2004 Long-Term Reliability Assessment

The Reliability of Bulk Electric Systems in North America

North American Electric Reliability Council
September 2004

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INTRODUCTION

The North American Electric Reliability Council's (NERC) Reliability Assessment Subcommittee (RAS) prepared this independent report, which includes:

EXECUTIVE SUMMARY

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NERC and the electric industry have taken significant steps to improve the reliability of the bulk electric system since the August 14, 2003, blackout. Both NERC and the U.S.-Canada Power System Outage Task Force issued thorough technical reports earlier this year that examined the causes of the blackout and made extensive recommendations on a wide range of actions needed to reduce the possibility of such an outage occurring in the future. NERC is working closely with the government task force to ensure that all recommendations resulting from these investigations are tracked and implemented.

The *Status Report on NERC Implementation of the August 14, 2003, Blackout Recommendations* outlines the actions that NERC and the industry have taken to improve reliability since the blackout. Most significantly, NERC has acted to:

1. **Rectify the direct causes of the blackout.** NERC required the entities directly involved in the blackout to correct by June 30 specific deficiencies identified during the blackout investigation. NERC has since verified that each entity has implemented its mitigation plan.
2. **Conduct extensive readiness audits of all major system operators.** To date, NERC has audited 30 of the largest control areas in North America to ensure that they are fully prepared to perform their reliability responsibilities. By year-end, more than 50 control areas will have been audited.
3. **Clarify existing reliability standards and develop new ones.** NERC is converting its existing planning standards and operating policies into a single set of Version 0 reliability standards. This effort will be completed by year-end and the new standards are expected to be in place in early 2005. NERC is also developing new standards on vegetation management and operator training. These efforts will ensure that the reliability "rules of the road" are understood and followed by all entities whose operations affect the reliability of the bulk electric system.

Although these and many other important initiatives have been completed or are well under way, some will take years to implement. Taken as a whole, these extensive and cooperative efforts will go a long way to reduce the risk of another major outage on the North American bulk electric system.

[illegible] Adequacy Satisfactory in the Near Term

Resource adequacy in the near term (2004–2008) will be satisfactory throughout North America, provided new generating facilities are constructed as anticipated. In spite of this favorable outlook, a chance remains that an excessive number of equipment problems, coupled with high demands caused by extreme weather, could create localized supply problems.

Electricity demand is expected to grow by about 69,000 MW over the next five years. Projected resource additions over this same period total about 67,300 MW, depending upon the number of merchant plants assumed to be in service. Generation additions and resulting capacity margins are not evenly distributed across North America, as shown in the *Data Analysis* section of this report.

Resource adequacy in the long term (2009–2013) is more uncertain, but should be satisfactory if current trends continue. Among the factors that will influence long-term adequacy are: timely completion of planned capacity additions, including the ability to construct the required associated transmission facilities; ability to obtain necessary siting and environmental permits; ability to obtain financial backing; price and supply of fuel; and political and regulatory actions.

In areas with deregulated electric service, the addition of new generating capacity is dependent on the response of power plant developers to market signals. In these areas, capacity margins will likely fluctuate, similar to normal business cycles experienced in other industries. In other areas, new capacity will primarily be constructed in response to resource adequacy criteria established by utility groups, individual utilities, or their regulators.

...n Systems Expected to Perform Reliably

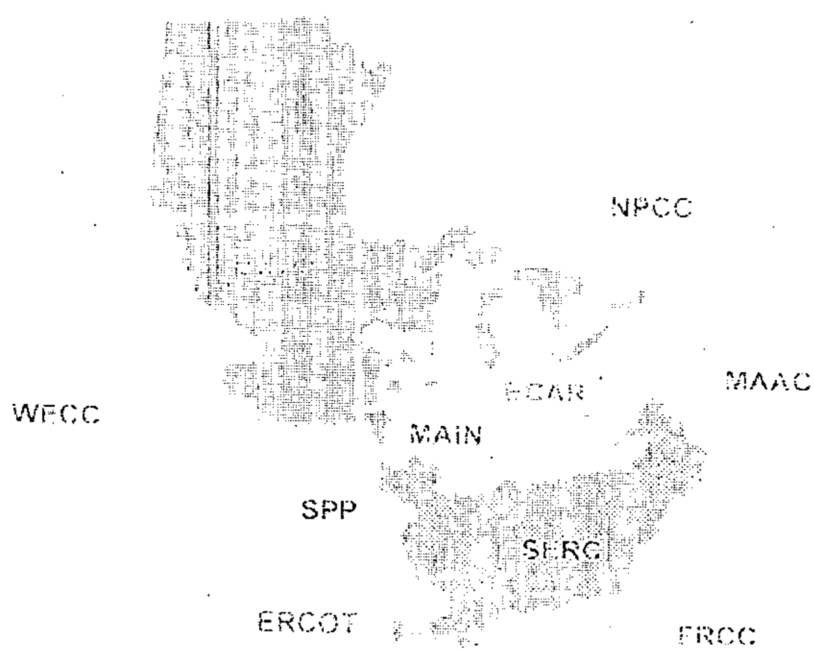
The North American transmission systems are expected to perform reliably in the near term. As customer demand increases and transmission systems experience increased power transfers, portions of these systems will be operated at or near their reliability limits more of the time. Under these conditions, coincident failures of generating units, transmission lines, or transformers, while improbable, can degrade bulk electric system reliability.

