh	Annual Peak MW
IMPERIAL	4,212,776	1,091
LADWP	33,314,726	6,249
MEXICO-C	15,278,260	3,209
PG&E_BAY	51,987,840	10,919
PG&E_VLY	79,993,555	19,549
SANDIEGO	22,962,706	5,058
SOCALIF	134,936,173	25,462
ARIZONA	104,761,526	22,626
NEVADA	29,345,006	7,276
NEW MEXI	27,245,822	4,730
WAPA L.C	1,590,561	252
ALBERTA	77,291,069	10,794
B.C.HYDR	74,158,753	12,457
NW_EAST	74,310,368	12,355
NW_WEST	107,629,066	17,913
B HILL	6,588,272	976
BHB	3,695,185	506
BONZ	1,242,519	237
COL E	62,135,625	10,727
COL W	6,440,916	993
IDAHO	18,631,181	3,694
IPP	-	1
JB	-	1
KGB	6,826,263	1,429
LRS	3,996,419	581
MONTANA	10,807,468	1,698
SIERRA	11,728,413	1,995
SW WYO	4,553,805	637
UT N	42,173,311	7,999
UT S	6,057,463	1,189
WYO	2,454,859	356
YLW TL	-	1
Total	1,026,349,907	192,959

	amounts. This is an area of improvement. • Existing and some forecasted demand side management (DSM) and energy efficiency programs are embedded in the load forecast. *Currently WECC does not have information to separate these amounts. This is an area of improvement.* In addition, new DSM programs are modeled as dispatchable resources in 2015 studies. • No load forecast sensitivities are run for the 2015 Reference Case.

Network Representation and Topology	• WECC's 2008 Heavy Summer power flow case (HS2A) is used for year 2015 with the following modifications to reflect incremental transmission additions between 2008 and 2015: - Palo Verde – Devers #2 - Tehachapi Wind transmission – 2 lines - Navajo/Desert Rock; Four Corners – Moenkopi - Moenkopi to Market Place - Coronado to Silver King line including series comp - 4 Corners to Phoenix - West of Devers upgrade - Capacity upgrade at N. Gila - Pinal Project - Amps Phase Shifter (Mill Creek Phase Shifter) - Added transmission to integrate Montana incremental transmission, increasing Montana to Northwest transfer by 750 MW (series compensation on the 500 kV lines) - Added transmission from Wyoming to Utah to integrate Bridger #5 and SW WY wind - Added transmission configured for the San Francisco Bay Area Project - Imperial 500 kV line (one to San Diego and one to LA) - Added transmission connection Kansas to Colorado, to integrate the 2-700 MW coal plants - Modified the connectivity of PDCI to reflect improvements applied in California (Reconfigured Sylmar to SCE) • Criteria for line additions in the 2015Reference Case: Use conservative transmission assumptions in the 2008 base case, with minimal additions; add only committed projects and necessary transmission to integrate new resources. The purpose of the Reference Case is to expose transmission problems. • The power flow case takes into account differences in time zones. • Topology: the WECC 22-bubble topology is used, with these exceptions: - The single NW bubble is split into west and east NW bubbles - The single PG&E bubble is split into two bubbles, to accommodate variations in load types and shapes - The RMATS topology is used for the Rocky Mountain states, except that the Montana bubbles are reduced from 2 to 1 With these changes, the SSG-WI topology includes a total of 33 bubbles. ***See Attachment 1 for SSG-WI topology diagram and Attachment 2 for changes to branches in 2015 Reference Case***
Transmission Path Ratings & Nomograms	• The Transmission Subgroup started with the WECC path rating catalog and applied modifications to capture operating limits for a number of key paths. • Derates to recognize historical OTC limitations are applied. • Nomograms take seasonal derates into consideration. ***See Attachment 3 for path ratings used in 2015 Reference case and Attachment 4 for a map of major paths***
Transmission Forced Outages	Grid View's ability to model transmission forced outages is not used in this study. Reason: transmission maintenance outages typically occur during off peak usage only (low impact) and forced transmission outages occur infrequently.
Wheeling rates	Wheeling rates are not included in the 2015 study. 2008 studies included sensitivities with wheeling rates on an inter-area basis. A decision was made to exclude the wheeling rates from 2015 studies. Reason: lack of sufficient data to include both non-firm and firm wheeling rates; most firm transactions include wheeling as a sunk cost. *This is an area that requires improvement.*
Transmission Losses	The transmission loss capability of Gridview is not used in this study. *This is an area that requires improvement.*
Reserves	The Gridview model allows modeling of reserves at a regional level. The 2015 Reference Case includes 4% reserves (3% for spinning and 1% for contingency) for each of the 5 regions, which approximates 50% of the WECC reserve requirement (after forced outages) – 7% for thermal and 5% for hydro.

