WECC Power Supply Assessment

October 27, 2003

A. Executive Summary

Purpose and Methodology

The purpose of this report is to present the results of the power supply assessment that was conducted in October 2003. Recent updates (through October 3, 2003) to the input data were used to study the supply/demand margin as described below. The studies cover the summer period from 2003 through 2012, and the winter period from 2003/04 through 2012/13. The structure of the report remains largely unchanged from the prior report.

The assessment utilized a deterministic approach in evaluating the power supply margin in meeting the total peak demand (firm plus non-firm) requirements for the peak hour of the study month. Uncertainties associated with such factors as resource availability and seasonal demand variations were considered explicitly by running additional scenario cases.

The peak demands represent the control area expected demand forecasts (1-in-2 probability) for the study months, and it was assumed that the forecast monthly non-coincidental peak demands for each zone will occur at the same time (no diversity).

Data changes from prior assessment

- The zonal demands in this assessment are the sum of the firm and non-firm (interruptible or controllable) demands. Non-firm demands were excluded in the prior assessments.
- A few allocations were changed for control area demands spanning multiple zones.
- Adverse hydro de-rates for all of the zones were applied (see tables #7a and #7b). Only the Northwest U.S. adverse hydro de-rate was used in the prior assessment.
- Planned retirements associated with uncommitted additions were changed to uncommitted. All retirements were assigned a committed status in the prior assessment.
- Changes to forecast demands were applied.
- Changes to planned additions and retirements were applied.
- Corrections to existing generation units were applied.
- Changes to zone to zone transfer capabilities were applied.

Results

Compared to the results of the prior assessment (see August 2003 Power Supply Assessment), the results of this assessment showed a slight improvement in supply margin. Some of the contributing factors are listed below.

- Several control areas reduced their peak demand forecasts. This helped to offset the inclusion of the non-firm demands in this assessment.
- For the studies where only committed[1] generation additions were included, the revised status for planned retirements associated with uncommitted additions kept this generation available.
- The start of construction on a few units since the prior assessment moved them from the uncommitted category to the committed category.
- A few of the transfer capabilities were increased based on data provided by control area representatives.

The results of the base summer study case (scenario #1) indicate that power supplies in WECC should exceed demands through 2008 (versus 2007 in prior assessment), provided that conditions do not change beyond those studied. The study used a 7% reserve margin to represent reserve requirements, and a 5% de-rate (8% for CAISO and LADWP) [2] to non-hydro generation to simulate forced outages. The hydro capacities were reduced to model an adverse hydro condition (see Table #7b), and the Northwest sustained peaking adjustment[3]. Resources included all existing generation plus generation additions that are currently under construction, minus planned retirements that are not associated with uncommitted additions. The zonal transfer capabilities were set at the adverse OTC levels (ratings that may reasonably be expected to apply under simultaneous high seasonal transmission loading conditions).

Three additional summer scenarios were run as sensitivity studies with various combinations of generation and reserve margin. These other scenarios provide sensitivity analysis for a higher reserve margin and/or the addition of uncommitted resources. In the studies where deficiencies developed in later years, surplus resources in the northwest were stranded by transmission constraints as depicted in the graphic on page 25.

Similar to the prior assessment, the studies using higher reserve margin requirements identified a potential congestion problem in Northern California in August 2004. With a reserve margin of 9% or higher, the forecast demand is in excess of the local resources and import capability. The upgrade of Path 15 in late 2004, together with the addition of planned generation between August 2004 and August 2005, alleviate the problem before August 2005.

A winter study case (scenario #6) was run using resource and demand data for January, and similar parameters to the base summer case. The adverse OTC transfer capabilities for winter conditions were used for this case. Under the conditions studied, the CFE-Mexico area showed a supply deficiency beginning in 2012.

Qualifications

The assessment model is designed to measure the power supply margin based on forecasts of peak demands and seasonal resource capacity. While peak demand forecasts for several years into the future are readily available from the WECC control areas, the forecasts of resource additions are only accurate for a few years into the future. Therefore, the validity of the results

[1] Committed generation is generation that is currently in start-up or under construction.
[2] These utilities have suggested that older generating plants and more stringent environmental limits increase the likelihood for forced outages of non-hydro units physically located within their defined zones.
[3] The sustained peaking adjustment is a reduction to available hydro capacity that is often used in northwest planning studies to model weekly capacity based on 10 hours per day and 5 days per week (see BPA White Book for further information).

decreases the further out one looks over the assessment period. There is a point where the results shift from a determination of supply margin to a determination of future needs.

A determination of a positive supply margin for a zone does not necessarily mean a positive margin for all demand centers within that zone. Transmission constraints internal to a zone may limit electricity transfers to local demand areas, leaving them without a positive margin. These transmission-constrained local demand areas may include one or more major metropolitan areas within a zone and may include most of the total population within a zone. WECC's seasonal assessments and Ten-Year Coordinated Plan Summaries address potential intra-zonal resource inadequacies based on information provided by representatives from the various areas.

Power supply studies related to the effect that reduced forward prices might have on the development of future generating resources are beyond the scope of the assessment methodology.

B. Introduction and Background

The WECC Power Supply Assessments address the need to study the power supply margins on a council-wide basis and to identify areas within WECC that have the potential for electricity supply shortages based on reported demand and resource data and considering transmission constraints between areas.

The WECC Reliability Subcommittee has the responsibility to establish the tools, methodology, and data requirements for conducting the power supply assessments. This responsibility is described in the attached document entitled "WECC Power Supply Assessment Policy." The attached policy document provides additional information regarding the need to conduct such assessments.

The WECC staff was given the assignment to use the WECC Loads and Resources (L&R) data as input for the California Energy Commission (CEC) model and utilize the model's results to measure the power supply margin in the sub-areas or zones within the WECC. The purpose of this report is to document the results obtained from the model with the updated input data for the years 2003 through 2012.

C. Model Topology

The topology of the CEC model is shown in the bubble diagram (Bubble diagram #1) on the next page. The lines between zones are intended to represent transmission connections between the zones and the listed numbers are the transfer path capabilities as reported by the control area representatives. The model observes these maximum capabilities as it solves each iteration.

Transfer capabilities have been reported based on the following criteria:

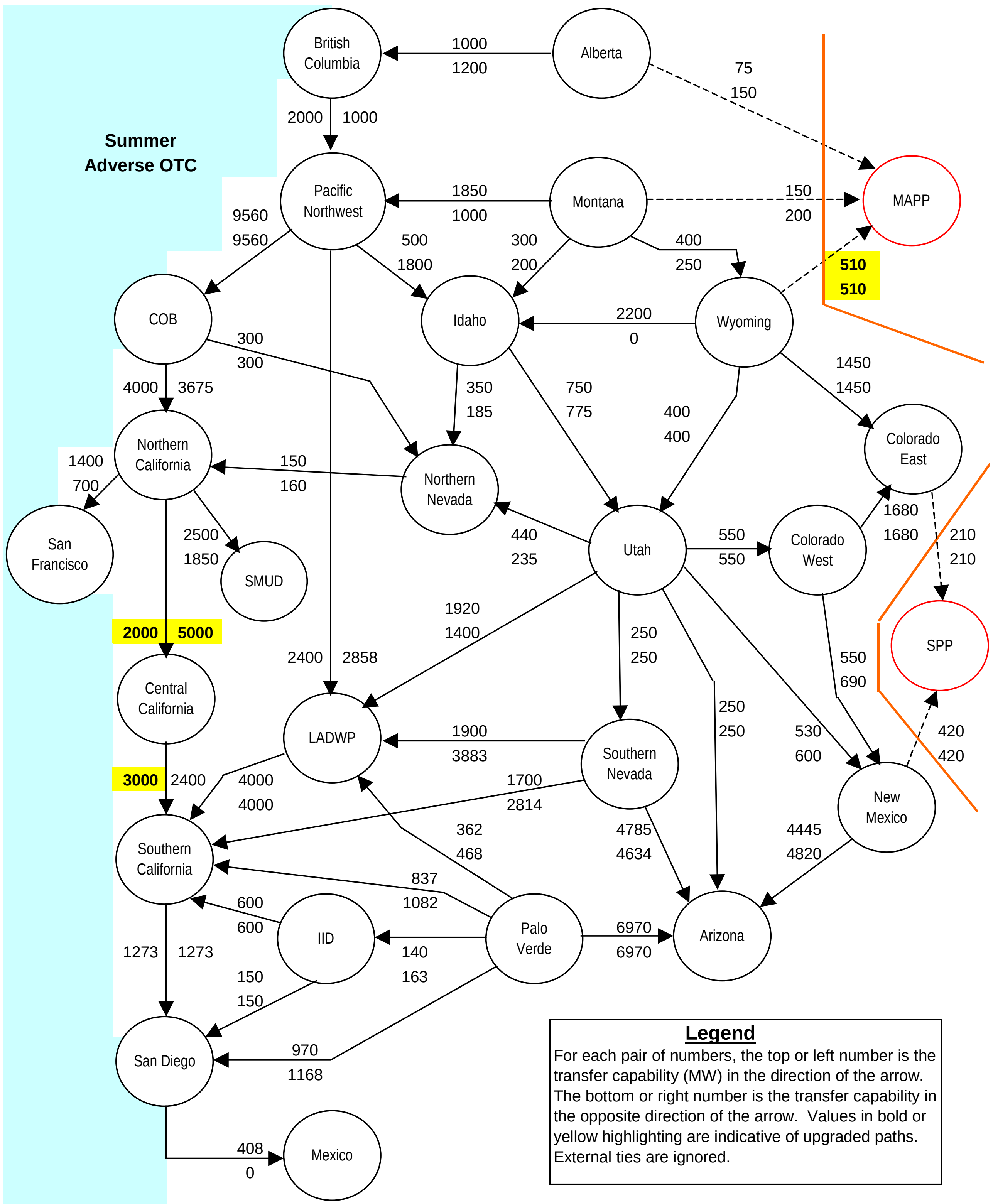
- Maximum Transfer Capabilities are the rated path capabilities associated with ratings found in the WECC Path Rating Catalog.
- Nominal OTC Transfer Capabilities are the transfer limits used in day-to-day operations based on seasonal thermal and/or stability limits.
- Adverse OTC Transfer Capabilities are the limits that may reasonably be expected to apply under simultaneous high seasonal transmission loading conditions.