Critical to maintaining system reliability under these conditions are:

Adequate Fuel in Most Regions

Most regions do not anticipate any problems with fuel supplies for the assessment period. Hydroelectric resources will be affected by the amount of precipitation each year, which cannot be accurately predicted very far into the future. The industry's growing dependence upon natural gas as a primary fuel for new power plants is addressed in the *Gas Electricity Interdependency Issues* section of this report.

Figure 1: NERC Regional Reliability Councils



ECAR
East Central Area Reliability Coordination Agreement

ERCOT
Electric Reliability Council of Texas

FRCC
Florida Reliability Coordinating Council

MAAC
Mid-Atlantic Area Council

MAIN
Mid-America Interconnected Network, Inc.

MAPP
Mid-Continent Area Power Pool

NPCC
Northeast Power Coordinating Council

SERC
Southeastern Electric Reliability Council

SPP
Southwest Power Pool

WECC
Western Electricity Coordinating Council

ECAR — Construction has begun on American Electric Power's (AEP) 765 kV project in southeastern ECAR, which is needed to guard against potential supply interruptions in that area. The likelihood of such interruptions will increase until this project is completed and operational in 2006.

ERCOT — Generating units fired by natural gas account for more than 60 percent of the installed capacity in ERCOT and are expected to maintain or increase that share over the assessment period. Because of this dependency and the impact of gas curtailment priorities on electric generation, ERCOT will continue to pay close attention to the availability of natural gas supply in the region.

To manage local transmission congestion, ERCOT has entered into contracts with reliability must run (RMR) generation that would otherwise not be operated. Transmission additions that would eliminate the need for existing RMR generation are planned to be completed during the assessment period.

FRCC — Electricity produced from natural gas generators in FRCC is forecast to increase from 26 percent in 2003 to 52 percent in 2013. Due to this increasing dependence, FRCC formed a Natural Gas/Electricity Interdependency Task Force (FRCC GEITF) to assess and monitor the risks associated with having an ever-increasing share of generating units fueled by natural gas. The FRCC GEITF is focusing on pipeline transportation adequacy and reliability as it affects electric generator operation and reliability in the region.

MAAC — A joint MISO-PJM Operating Agreement has been finalized to enhance reliability and manage congestion at the interface between MISO and PJM. In addition, each regional transmission organization (RTO) has the ability to request generation be operated in the other RTO to preserve agreed-upon transmission rights and to relieve congestion in their footprint.

MAIN — MAIN remains concerned about the natural gas supply and the potential for a single-mode pipeline failure to impact multiple generating plants.

MAPP — Outages of 345 kV tie lines connecting the Minneapolis-St. Paul Twin Cities area to the Iowa and Wisconsin regions are continuing to result in limits on energy transfers from the Twin Cities to Iowa and Wisconsin. The Arrowhead-Weston 345 kV transmission line has been identified as a significant reinforcement to improve the overall performance of this interface and is expected to be in service in 2008.

NPCC — ISO New England (ISO NE) has finalized agreements to secure emergency energy resources to meet critical electric system reliability needs in southwestern Connecticut for the next four years. ISO NE is concerned about the availability of natural gas for electric generation due to the high demand for natural gas in the winter for home heating needs.

Because of load growth in Boston, transmission upgrades are needed to reliably serve loads. Plans are in place that will increase New England's import capability and eliminate the dependency on certain generating resources. These upgrades are expected to be in service by 2006.