Generating Resources	Resource information is collected at the unit level of detail. Existing resources • Existing resources are resources assumed to be online by 12/31/2008. These resources were identified through the WECC power flow case (HS2A PF) and the SSG-WI 2003, CEC, RMATS, and other data bases. The states reviewed the list of resources and capacities, and their comments are included to the extent possible. Generating resource capacities are based on the power flow case. Thermal unit capacities are net of station service. *Net to grid generation of cogeneration resources is not explicitly modeled except in Alberta. This is an area of improvement.* The power flow capacities are compared to CEC, Platts, and other data sources and the majority of differences are minimal where material difference are noted by experts, capacities are edited. Incremental resources • Incremental resources are resources expected to be placed in service between 2009 and the 2015 (inclusive) as well as a few pre- 2009 resources omitted from the 2008 study. • Generation subgroup collected data from utilities' IRPs and coordinated with state representatives, NTAC and NWPCC. RPS requirements and NREL's recommended wind generation additions are also considered.
Thermal Unit Operational Info	• Thermal unit commitment is modeled in the study. • Data requirements for unit commitment include capacity information, planned and forced outage assumptions, heat rate curves, ramp rates, minimum up/down times, start-up costs, non-fuel variable O & M costs (Emission rates/constraints and must-run status are capabilities in GridView but are not modeled at this time). • The NWPCC's database supporting the Council's Fifth Power Plan, CEC information, Platts database, and other sources are used to develop generic assumptions for various thermal technologies and locations. Thermal units are broken into categories on the basis of fuel type, technology type, vintage, and capacities. A set of assumptions is developed for each unit category, with more detailed data included for gas-fired units. Most incremental resources added in the 2015 Reference case fit into one of the existing categories. • No resource sensitivities around 2015 Reference Case are done at this time.

Thermal forced and scheduled outages	• Database supporting EIA's energy Outlook 2005 is used to develop forced and planned maintenance outages rates • Occurrences of forced outages are modeled probabilistically using GridView's Monte Carlo capability. Forced (%) / Planned (%) Existing Coal 6.6 / 7.1 New Coal Plant 6.0 / 6.5 Oil/Gas Steam 7.1 / 10.5 Combustion Turbine 3.6 / 4.1 Combined Cycle 5.5 / 4.1 Existing Nuclear 7.0 / 7.5 Advanced Nuclear 3.8 / 6.1
Thermal start-up costs; minimum up/down time; ramp-rates	• Start-Up costs are based on IRP and expert input, and include fuel, O&M and other costs to reach point of synchronization. Minimum up and down times are provided by SSG-WI members. • Ramp rates are provided by experts. • Non-fuel variable O&M rates Start-Up Costs $/Unit per Start / Min Up/Min Down Hrs Combustion Turbine $ 2,000 / 8/8 Combined Cycle $10,000 / 8/8 Oil/Gas Steam $3,100 / 8/8 Coal Steam $15,000 / 8/8

	Ramp rate MW/Min Combustion Turbine 1 Combined Cycle 1 Oil/Gas Steam 1 Coal Steam 2.5