Only the Adverse OTC Transfer capabilities were used for this assessment. The values shown on Bubble diagram #1 are the adverse OTC capabilities for the summer season (winter capabilities are represented in Bubble diagram #2). The capabilities shown with yellow highlighting reflect changes in transfer capability during the study period (see list below). Transfers with other regional councils such as MAPP and SPP are ignored in this assessment.

For this assessment, the following transfer capability changes (selected from the Phase 3 projects of the WECC Three-Phase Rating Process) were represented.

- Utah – Northern Nevada, new adverse OTC capability of 440 MW east to west (235 MW west to east) due to planned addition of Falcon-Gonder line, effective May 2003.
- California, Central – California, South, new adverse OTC capability of 3,000 MW north to south due to Path 26 up-rate, effective September 2003.
- California, Central – California, North, new adverse OTC capability of 5,000 MW south to north due to Path 15 upgrade, effective November 2004.

Bubble Diagram #1 – Zone Topology (Summer – Adverse OTC)



D. Study Cases and Results

The criteria used in the study cases are summarized in the following table. Note that “additions” refers to generation additions and retirements. Scenarios #4 and #5 were not studied in this assessment due to timing issues. Scenario #5a is a new study using a 15% reserve margin.

Table #1 – Scenario Criteria

	Study Scenarios							
Criteria	**#1**	**#2**	**#3**	**#4**	**#5**	**#5a**	**#5b**	**#6**
Generation								
Existing as of 12/31/02	yes	yes	yes	~~yes~~	~~yes~~	yes	yes	yes
Committed Additions (units that are under construction)	all	all	all	~~July 2003~~	~~July 2004~~	all	all	all
Uncommitted Additions (units that have not yet started construction)	no	yes	no	~~no~~	~~no~~	no	no	no
Non-Hydro De-rate (%) to model forced outages *	5%	5%	5%	~~5%~~	~~5%~~	5%	5%	5%
L&R Sched. Maint. and Inoperable	yes	yes	yes	~~yes~~	~~yes~~	yes	yes	yes
Adverse Hydro de-rate	yes	yes	yes	~~yes~~	~~yes~~	yes	yes	yes
Peak Demands / Reserves								
Peak Month	Aug	Aug	Aug	~~Aug~~	~~Aug~~	Aug	Aug	Jan
Margin Applied to Peak Demands (%)	7%	7%	12%	~~7%~~	~~7%~~	15%	18%	7%
Transfer Capability								
Maximum Path Rating								
Seasonal OTC Rating								
Adverse OTC Rating	X	X	X	~~X~~	~~X~~	X	X	X

*The non-hydro de-rates were set at 8% for the following zones: Northern California, Central California, Southern California, San Diego, San Francisco, and LADWP. See “Resource Adjustments” section for the restrictions used for hydro generation.

The following pages present the detailed results of each of the scenarios, including graphical representations of the annual margin by WECC area (areas are defined in Table #2). Note that the results may not accurately reflect the extent of the supply surplus or deficiency for a given area. If multiple areas are in need of additional capacity, several factors may determine which area(s) get access to any surplus capacity. Generally, the model will make excess capacity available first to the deficit area that is closest to the surplus area.

Table #2 – Area definitions

Area	Zones in Area	Area	Zones in Area
Canada	Alberta, British Columbia	No. CA	Central CA, Northern CA, San Francisco, SMUD
Northwest	COB, Idaho, Montana, No. Nevada, Northwest, Utah	Desert SW	Arizona, IID, New Mexico, Palo Verde, So. Nevada
Rockies	Colorado-East, Colorado-West, Wyoming	So. CA/MX	CFE-Mexico, Southern CA, San Diego, LADWP

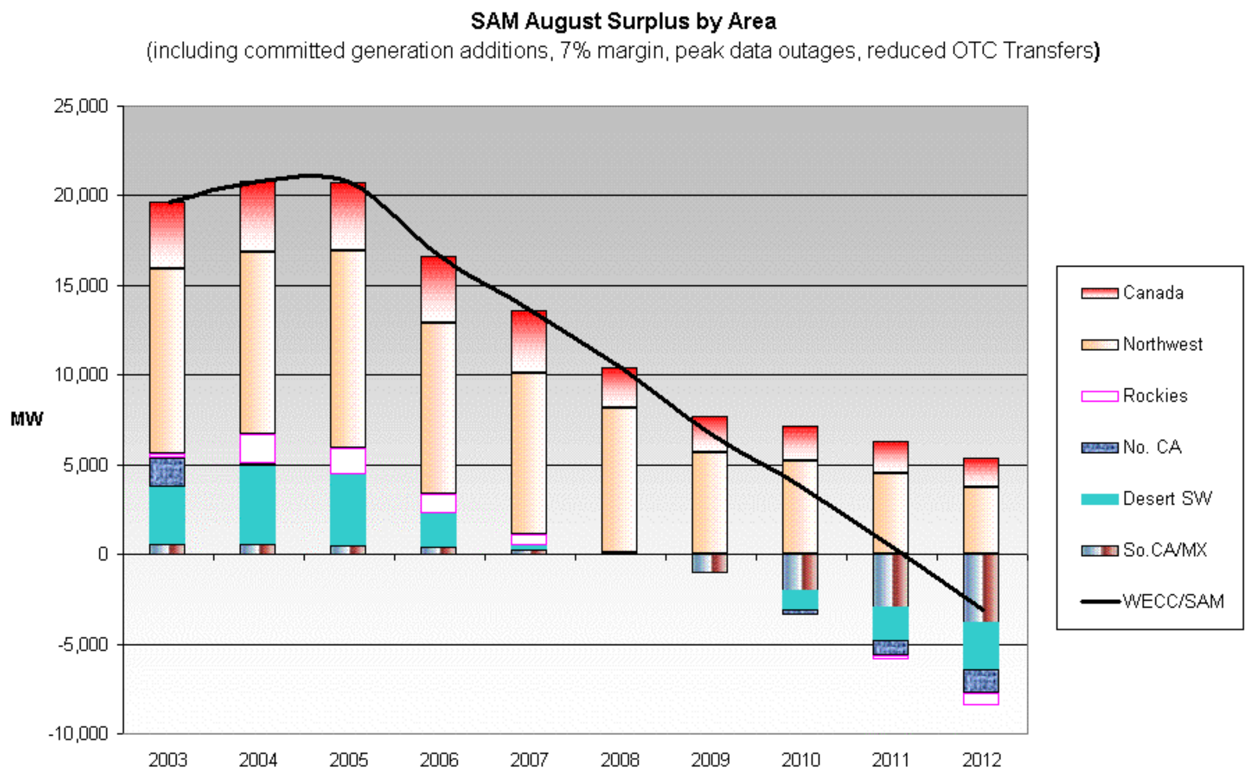
Scenario #1 – Results

Criteria: August peak demands, Reserve Margin 7%, Generation Additions = Committed [4] through August 2012, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse Hydro, Adverse OTC ratings.

The results of this case predict that under the studied conditions, power supplies in WECC will exceed demands through 2008. Beginning in 2009, transmission constraints prevent a surplus in the north (see north – south division in Bubble Diagram #3 on page 25) from reaching the deficit areas in the south. By 2012, the south deficit is larger than the north surplus, resulting in an overall deficiency for WECC.

The following graph presents the results by WECC area. When the surplus for an area is zero (0) and no bar is shown on the graph, the area is in resource/demand balance, or else it is importing to meet its demand.

Graph 1 - Scenario #1 Margin Graph [5]



The dip in 2006 is the result of the Mohave power plant retirement. Note that the results for 2003 are based on preliminary actual non-simultaneous demands.