Significant transmission reinforcement will be required in the Greater Toronto Area (GTA) to maintain an acceptable level of supply reliability over the ten-year period. The need for transmission reinforcement is due to forecast load growth, as well as the removal from service of the 1,150 MW coal-fired Lakeview Thermal Generating Station in 2005. Additional reactive supply capability will be also be required before the Lakeview shutdown takes place. Plans have been developed and are being implemented to address these concerns. In the short term, these plans involve construction of a new transformer station and the installation of shunt capacitors by the summer of 2005. In the longer term, additional supply and transmission reinforcements will be required in the GTA.

NPCC and the New York ISO (NYISO) believe that renewal of the New York *Article X* siting law is essential for meeting the state's resource adequacy requirements over the long term.

SERC — Large and variable loop flows are expected to impact transfer capabilities on a number of interfaces within SERC and between SERC and other regions. Although no projects have been identified or planned for the sole purpose of relieving loop flow issues, members are relieving constraints that affect transfer capabilities through other reliability improvement projects, which will help to relieve loop flow issues as well.

SPP — SPP is in the process of becoming the first NERC regional reliability council to become an RTO. SPP is implementing several initiatives that will result in transmission expansion and better utilization of the existing assets in the footprint.

WECC — Due to the addition of several generating plants in Arizona, southern Nevada, and Mexico, the bulk transmission system in the southwest is becoming increasingly congested. Special protection schemes have been implemented for new generation connected to the Imperial Valley substation to relieve some of the congestion. Also, operating limits have been established that restrict the simultaneous operation of generating plants connected to the Imperial Valley substation and imports from Comision Federal de Electricidad and Arizona.

The California Independent System Operator (CAISO) anticipates that the 500 kV interconnection between Arizona and California that connects to the Imperial Valley substation will be constrained most of the time due to increased imports from new southwest generation. San Diego Gas & Electric (SDG&E) has approval to acquire internal resources as needed to meet the reliability requirements identified due to these constraints.

Multi-Regional — Beginning in January 2005, the U.S. Department of Transportation (DOT) will begin requiring compliance with new regulations (Pipeline Safety Act) designed to ensure the physical integrity of natural gas pipelines. DOT started the assessments in June 2004 and will require that an Integrity Management Program/Plan be in place by December 2004.

The regulations mandate that the assessment and inspection of 50 percent of the most critical gas transmission pipelines be completed by December 2007, and that the industry complete the entire baseline assessment by December 2012. Periodic reassessments will occur within seven years thereafter.

These pipeline assessment activities are of concern because inspections uncovering potentially serious pipeline integrity/safety issues could cause the pipeline to be taken out of service for repairs on short notice. Reliability coordinators and generator operators in those regions with major reliance on natural gas-fired generation should communicate with their gas pipelines to ensure that these inspections are coordinated with their own maintenance outage schedules to the extent possible.

of Relia…

NERC defines the reliability of the interconnected bulk electric system in two basic, ways:

1. Adequacy — The ability of the electric system to supply the aggregate electrical demand and energy requirements of customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.
2. Operating Reliability — The ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated failure of system elements.

…ata Used in This Report

Detailed background data used in the preparation of this report is available in NERC's Electricity Supply & Demand (ES&D) database, 2004 edition (http://www.nerc.com/~esd/).

Most new generation additions over the next few years will be constructed by the merchant generation industry. NERC has contracted with Energy Ventures Analysis, Inc. (EVA) (http://www.evainc.com) to monitor and track the status of proposed new power plant projects as well as plant cancellations, delays, and retirements. In some cases, data available from EVA are used in this report to supplement data submitted by the regions.

NERC's mission is to ensure that the bulk electric system in North America is reliable, adequate, and secure. Since its formation in 1968, NERC has operated successfully as a voluntary self-regulatory organization, relying on reciprocity, peer pressure, and the mutual self-interest of all those involved. Through this voluntary approach, NERC has helped to make the North American bulk electric system the most reliable in the world.

The August 14 blackout clearly demonstrated that the existing scheme of voluntary compliance with NERC reliability rules is no longer adequate for today's competitive electricity markets, however. To ensure the continued reliability of the interconnected transmission grid, reliability rules must be made mandatory and enforceable and they must be applied fairly to all participants in the electricity marketplace throughout North America. Changing from a strictly voluntary reliability system to an enforceable one requires federal legislation in the United States to establish an independent electric reliability organization. It is imperative that Congress pass the reliability legislation pending before it.