Fuel Prices	Gas prices: • Several Henry Hub price sensitivities are used (2005$/MMbtu): $5, $7, and $9. $5 is the base assumption in the Reference Case. • The NW Power and Conservation Council's methodology in the Fifth Power Plan is used to estimate Western gas market hub and burner tip area differentials. • Fixed transportation cost (capacity charge) of delivering gas from regional hubs to burner tip areas is included with other fixed costs of the scenario. The fixed transportation charge was calculated using data from CEC Integrated Energy Policy Report 2005. Coal prices: • The coal price forecast in the EIA's "Annual Energy Outlook 2005" is used. This forecast is based on historical trends. The EIA forecast of transportation costs includes two tiers of transportation adders: - Tier 1 (based on historical trends) - Tier 2 (tier 1 plus additional transportation for high demand areas) • The tier adders are applied to each coal plant taking into account the sources of coal supplies and the demand area (generator location). The transportation adders are then added to the coal price to get the total price at each plant. The combined price is then averaged over all plants within each SSG-Wi topology bubble, and the averages are entered in GridView. Other fuels: • Assumptions for other fuels are based on RMATS study.
Hydro Generation	• The following sources of hydro data are used for the study: - NW federal, Mid-C Nonfederal, and PacifiCorp: recent historical hourly hydro generation that is reasonably reflective of latest Biological Opinion. Actual hourly hydro data from three historical years is chosen: Medium (2002), Low (2003) and High (2000). The Reference Case run reflects the Medium hydro case only. Sensitivities are not run for the Low and High cases. - Other NW nonfederal: actual hourly data is lacking. Fallback is monthly actual data, to which peak shaving algorithm is applied - Central Valley Project: Due to difficulty of disaggregating hourly forecasted data to individual plants, CAISO historical hourly data is used - Other California: CAISO has provided hourly historical hydro data aggregated by river system. - Colorado: Bureau of Reclamation--Upper and Lower Colorado Regions provided monthly forecasted data, which reflects recent severe drought in terms of updated hydrology and operational algorithms, to which GV peak shaving algorithm is applied. Still need to obtain non-Federal Hydro data. - Canada: BC Hydro provided monthly hydro for adverse, average and above average hydro conditions grouped by their coastal, Peace River and Columbia River facilities. Data is shaped using year 2002 actual loads and hourly flows in and out of BC Hydro territory (BCH-US and BCH-Alberta paths), combined with treating the thermal generation as a block resource. Peak shaving algorithm is utilized for incremental hydro resources added for 2015 study. *BC Hydro modeling is an area of improvement.* - Arizona/Desert SW: Non-Federal hydro data from Salt River Project and other projects is used. • Originally, SSG-WI planned to use the Council's GENESYS model to simulate hydro generation. Data and other technical issues arose that prevented this. However, ABB is working to include this algorithm in the GridView model for the region's future use. This is an area of improvement.
Renewable Generation	• Hourly wind shapes used to model all wind generating resources are supplied by National Renewable Energy Lab (NREL). Exception: CAISO provided wind shapes for its areas based on actual data. Wind is treated as a fixed input to the model. • Geothermal plants are modeled as base load plants as confirmed by Clean and Diversified Energy Initiatives

<table>
<tr><td></td><td>Geothermal Task Force. Data to model specific plants in CA is provided by CAISO.
• Solar production profiles are provided by NREL.</td></tr>
<tr><td>DSM/Energy Efficiency</td><td>• Existing and some forecasted DSM and energy efficiency programs are embedded in the load forecast. These amounts are not explicitly collected by WECC.
• In addition, some new DSM programs are modeled as dispatchable resources in 2015 studies.</td></tr>
<tr><td>Incremental Resources' Capital Costs and Fixed O&M (not part of production cost modeling)</td><td>• Generic capital cost and fixed O&M assumptions from the NWPCC 5th Power Plan are used where specific resource costs are not available. NREL provided assumptions for capital costs of solar resources. Initial investment costs include a resource's development, construction, and interconnection costs (interest during construction, AFUDC, was calculated separately using a rate of 7.5%). Specific capital costs were used for resources from PacifiCorp IRP, BC Hydro, Alberta. Capital costs for Alberta cogeneration facilities were calculated using net to grid MW instead of nameplate capacity.
• DSM costs for new programs are assumed to be incentive payments for commercial and industrial customers to participate in the program (included as part of fixed O&M line item in the table). Costs for DSM and energy efficiency programs embedded in the load forecast are not captured in this analysis. This is an area of improvement.
<table>
<tr><th>Resources:</th><th>Initial Investment $/kw</th><th>Fixed O&M $/kw/yr</th></tr>
<tr><td>Coal</td><td>1,373</td><td>44</td></tr>
<tr><td>Gas</td><td></td><td></td></tr>
<tr><td>SCCT</td><td>663</td><td>9</td></tr>
<tr><td>CCCT</td><td>580</td><td>8</td></tr>
<tr><td>Wind</td><td>1,116</td><td>22</td></tr>
<tr><td>Geothermal</td><td>2,021</td><td>106</td></tr>
<tr><td>Solar</td><td></td><td>35</td></tr>
<tr><td>Solar CSP</td><td>3,040</td><td>38</td></tr>
<tr><td>Solar PV</td><td>7,732</td><td>35</td></tr>
<tr><td>Biomass</td><td>2,196</td><td>91</td></tr>
<tr><td>DSM (program costs)</td><td></td><td>60</td></tr>
<tr><td>AFUDC</td><td></td><td>7.5%</td></tr>
</table></td></tr>
<tr><td>Incremental Transmission Capital Costs and Fixed O&M (not part of production cost modeling)</td><td>▪ Generic capital costs provided by Transmission subgroup are used in all instances where specific capital cost estimates were not provided. Work done by NTAC, BPA and RMATS served as a source of generic assumptions. Initial investment estimates for transmission include planning, materials and construction, land, overheads, interest during construction, etc.
▪ Fixed O&M is assumed to be 2% of initial investment (source RMATS).</td></tr>
</table>