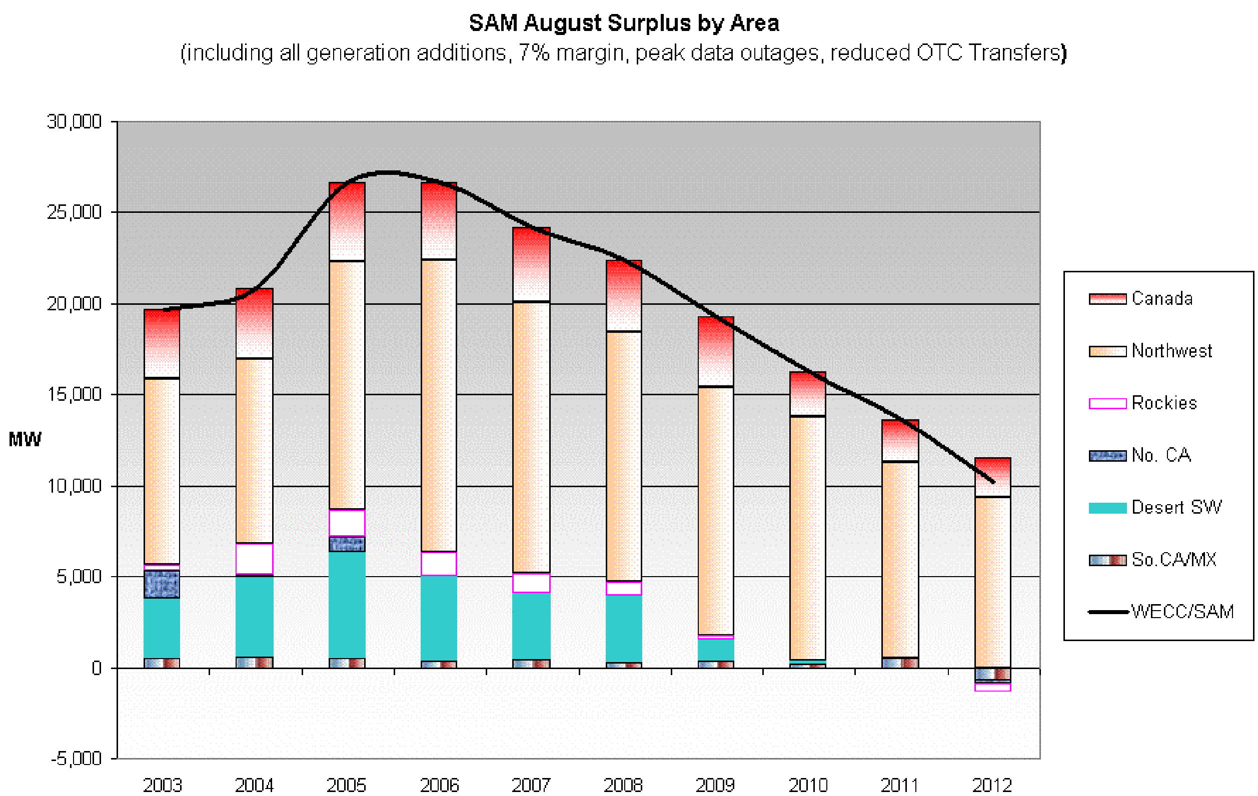
[4] Committed generation is generation that is currently in start-up or under construction.
[5] It is estimated that only 10% to 15% of the Northwest Capacity margin is firm energy availability.

Scenario #2 – Results

Criteria: August peak demands, Reserve Margin 7%, Generation Additions = Committed + Uncommitted through August 2012, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse hydro, Adverse OTC ratings.

The results of this case predict that with the inclusion of the uncommitted generation additions and under the studied conditions, area power supplies will exceed demands through 2011. There are still several uncommitted resource additions, most of which are scheduled to come online during 2005 and 2006 (see table #5). Since these projects have not started construction, there is a higher likelihood that a portion of them will be delayed or canceled. The following graph presents the results by WECC area.

Graph 2 - Scenario #2 Margin Graph



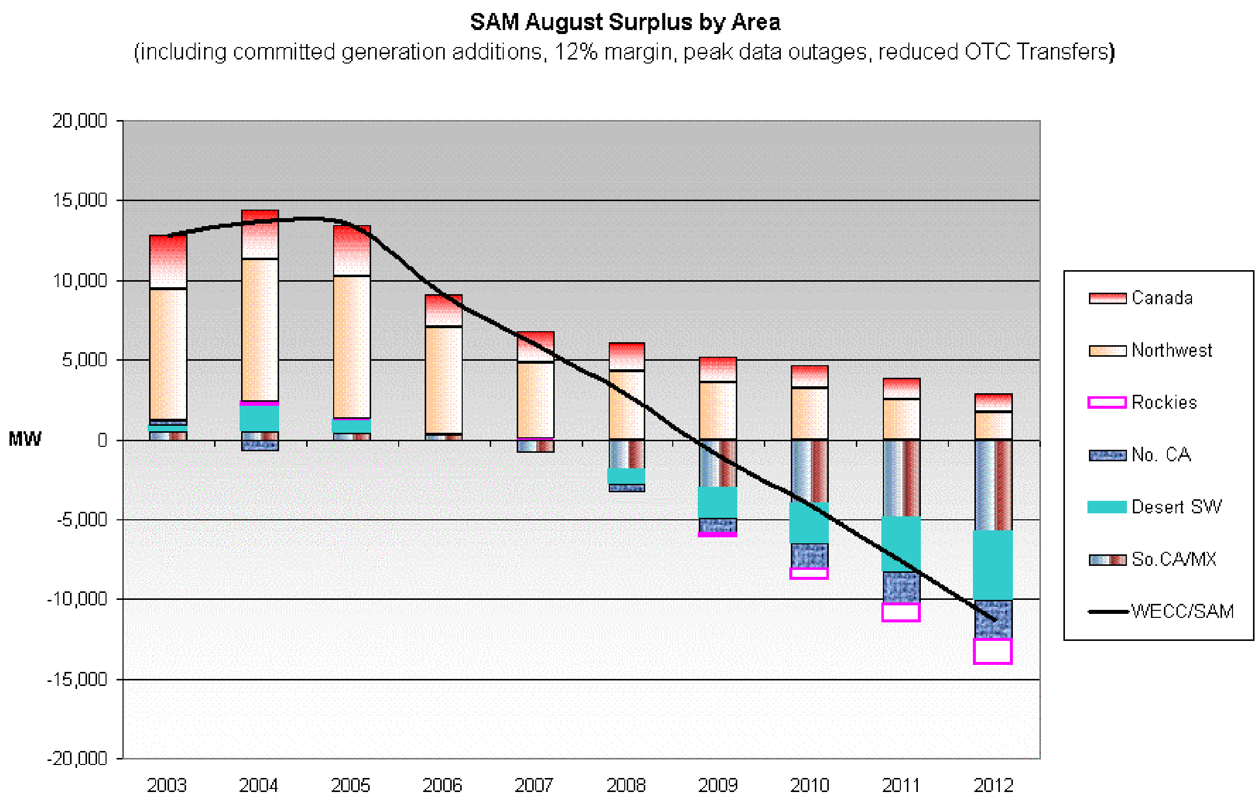
Once again, only a portion of the Northwest capacity margin is firm energy availability. With the planned addition of uncommitted thermal generation in the Northwest, the amount of firm energy availability is higher here than in the previous scenario. The Desert SW surplus is reduced in 2006 by the retirement of Mohave.

Scenario #3 – Results

Criteria: August peak demands, Reserve Margin 12%, Generation Additions = Committed through August 2012, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse hydro, Adverse OTC ratings.

With a 12% reserve margin, a deficit condition occurs in 2004 for Northern California due to transmission constraints. This is alleviated in 2005 by the Path 15 upgrade and new generation additions. However, increasing demands create a north/south split (see Bubble Diagram #3) by 2007 to prevent a surplus in the north from reaching the deficit areas in the south. By 2009, the south deficit is larger than the north surplus, resulting in an overall deficiency for WECC. The following graph presents the results by WECC area.