NERC is a not-for-profit corporation whose members are ten regional reliability councils. The members of these councils include all segments of the electric industry: investor-owned utilities; federal power agencies; rural electric cooperatives; state, municipal and provincial utilities; independent power producers; power marketers; and end-use customers. These entities account for virtually all the electricity supplied and used in the continental United States, Canada, and a portion of Baja California Norte, Mexico.

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d Resource Projections

Electricity demand is expected to grow by about 69,000 MW through the summer of 2008. Projected resource additions over this same period total about 67,300 MW, depending upon the number of merchant plants assumed to be in service.

The average annual peak demand growth over the assessment period is projected to be 2.0 percent for the United States and 1.1 percent for Canada. The average annual peak demand growth rate for the last ten years has been 2.2 percent for the U.S. (summer), and 1.6 percent for Canada (winter). It is important to note that the demand growth rate projections are a ten-year average and that individual years may experience higher or lower growth rates due to variations in economic conditions and weather.

In Figures 2 and 3 (on the next page), the demand projections represent an aggregate of weather-normalized regional member projection assembled by the NERC Data Coordination Working Group. NERC's Load Forecasting Working Group (LFWG) then develops bandwidths around the aggregate U.S. and Canadian demand projections to account for uncertainties inherent in demand forecasting. NERC does not prepare its own independent demand forecast because local entities are best suited to make appropriate assumptions concerning diversity, weather, and economic conditions, which are key drivers of the demand forecast.

Forecast Bandwidths

Forecasts cannot precisely predict the future. Instead, many forecasts attach probabilities to the range of possible outcomes. Each base demand projection, for example, represents the midpoint of possible future outcomes. The future year's actual demand has a 50 percent chance of being higher and a 50 percent chance of being lower than the forecast value. Capacity resources historically have been planned for the 50 percent demand projections.

For planning purposes, it is useful to have an estimate not only of the midpoint of possible future outcomes, but also of the distribution of probabilities on both sides of that midpoint. Accordingly, NERC's LFWG develops upper and lower 80 percent confidence bands around the NERC-aggregated demand projections. Therefore, the chance of future demand occurring within these bands is 80 percent, occurring below the lower band is 10 percent, along with an equal 10 percent chance of future demand occurring above the upper band.

Figures 2 and 3 also show overlays of projected capacity resources on the projected demand bandwidths. The NERC regions report all capacity committed to serve demand within their borders, but capacity that is not committed to serve a specific demand might not be reported to NERC through its traditional data collection process.

It is difficult to accurately predict the exact number and in-service dates of future capacity additions merchant developers will actually construct. To supplement these traditional data sources in order to better understand the potential impacts of new generators, RAS has enlisted the services of EVA to provide detailed project information.[1] Using this information, announced new merchant plants were screened to establish those most likely to be built.
Two resource curves are shown: the first is based on NERC regional projections; and the second is the subcommittee's best estimate of future capacity resources (Existing plus EVA).

[1] EVA maintains a database of all proposed new power plants in the United States and tracks various milestones associated with the completion of the projects, including applications for environmental permits, siting, acquisition of equipment, financing, and contractual arrangements to sell the output of the facilities. Using this information, announced new merchant plants were screened to establish those most likely to be built. EVA does not monitor merchant development activity in Canada.

Figure 2: U.S. Summer Capacity vs Demand Growth

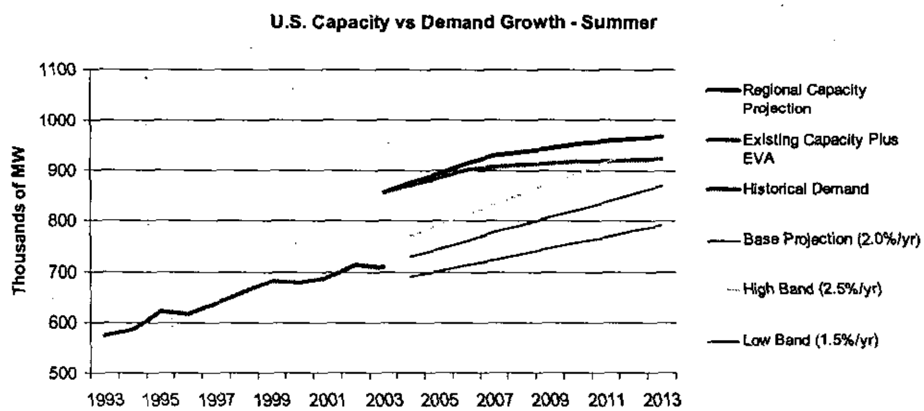

Figure 3 shows Canada's projected capacity resources for the assessment period, including all proposed new capacity resources reported by the NERC regions. Information regarding proposed new Canadian capacity additions beyond that reported by the regions is not currently available.