Attachment C

A Conceptual Outline for the WECC Transmission Expansion Planning Studies Report

1.0 Preamble

1.1 This is the first product of TEPPC process
1.2 It uses best available models and public data
1.3 Methodology evolved from previous SSG-WI efforts
1.4 Process is adaptive and will improve with each biennial cycle
1.5 Acknowledgements

2.0 Purpose and Nature of Report

2.1 Goals and Objectives (from TEPPC Charter, FERC Order No. 890, DOE, etc.)
2.2 Contributing Organizations
2.2.1 WECC
2.2.2 Sub-regional planning groups
2.2.3 States and provinces
2.2.4 Stakeholders
2.3 The Western Interconnection planning process is a vigorous collaborative effort that combines the advantages of both a west-wide focus and narrower sub-regional approach
2.3.1 TEPPC focuses on the west-wide system view
2.3.1.1 Has open stakeholder participation
2.3.1.2 Produces database for economic simulation
2.3.1.3 Conducts studies of west-wide issues
2.3.1.4 Provides forum for collaboration between subregional groups
2.3.1.5 Provides centralization of information from sub-regions, project developers, etc.
2.3.2 Sub-regional groups focus on more localized concerns
2.3.2.1 Has open stakeholder participation
2.3.2.2 Provides ability to include smaller organizations that might not participate in the larger TEPPC process
2.3.2.3 Conducts studies of more localized sub-regional issues not addressed by TEPPC
2.3.2.4 Capitalizes on west-wide effort by using TEPPC products (database and studies) for sub-regional planning studies
2.4 Provides communications to information users: DOE, FERC, state and provincial agencies, etc.
2.5 Description of the components of the report

3.0 TEPPC Study Program

3.1 Planning Study Preparations
3.1.1 Historical analysis to identify problems for evaluation in planning studies

3.1.2 Selecting the appropriate models and providing ongoing model improvement
3.1.3 Data Collection
3.1.3.1 Physical system and its constraints
3.1.3.2 The economic value and use of resources
3.1.4 Data Test Cases
3.1.4.1 Basis for TEPPC studies
3.1.4.2 Made available on an open, transparent basis for use by subregional groups, project developers, etc. (including explanation of access principles through WECC that meet CEII requirements)

3.2 Transmission Planning Study Program
3.2.1 Overall aims of the program
3.2.1.1 Identify congestion problems and potential solutions.
3.2.1.2 Meet reporting requirements or information needs of DOE, FERC, states & provinces
3.2.1.3 Provide assistance to and regional framework for transmission providers responding to study requests made under OATT Attachment K (Order 890 requirements)
3.2.2 Overall description of and rationale for the Study Program and connection to the overall program aims
3.2.2.1 …..details as needed
3.2.3 Technical basis for the biennial planning study (and mid-term updates as necessary)
3.2.3.1 Methodology
3.2.3.2 Major assumptions made
3.2.3.3 Cases developed

4.0 Study Results

4.1 Study Results – Identification of Potential Needs
4.1.1 Case/Scenario 1
4.1.2 Case/Scenario 2
4.1.3 ….etc.

4.2 Study Results – Evaluating cost and operational impacts of congestion

4.3 Study Results – Identification of potential solutions
4.3.1 Non-wires alternatives
4.3.1.1 Discussion of conceptual approaches to relationship of demand-side programs and local generation to transmission investment
4.3.1.2 The approach taken by TEPPC
4.3.1.2.1 Demand-side programs examined in studies, both passive (load reduction) and active (load shaping, price response, etc.)
4.3.1.2.2 Local generation examined in studies as an alternative to transmission construction