Graph 3 - Scenario #3 Margin Graph



Scenarios #4 and #5 were not run

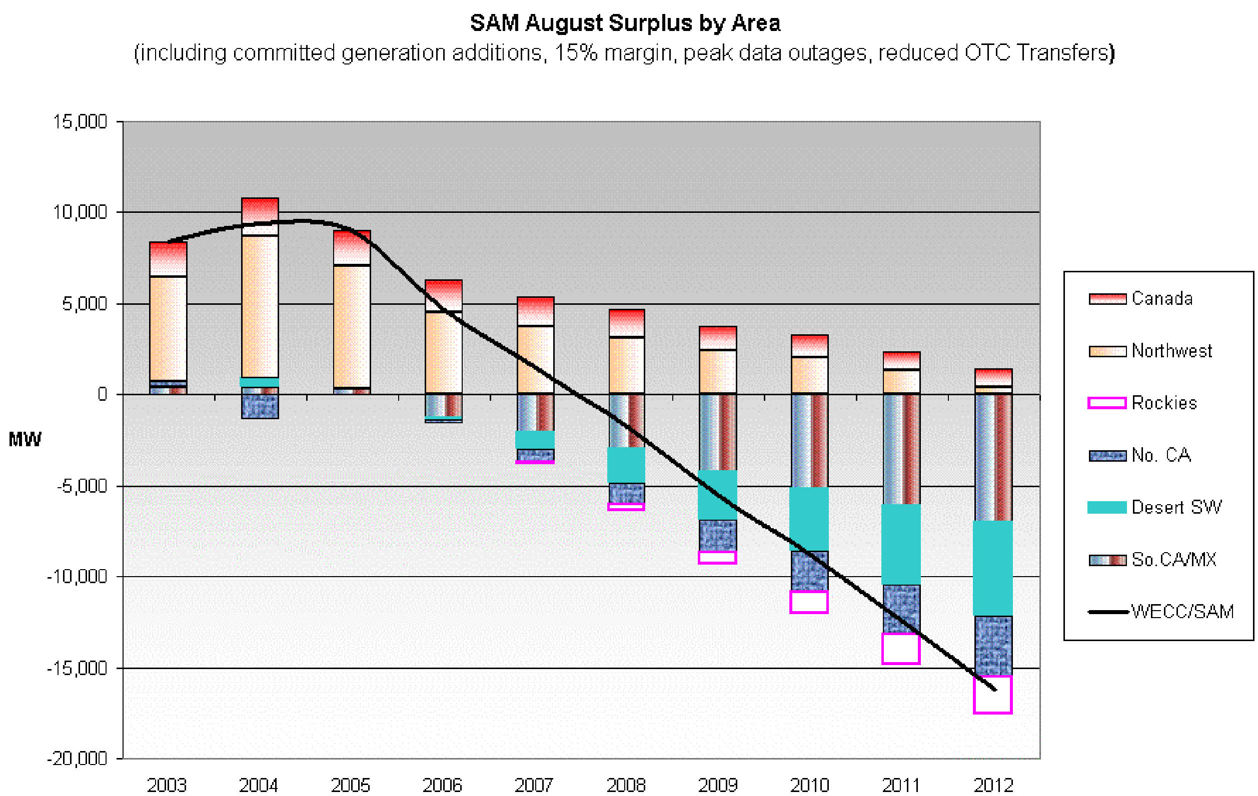
Due to the cut-off of generation additions in July 2003 and July 2004 in the prior assessment, Scenarios #4 and #5 do not make sense for this updated assessment. In future assessments, these scenarios will likely be replaced with studies involving coincidental demand.

Scenario #5a – Results

Criteria: August peak demands, Reserve Margin 15%, Generation Additions = Committed through August 2012, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse hydro, Adverse OTC ratings.

With a 15% reserve margin, a deficit condition occurred in 2004 for Northern California due to transmission constraints. This is alleviated in 2005 by the Path 15 upgrade and new generation additions. However, increasing demands create a north/south split (see Bubble Diagram #3) by 2006 to prevent a surplus in the north from reaching the deficit areas in the south. By 2008, the south deficit is larger than the north surplus, resulting in an overall deficiency for WECC. The following graph presents the results by WECC area.

Graph 5a - Scenario #5a Margin Graph

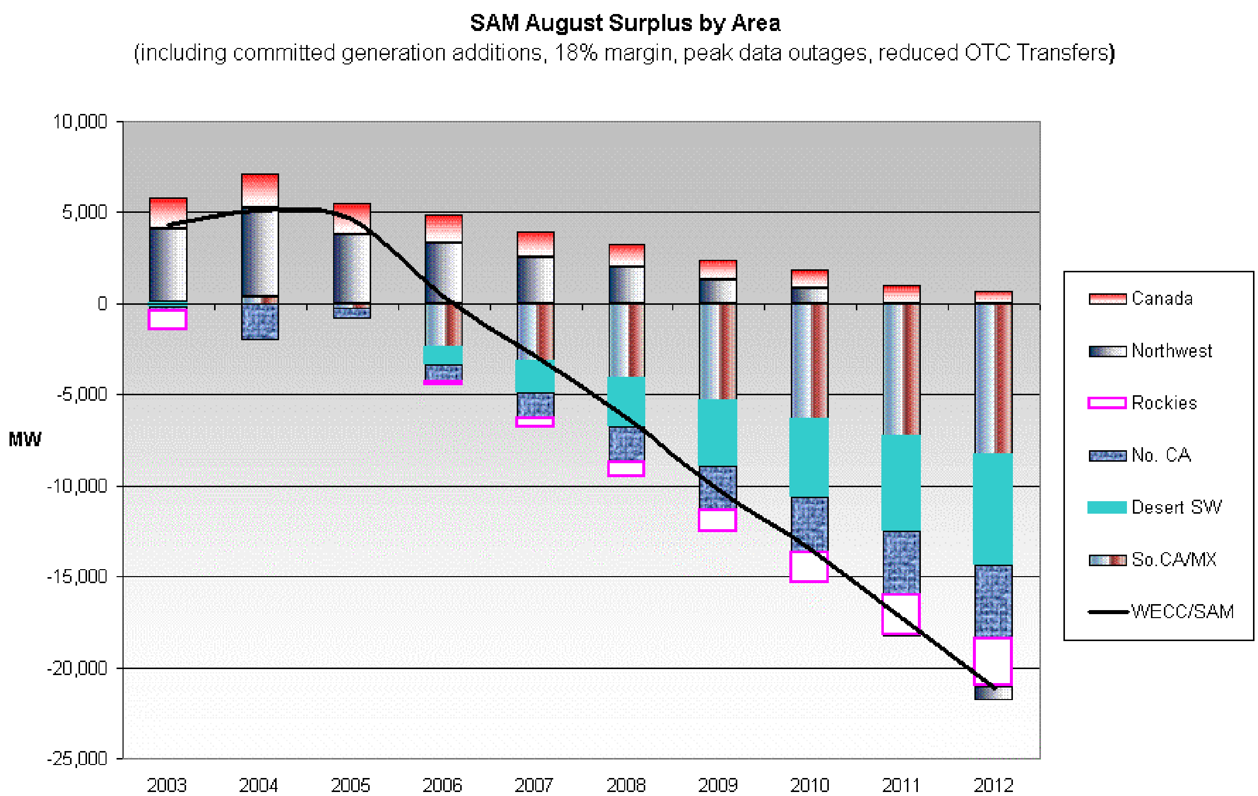


Scenario #5b – Results

Criteria: August peak demands, Reserve Margin 18%, Generation Additions = Committed through August 2012, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse hydro, Adverse OTC ratings.

With an 18% reserve margin, the higher demands created a north/south split (surplus in north, deficit in south) in 2003, the first year of the study period. New generation additions eliminated the south deficit in 2004, but transmission constraints into Northern California caused a deficit condition there. The north/south split returned in 2005 and remained through the rest of the study period. By 2007, the south deficit is larger than the north surplus, resulting in an overall deficiency for WECC. The following graph presents the results by WECC area.