Figure 3: Canadian Winter Capacity vs Demand Growth

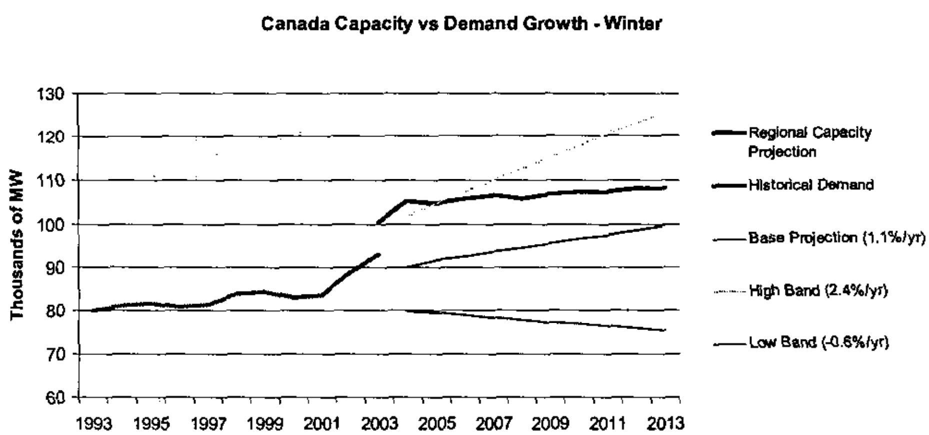

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Table 1 illustrates the effects of the recent new power plant delays and cancellations.

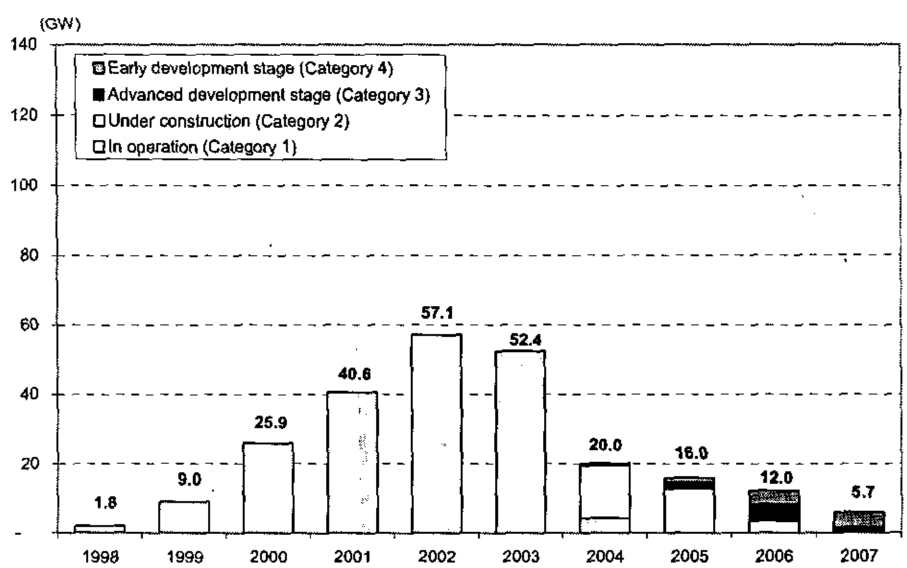
Table 1: New Gas-Fired Power Projects Under Development

Year	As Reported March 2004 (GW)	As Reported December 2001 (GW)	Difference (GW)
2002	57.1	69.3	-12.2
2003	52.4	91.3	-38.9
2004	20.0	95.8	-75.8
2005	16.0	24.5	-8.5
2006	12.0	1.1	10.9
2007	5.7	1.7	4.0
Total	**163.2**	**283.7**	**-120.5**

Source: EVA

As seen in Figure 4, the projected amount of new gas-fired generation is decreasing.