4.3.2 Discussion of transmission construction alternatives,
- *4.3.2.1 Conceptual approaches to identified problems*
- *4.3.2.2 Proposed projects and their effect on identified problems*

4.3.3 What problems are not currently addressed by any proposed projects?

5.0 Catalog of Proposed Transmission Projects

5.1 Thumbnail descriptions of proposals developed by SPGs (Transmission Projects and Non-wire Projects addressing transmission system problems):

5.1.1 SPG X

5.1.1.1 Project F

- *Description – Purpose, physical additions, location, capacity, etc.*
- *Sponsors, contact information and web site, if any*
- *Developmental status*
- *Estimated cost*
- *Needs addressed – benefits identified by TEPPC studies and other studies*
- *Coordination between sub-regions if appropriate*

5.1.1.2 Project G …

5.1.1.3 Project H …

5.1.2 SPG Y

5.1.2.1 Project R …

5.1.2.2 Project S …

5.1.2.3 Project T…

5.1.3 Process for finding joint approaches across sub-region boundaries.

5.2 Proposals generated by project developers and other organizations

5.2.1 Project J

5.2.2 Project K…

5.2.3 Project L…

6.0 Project Development Process and Decision Making

6.1 TEPPC studies and activities serve as a project incubator

6.2 Specific projects are developed by willing sponsors

6.2.1 Overview of sponsor's role

6.2.2 Examples of project development

6.3 Descriptions of the decision making processes being used to trigger construction of proposed projects

6.3.1 Traditional investment approach

6.3.2 Advance sales of capacity (the gas pipeline model)

6.3.3 Possible state enabling incentives

6.3.4 Etc.

7.0 Lessons Learned from this Biennial Cycle

7.1 *TEPPC process is adaptive, learning and changing with each cycle*

7.2 Transmission needs identified -- looking across all scenarios:

7.2.1 What are most pressing needs?

7.2.2 What policy decisions are needed near term?

7.2.3 Etc….

7.3 The TEPPC planning process:

7.3.1 What improvements should be made in models and data for the next cycle?

7.3.2 How can study methodology be improved to get better analysis of transmission needs?

7.3.3 What process improvements should be made?

7.3.4 What the organization improvements should be made within and between contributing organizations?

7.3.5 Etc….

Attachment D
Acronyms in Study Plan

APS	Arizona Public Service
BPA	Bonneville Power Administration
CAISO	California Independent System Operator
CCPG	Colorado Coordinated Planning Group
CDEAC	Clean and Diversified Energy Advisory Committee
CEC	California Energy Commission
CREPC	Committee on Regional Electric Power Cooperation
DOE	US Department of Energy
DR	Demand Response
EIA	Energy Information Administration
EPACT	Energy Policy Act of 2005
FERC	Federal Energy Regulatory Commission
GWh	Gigawatt Hour
GPS	GHG Performance Standard
HWG	Historical Work Group
IRP	Integrated Resource Planning
LRS	Load and Resources Subcommittee (WECC PCC)
L&R	Load and Resource Data
LSE	Load Serving Entities
MW	Megawatt
MWh	Megawatt hour
NERC	North America Electric Reliability Corporation
NREL	National Renewable Energy Laboratory
NTAC	Northwest Transmission Advisory Committee
NTTG	Northern Tier Transmission Group
NWPP	Northwest Power Pool
OATT	Open Access Transmission Tariff
O&M	Operations & Maintenance
PCC	Planning Coordination Committee (WECC)
PSA	Power Supply Assessment
PWG	Planning Work Group
RMATS	Rocky Mountain Area Transmission Study
RMPA	Rocky Mountain Power Authority
RPS	Renewable Portfolio Standard
SSG-WI	Seams Steering Group- Western Interconnection
STEP	Southwest Transmission Expansion Project
SWAT	Southwest Area Transmission
SWG	Studies Work Group
TAS	Technical Advisory Subcommittee
TEPPC	Transmission Expansion Planning Policy Committee
WAPA	Western Area Power Administration (“Western”)
WCATF	Western Congestion Assessment Task Force
WECC	Western Electricity Coordination Council
WGA	Western Governors’ Association
WI	Western Interconnection