Graph 5b - Scenario #5b Margin Graph

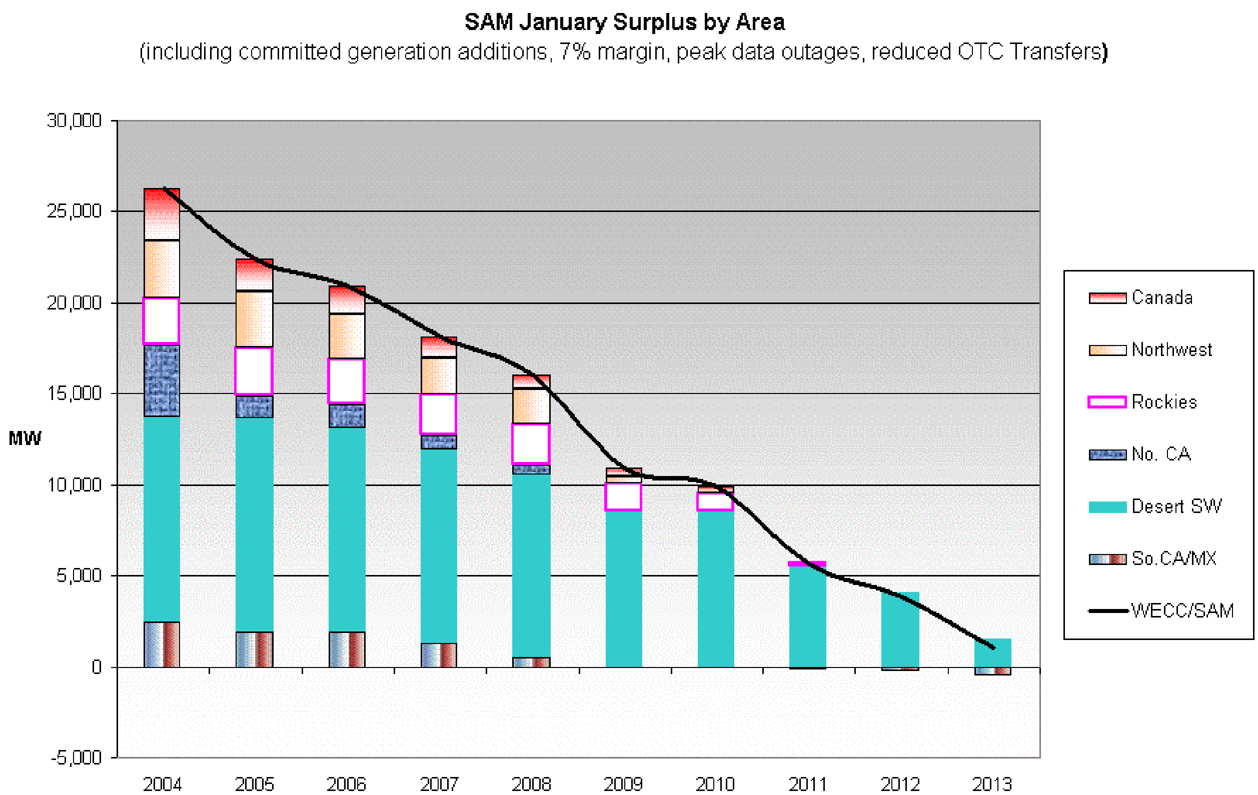


Scenario #6 – Winter Results

Criteria: January peak demands, Reserve Margin 7%, Generation Additions = Committed through January 2013, Scheduled outages & Inoperable, De-rates - Non-hydro 5% (8% CAISO & LADWP), Adverse hydro, Adverse OTC ratings.

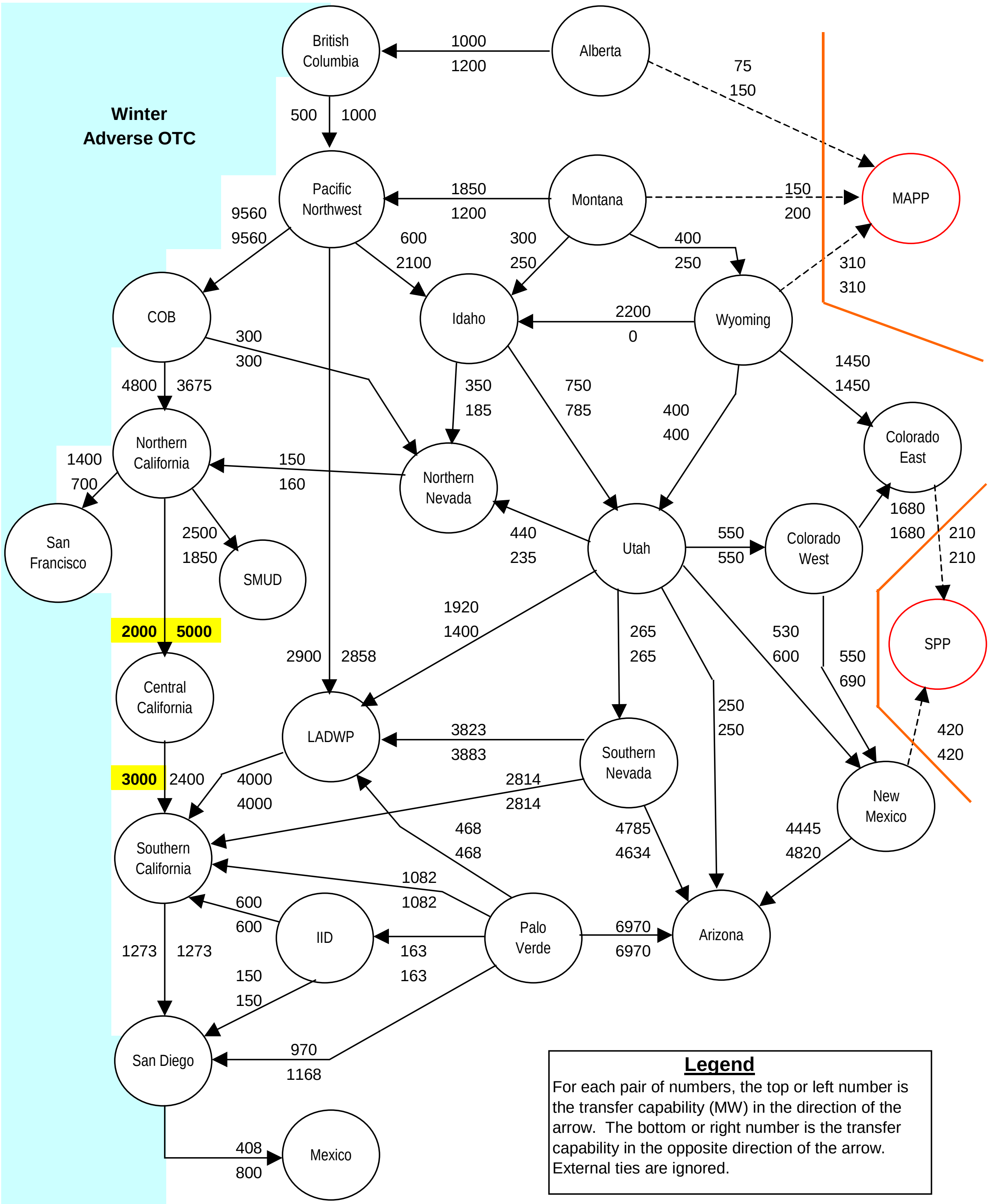
The results of this case predict that under the studied conditions, winter power supplies in WECC will exceed demands through 2012 (winter is the December to February period). In 2012, a deficit developed in CFE-Mexico due to the path from San Diego to Mexico being fully loaded. The following graph presents the results by WECC area, and Bubble Diagram #2 represents the winter adverse OTC transfer capabilities.

Graph 6 - Scenario #6 Margin Graph



The dips in 2009 and 2011 are due to an increase in the reported scheduled maintenance for those years.

Bubble Diagram #2 – Zone Topology (Winter – Adverse OTC)



Legend

For each pair of numbers, the top or left number is the transfer capability (MW) in the direction of the arrow. The bottom or right number is the transfer capability in the opposite direction of the arrow. External ties are ignored.

E. Description of Model

The "Supply Adequacy Model" (SAM) was developed by the CEC to study the balance between projected demands and resources in California and other WECC areas, taking into consideration transmission limitations between sub-areas. The model has the capability to perform either multiple-iteration probabilistic (stochastic) studies or single-iteration deterministic studies. Per instructions from the Reliability Subcommittee, all of the studies conducted for this report were deterministic. If probabilistic studies are requested in the future, it will be necessary to collect additional information.

For the purposes of this model, the WECC region is divided into the following sub-areas or zones. The zones are configured around demand centers and transmission hubs. Refer to the topology bubble diagram for connections between zones.

Alberta	Calif., San Francisco	Montana
Arizona	California, SMUD	Nevada, North
British Columbia	California, South	Nevada, South
California, Central	CFE-Mexico	New Mexico
California, IID	COB	Northwest
California, LADWP	Colorado, East	Palo Verde
California, North	Colorado, West	Utah
California, San Diego	Idaho	Wyoming

The following acronym definitions apply to this report.

AZ-NM-SNV	Arizona – New Mexico – Southern Nevada
CA-MX	California – Mexico (CFE –WECC)
CFE	Comision Federal de Electricidad
CAISO	California Independent System Operator
COB	California Oregon Border
IID	Imperial Irrigation District
LADWP	Los Angeles Department of Water and Power
MAPP	Mid-Continent Area Power Pool
NWPP	Northwest Power Pool
PSC	Public Service of Colorado
RMPA	Rocky Mountain (Colorado – Wyoming)
SMUD	Sacramento Municipal Utility District
SPP	Southwest Power Pool
WACM	WAPA – Colorado / Missouri
WALC	WAPA – Lower Colorado

Demands

Estimated monthly peak demands for each SAM zone are included in the input data. These peak demands are derived from the peak demand forecasts that were submitted with the L&R data, and represent a 1-in-2 year probability forecast (50% probability of not being exceeded). The current methodology assumes that every zone will experience its monthly peak demand at the same time. This non-coincidental approach has a tendency to overstate the peak demands where geographical and temperature diversity decrease the likelihood of simultaneous peaks across an area or region. Demand diversity may be accounted for in future assessments, provided that the necessary data can be gathered. Note that the demands for 2003 are based on preliminary actual non-simultaneous demands.

Where control areas spanned more than one zone, the demands were allocated by percentages (see details in Assumptions). The following table (Table #3a) is an area summary of the actual and forecast total (firm plus non-firm) August peak demands through 2007. The non-firm and prior firm only values are also shown in tables 3b and 3c. Several control areas submitted reduced demand forecasts for this assessment, compared to those for the prior assessment.