Figure 4: New Gas-Fired Turbine-Based Capacity by Year and Development Status

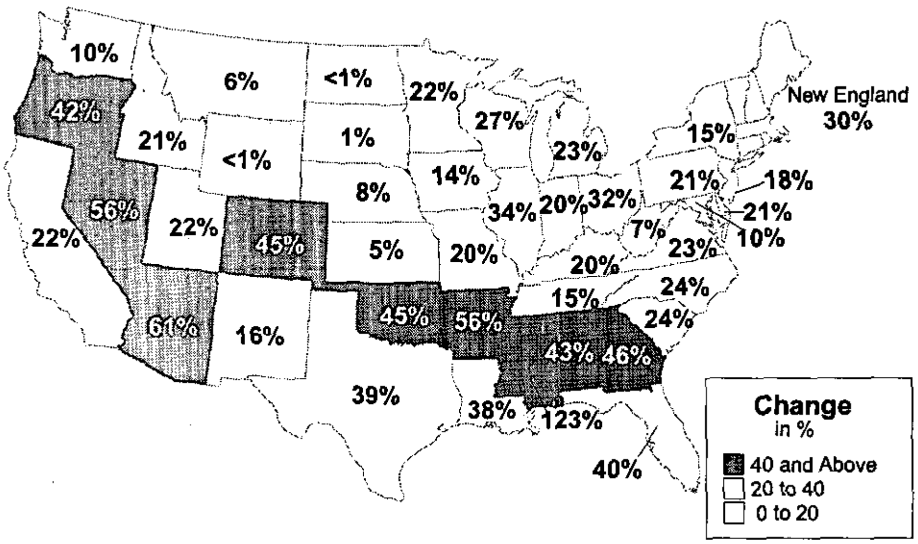


Source: EVA — June 2004[2]

[2] Projections for 2008 through 2013 were not available at the time of this publication.

As seen in Figure 5, the locations being selected for the installation of new generators vary by state.

Figure 5: Percentage of Projected New Generator Additions 1999–2007 as a Percentage of 1998 Total Installed Generation



Source: EVA

Capacity Margins

Two different capacity margin projections are shown in Figure 6. The line labeled "Reported by Region" reflects the capacity margins as reported by NERC Regions. The line labeled "EVA Supplement" reflects the projected capacity margins after adjusting regional data with data received from EVA. The regional reporting often includes plans for generation additions based on capacity adequacy requirements, without firm construction plans. All of the preceding capacity margin projections include the effects of currently planned generating unit retirements.

Figure 6: U.S. Summer Capacity Margins in Percent

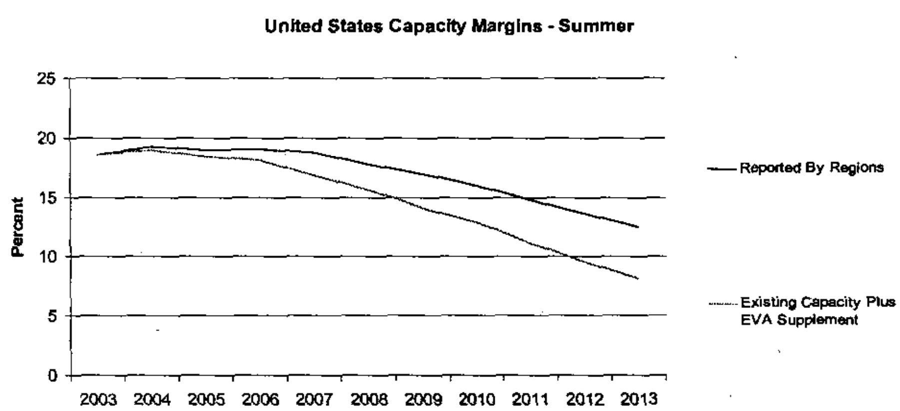


Figure 7 compares a series of four ten-year capacity margin projections for the U.S. as reported to NERC by the regions. Projected 2006 U.S. summer capacity margins are about 13.3 percent lower this year than last year's projection for 2006. The projected margin continues to decline during the latter half of the ten-year period to about 12.3 percent.