Table #3a - Total August Peak Demands by Sub-Region (MW)

Sub-Region	2001	2002	2003	2004	2005	2006	2007
AZ-NM-SNV	22,768	23,976	25,268	25,947	26,756	27,496	28,185
CA-MX	48,374	50,260	52,710	55,016	56,166	57,152	58,380
NWPP	44,689	47,008	47,861	48,293	49,231	50,142	51,047
RMPA	9,232	10,135	10,952	10,595	10,696	10,885	11,022
Total WECC	125,063	131,379	136,791	139,851	142,849	145,675	148,634

Table #3b – Non-firm August Peak Demands by Sub-Region (MW)

Sub-Region	2001	2002	2003*	2004	2005	2006	2007
AZ-NM-SNV	245	228	81	256	257	259	258
CA-MX	1,374	1,519	1,320	1,320	1,320	1,320	1,320
NWPP	245	228	0	199	199	199	199
RMPA	6	45	0	56	46	46	46
Total WECC	1,870	2,020	1,401	1,831	1,822	1,824	1,823

*Breakouts of firm and non-firm demands for 2003 were not yet available from some of the control areas.

Table #3c – Prior Firm Only August Peak Demands by Sub-Region (MW)

Sub-Region	2001	2002	2003	2004	2005	2006	2007
AZ-NM-SNV	22,523	23,748	24,923	25,764	26,597	27,366	28,052
CA-MX	47,000	48,741	52,014	55,231	56,223	57,047	58,068
NWPP	44,444	46,781	47,402	48,329	49,289	50,159	51,043
RMPA	9,226	10,089	10,427	10,539	10,649	10,839	10,976
Total WECC	123,193	129,359	134,766	139,863	142,758	145,411	148,139

Resources

The resource data includes the existing generation units, the generation additions, the generation retirements, the scheduled maintenance, the inoperable generation, the forced outages, and miscellaneous deratings. The net resource capacities were summarized by zone and type (hydro or non-hydro) before being copied into the model. The detailed generation data (excluding the updates used in this assessment) are available in the WECC publication (*Existing Generation and Significant Additions and Changes to System Facilities 2002 – 2012*).

The tables below are a summary of the generation additions/retirements that became available or unavailable from 2002 through 2007 (months are inclusive). Committed generation is generation that is currently in start-up or under construction. Uncommitted generation is generation that has not started construction. Although the plans could change, generation retirements were considered as committed, unless the associated generation additions were uncommitted.

Table #4 - Committed Generation Additions / Retirements by Sub-Region (MW)

Sub-Region	1/02-8/02	9/02-8/03	9/03-8/04	9/04-8/05	9/05-8/06	9/06-8/07
AZ-NM-SNV	2,218	4,937	2,821	1	-1,450	1
CA-MX*	2,658	4,340	-471	3,087	20	10
NWPP	2,183	1,462	1,277	226	32	0
RMPA	736	923	625	0	0	0
Total WECC	7,795	11,662	4,252	3,314	-1,398	11

*The CA-MX 2002 additions do not reflect data adjustments to existing generation in the CAISO control area.

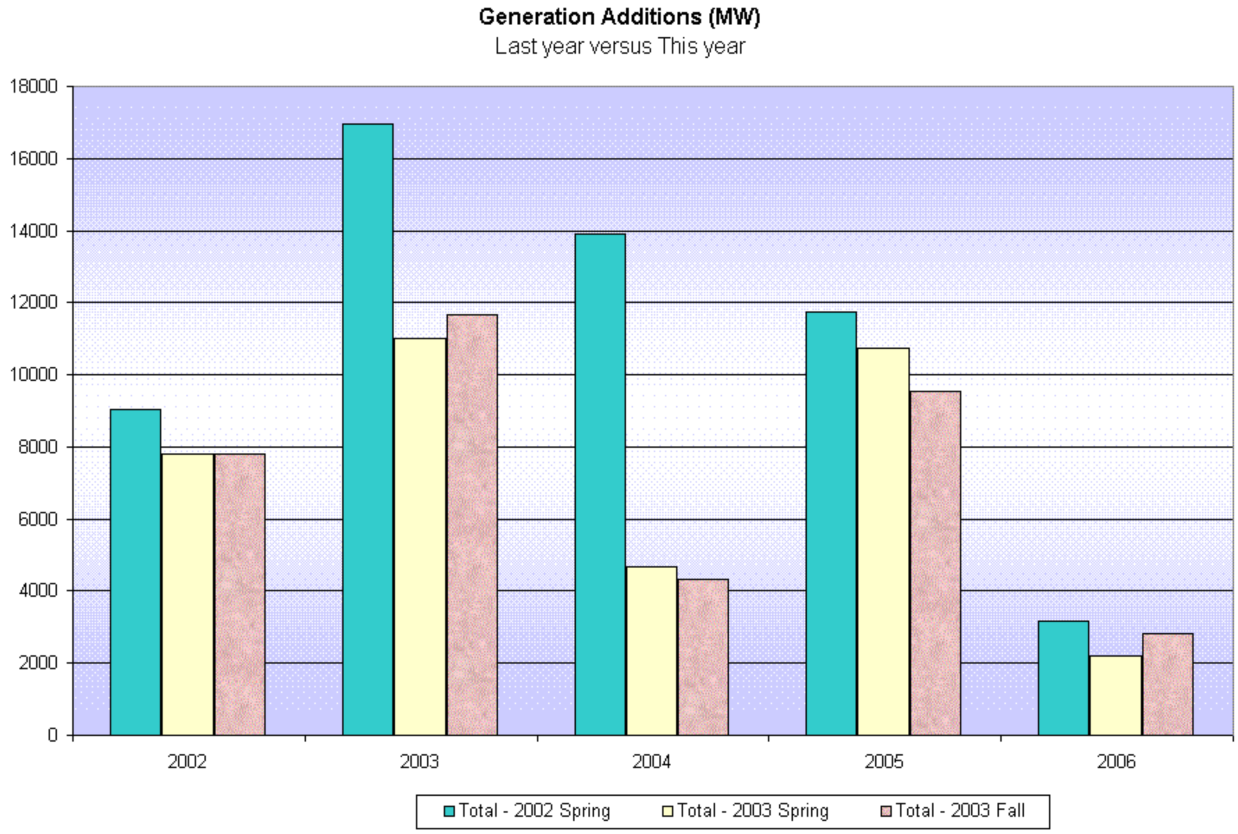
Only the years of most significance are shown in the tables. Data to support studies from 2003 through 2012 are included in the model.

Table #5 - Uncommitted Generation Additions by Sub-Region (MW)

Sub-Region	1/02-8/02	9/02-8/03	9/03-8/04	9/04-8/05	9/05-8/06	9/06-8/07
AZ-NM-SNV	0	0	0	1,525	1,020	120
CA-MX	0	0	24	1,395	306	424
NWPP	0	0	49	3,317	2,625	0
RMPA	0	0	0	0	274	0
Total WECC	0	0	73	6,237	4,225	544

As indicated in the following graph, WECC has experienced a significant decrease in planned generation additions since last year. The data changes for this updated assessment don't show any dramatic changes since the prior assessment.

Graph #7 – Comparison of Planned Generation Additions



As new efficient plants are added, older inefficient plants are retired. The following table breaks out retirements by sub-region from 2002 through 2009. Note the retirement of Mohave in early 2006. Several retirements are associated with replacement units at the same site.

Table #6 - Retirements by Sub-Region (MW)

Sub-Region	1/02-8/02	9/02-8/03	9/03-8/04	9/04-8/05	9/05-8/06	9/06-8/07	9/07-8/08
AZ-NM-SNV	0	0	0	0	-1,628	0	0
CA-MX	-152	-1,094	-1,166	-607	-358	-1,021	0
NWPP	0	-147	0	0	0	0	0
RMPA	0	-90	0	0	0	0	0
Total WECC	- 152	-1,331	-1,166	- 607	-1,986	-1,021	0

Scheduled maintenance and inoperable generation as reported in the L&R data were included as indicated in the studies. The majority of the August outages are scheduled for generation in Alberta and British Columbia. Other areas try to have all their units available for the summer peak. Some environmental constraints and wind de-rates in California are also represented.

Resource Adjustments - Hydro

In addition to the individual hydro generation capacities (seasonal median output) submitted with the L&R data, aggregate hydro capacities to reflect adverse water conditions are provided by the

WECC control areas. The differences in total capacity represent the hydro capacity de-rates for each control area. The following tables present the hydro de-rates by sub-region for January and August.

Table #7a – January Hydro De-rates by Sub-Region (MW)

Sub-Region	2004	2005	2006	2007	2008	2009	2010
AZ-NM-SNV	0	0	0	0		0	0
CA-MX	541	540	540	540	540	540	540
NWPP	3,524	3,524	3,296	3,337	3,357	3,357	3,071
RMPA	108	108	108	108	108	108	108
Total WECC	4,173	4,172	3,944	3,985	4,005	4,005	3,719

Table #7b – August Hydro De-rates by Sub-Region (MW)

Sub-Region	2004	2005	2006	2007	2008	2009	2010
AZ-NM-SNV	0	0	0	0	0	0	0
CA-MX	40	40	40	40	40	40	40
NWPP	4,512	4,624	4,390	4,410	4,410	4,410	4,162
RMPA	0	0	0	0	0	0	0
Total WECC	4,552	4,664	4,430	4,450	4,450	4,450	4,202

In addition, adjustments were applied to the Northwest hydro generation to reflect the "Sustained Peaking Adjustment" values that are commonly used in the northwest (January = -6,972 MW, August = -1,388 MW).

The hydro generation unit capabilities submitted by the CAISO were "p-max" capabilities. These were reduced from "p-max" to nominal levels in accordance with data found in the CAISO seasonal assessments.

Resource Adjustments – Non-hydro

The non-hydro generation capacities were de-rated in all of the scenarios to model forced outages. An 8% de-rate was applied to the zones associated with the CAISO and LADWP due to a high proportion of older thermal units and stringent environmental levels. In all of the other zones the seasonal non-hydro capacities were reduced by 5%.

Transfer Paths

The transfer paths used by the program are based on the SAM zones, with paths connecting one SAM zone to another SAM zone where applicable. The model has data fields for the path, transfer capability, wheeling cost, and loss factor. The wheeling costs for each path are used to calculate the transfer costs for any imports into a zone. The loss factors are used to calculate the net transfer after losses for any imports into a zone. Standardized wheeling costs were used in the studies.

A request was sent out to a key control area in each zone to provide information on the transfer capabilities between zones. The responses were used to update the capabilities in the model based on the values provided.

Solution

Microsoft Solver, a third-party tool included with Excel for solving constraint-based problems, is used to solve the demand/resource balance and calculate the surplus generation in each zone. The solution seeks the lowest overall resource cost subject to the following constraints:

- the demand requirements of each zone must be met (surplus >= 0); but it's possible for a zone to be deficit before solver starts
- the resource solution for each zone must be equal to or greater than zero
- the resource solution for each zone must not be greater than the available resources
- the resource solution for each zone must not be less than the minimum resource allocation

The solution uses transfers between zones to export resources from surplus zones to deficit zones. If a deficit is greater than the available transfer capability from the connected zones, then the zone will have a net deficit. The solution will also back off internal generation in a zone if a connecting zone has a surplus that is less expensive and the transfer path has available capability. Lower cost resources such as hydro resources are given priority within a zone and as imports, to serve local load and to displace more expensive generation.

The assessment model is designed to measure the supply/demand margins based on forecasts of peak demands and resources. While peak demand forecasts for several years into the future are readily available from the WECC control areas, the forecasts of resource additions only exist for a few years into the future. Therefore, the validity of the results decreases the further out one looks. The assessment results for the period beyond 2005 or 2006 are not a realistic picture of future supply margins. The addition of generation plants that are not accounted for in the current data should be expected. There is a point where the results shift from a determination of supply margin to a determination of future needs.

F. Application Summary

The SAM program uses an iterative methodology to determine the supply/demand margin. By design it isn't intended to perform a sophisticated engineering analysis. The solver add-in attempts to find a solution where resources and imports satisfy the demand requirements in each zone. The stochastic solutions model the system uncertainties based on historical demand and outage factors. The deterministic solutions simply compare total resources to total demands without modeling the uncertainties. For these studies, surplus is defined by the following formula.

Surplus = Internal Resources + Imports - Demand - Exports

While the model does consider transfer capabilities between zones, it is not designed to perform any sophisticated analysis of transfer limitations involving simultaneous flows or loop flows.

WECC Workarounds / Enhancements

WECC has implemented workarounds and enhancements to address problems with using the WECC L&R data in SAM, and problems with external resources and the posting of summary results. An intermediate spreadsheet was developed that reads the L&R data from the standard WECC data files and aggregates the demands and resources by SAM zone.

A workaround to account for external resources was developed to force the transfer of some jointly owned generation (such as Palo Verde, Colstrip, and others) from the host zones to the appropriate participants' zones.

An enhancement to account for changes to transfer path capacities was also added.

Assumptions

The following assumptions were used for the WECC studies:

- The input data represents demand forecasts and resources as of October 2003.
- Non-coincidental demands were used such that the monthly peak zonal demands are the sum of the control area peak demands for each zone.
- August data was used for the summer peak period for each year. January data was used for the winter peak period.
- This assessment assumes that the demand for a given zone is the sum of the control area customer demands within that zone. This differs from the "load requirement" concept where the load that must be served is the customer demand plus the firm exports. Under most circumstances, the application of "forced transfers" to accommodate firm exports would tend to undermine the model solution.
- Peak demands for CISO, PSC, WACM, and WALC were allocated to SAM zones based on the following ratios reported by the PCC representatives as part of their semi-annual review. Values in bold were revised since the prior assessment.

Table #8 - Percent of Control Area Demand Allocated to Zones

Zones \ Control Area	**CISO**	**PSC**	**WACM**	**WALC**
Arizona				72%
Colorado, East		88%	**50%**	
Colorado, West		12%	**28%**	
New Mexico				28%
Wyoming			**22%**	
California, North	39.4%			
California, Central	6.5%			
California, South	43.0%			
California, San Diego	8.6%			
California, San Fran.	2.5%			

- Since insufficient data were available for a detailed economic solution, the summary resources in each zone were all assigned the same costs (Hydro = $5/MWH, Non-hydro = $20/MWH), with the exception of Palo Verde ($15/MWH).
- The adjustments for external generation that were used in the studies were for Bridger, Colstrip, Four Corners, Hayden, Hoover, Intermountain, Mohave, Navajo, Palo Verde, and San Onofre. No other adjustments were made for other joint plants or firm purchases.
- Ties to MAPP and SPP are not modeled since this would require generation and/or demand to be associated with these external areas.
- The model freely transfers resources from areas with surplus generation to deficit areas, considering transfer path constraints and transmission losses. Simultaneous flows, loop flows, and other transfer restrictions are approximated by the adverse OTC ratings that were used in the studies.
- The model is not intended to measure the supply margins in the individual control areas (unless the zone definition and transfer capabilities exactly match the control area). The model assumes that there are no constraints internal to a zone.

G. Observations

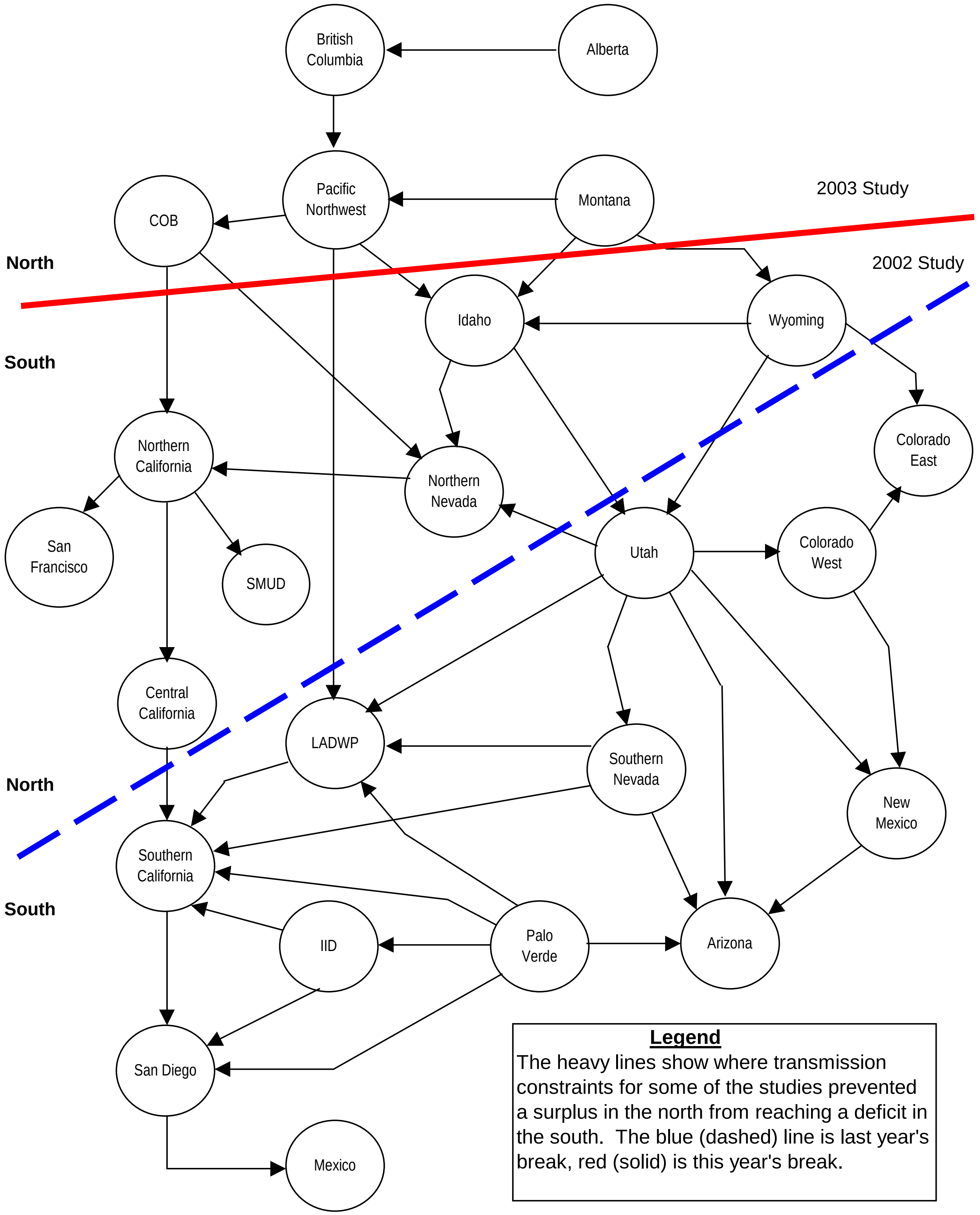
1. Surplus generation in the Pacific Northwest was often stranded due to transmission limitations (see Bubble Diagram #3 on page 25 for constraint points). The accuracy of the stranded surplus is uncertain, in light of the complicated hydro restrictions that apply to the northwest. For example, in the spring and early summer hydro flows are increased to simulate to some degree natural spring runoff for fish migration. The goal of filling the reservoirs for summer recreation use and winter power generation is often unrealized.
2. There were cases where surplus resources were available, but transfer path limitations prevented the surplus from reaching the areas with deficits. Whenever an individual zone became deficit while the Interconnection overall had a surplus (sum of zonal surpluses/deficits were greater than zero), the deficit was due to transfer path limitations between the surplus area(s) and the deficit area(s). The predominant locations of these constraints are different than they were in last year's assessment (see Bubble Diagram #3 on

page 25), and they didn't change for this updated assessment. The following factors contributed to this change.

- In each of this year's studies, adverse transfer capabilities were used in place of last year's maximum ratings. There is no doubt that this affected the Idaho and Wyoming zones.
- The Path 15 upgrade increased the amount of capacity that Northern California could import from Central California. Also, the Path 26 uprate increased the transfer capability from Central California to Southern California.
- Generation additions in several key locations in WECC have changed the import requirements for several zones.

3. The assessment results for the period beyond 2005 are not a realistic picture of future power supply margins. The addition of generation plants that are not accounted for in the current data should be expected. There is a point where the results shift from a determination of supply margin to a determination of future needs.
4. The model assumes an idealistic efficiency where resources and transmission become immediately available as necessary to meet demand requirements. Economical system operation and other conditions could adversely affect the availability of resources, and could impact the amount and timing of power supply deficiencies.
5. The most common approaches for resolving power supply deficiencies are the addition of generating capacity or the addition of transmission capability. Given the projected rate of load growth and the difficulties in financing and siting transmission lines, it may be more practical to add generation capacity in the areas that are anticipating supply deficits.

Bubble Diagram #3 – Constrained Paths (Summer)



Legend
The heavy lines show where transmission constraints for some of the studies prevented a surplus in the north from reaching a deficit in the south. The blue (dashed) line is last year's break, red (solid) is this year's break.

H. Recommendations For Future Assessments

1. The WECC member systems should continue to be involved in the verification of the data.

2. Appropriate factors should be applied to the studies to account for sensitivities to demand variations, hydro conditions, forced outages, or transfer path de-ratings.

3. The effect of using non-coincidental demands should be examined. Preliminary studies indicate that the simultaneous combined peak demand for WECC has a variance of 1% to 3%, compared to the non-simultaneous demand. A recommendation from the Reliability Subcommittee is pending.

4. The dynamic status of new generating plants in the WECC has introduced some additional uncertainty to the power supply assessment. The WECC members should be encouraged to provide information about planned resources in a timely manner to WECC for the purpose of conducting power supply assessments. Information regarding the retirement of existing units should also be provided. For merchant plants, the host control areas need to assume the responsibility for collecting and submitting the relevant data.

5. The hydro generation capability in the Northwest may have limitations beyond those assumed for this assessment. The seasonal operation of the coordinated hydro system is subject to dozens of parameters to accommodate the various interests in the river systems. These parameters should be addressed in future assessments.

6. Future plans for the model may include conducting probabilistic or stochastic studies to study the effects of random uncertainties. This would require that the members provide additional information such as resource forced outage rates, resource operating costs, demand variations, transmission loss data, and transmission wheeling costs.

7. Planned changes to the transfer path capabilities must be reflected in the model to accurately measure their effect on the results. Since they would usually directly affect the results, only changes that are highly probable should be taken into consideration.

8. The studies described in this report do not address the energy supply in WECC. While WECC recognizes the need for an assessment of energy supplies, it is expected that the data and manpower requirements would be significantly higher than for this peak hour assessment. A more sophisticated model would also be needed. Some of the concepts that would have to be addressed are:

   - What is the minimum time resolution that must be studied? It may be necessary to study every hour of every day.
   - What generation parameters would be required? Minimum and maximum hydro availability for each hour, each day, each week, and each month may be required. Emissions limitations should be taken into account. Economic dispatch and startup requirements should be addressed.
   - The model would also need to consider interchange and transmission constraints.

WESTERN ELECTRICITY COORDINATING COUNCIL

POWER SUPPLY ASSESSMENT POLICY

INTRODUCTION

The Western Electricity Coordinating Council was established to promote the reliable operation of the interconnected bulk power system by the coordination of planning and operation of generating and interconnected transmission facilities.

The Planning Coordination Committee assigned the Reliability Subcommittee the task of developing an Adequacy of Supply Assessment Methodology. This document establishes the policy for conducting power supply assessments using the methodology developed by the Reliability Subcommittee. This policy shall be periodically reviewed and revised as experience indicates.

PURPOSE OF POWER SUPPLY ASSESSMENT

To ensure the reliability of the interconnected bulk electric system, it is necessary to assess both the security and the adequacy of the overall Western Interconnection. This document is focused on the portion of the assessment dealing with the adequacy of power supply. As electric industry restructuring has begun to break apart the traditional model of the vertically integrated utility, the responsibility for maintaining the adequacy of the power supply is moving toward market mechanisms. Though there may not be specific entities entrusted to plan for adequate resources, there exists a need to assess whether projected resources will be sufficient to reliably meet demand. Such information will allow regulators and policy makers to anticipate potential shortfalls so that determinations can be made as to whether impediments or insufficient incentives exist in the market.

It is not the intent of an adequacy assessment to replace the market, create sanctionable criteria or anticipate future energy prices. Its purpose is to project whether enough resources exist, at any price, to meet load and possible reserves while considering the transmission transfer capabilities of major paths. Such an assessment is required to comply with the NERC Planning Standards. These standards require that each region perform a regional assessment of existing and planned (forecast) adequacy of the bulk electric system.

It is recognized that it is impossible to provide 100% adequacy of power supply. It is the purpose of this document to establish a uniform policy for assessing the adequacy of installed and planned resources within the WECC region for the purposes of reporting within the Council, and to outside agencies. The assessments shall cover a period encompassing the next 5 years.

Attachment 1

ASSESSMENT METHODOLOGY

The Power Supply Assessment Methodology shall be developed and maintained by the Reliability Subcommittee. Adequacy of supply may be defined and measured in terms of generating reserve margins and transmission limitations between load and resource areas and/or based on probabilistic methods. Appropriate technical tools shall be developed and utilized in conducting the assessments. The assessments shall account for diversity of load and generation, and account for transmission constraints between load and resource areas.

DATA REQUIREMENTS

To aid WECC in assessing resource adequacy, the following information shall be provided by the WECC member systems:

Load Forecasts

- Electricity demand and energy forecasts, including uncertainties
  - Variations due to weather
  - Variations due to other factors affecting forecasts

Demand Side Management (DSM) Programs

- Existing and planned demand-side management programs
  - Direct controlled interruptible loads
  - Aggregate effects of multiple DSM programs

Resource Information

- Supply-side resource characteristics, including uncertainties
  - Consistent generator unit ratings, including seasonal variations and environmental considerations affecting hydro and thermal units
  - Availability of generating units
  - Fuel type

Transmission Information

- Capabilities, availability of transmission capacity, and other uncertainties

Attachment 1

REPORTING OF POWER SUPPLY ADEQUACY

The assessment of generating reserve margins and transmission limitations between load and resource areas as well as probabilities of supplying expected load levels, accounting for uncertainties, shall be developed and the results reported on a seasonal basis. The assessment shall be consistent with the requirement for maintaining operating reserves as defined in the *WECC Minimum Operating Reliability Criteria* and NERC Operating Policies.

Approved by Reliability Subcommittee June 16, 2000
Approved by Planning Coordination Committee June 30, 2000
Approved by Board of Trustees August 8, 2000
Revised April 18, 2002