Figure 7: U.S. Summer Capacity Margin Projections

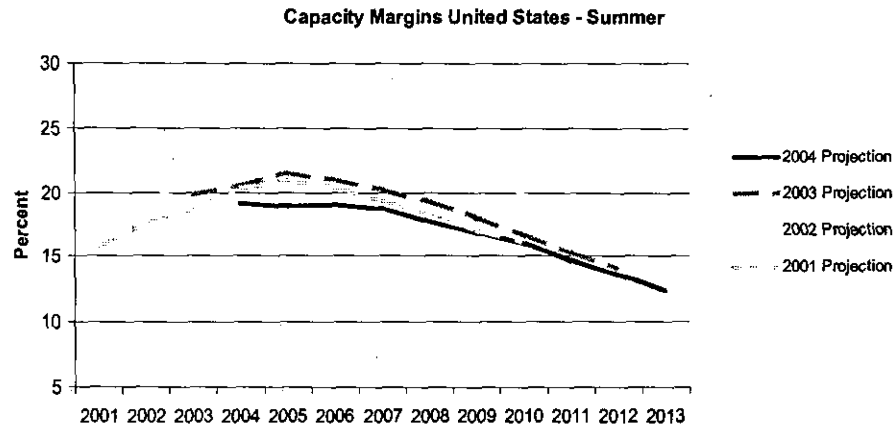
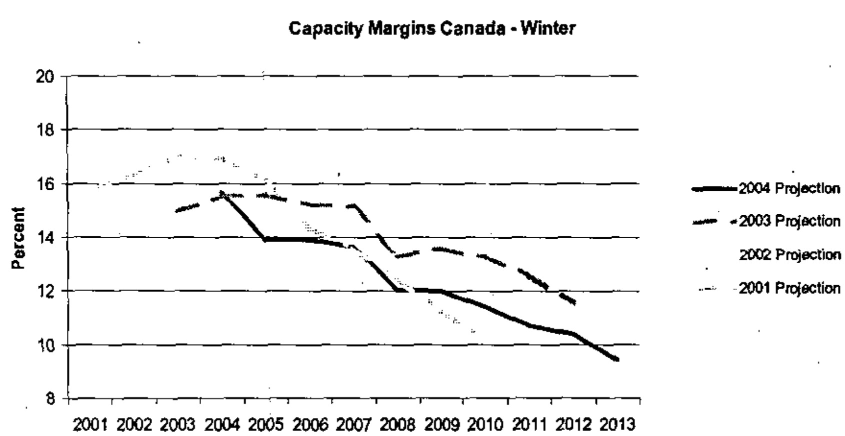


Figure 8 compares a series of four ten-year capacity margin projections for Canada as reported to NERC by the regions. Canadian projected winter capacity margins drops off significantly from 15.6 percent in 2004/05 to 11.9 percent by 2008/09. A 0.3 percent growth rate over the next ten years is outpaced by a 1.1 percent growth in demand.

Figure 8: Canada Winter Capacity Margin Projection



Figures 7 and 8 are based purely upon regional data submittals.

Energy Projections

Figures 9 and 10 show ten-year projections of net energy for load for the United States and Canada.

Figure 9. U.S. Net Energy for Load 2004–2013

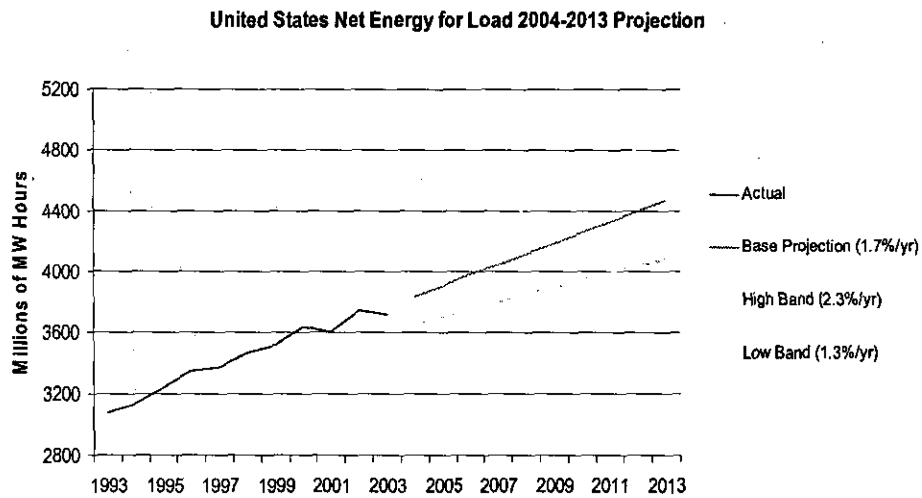
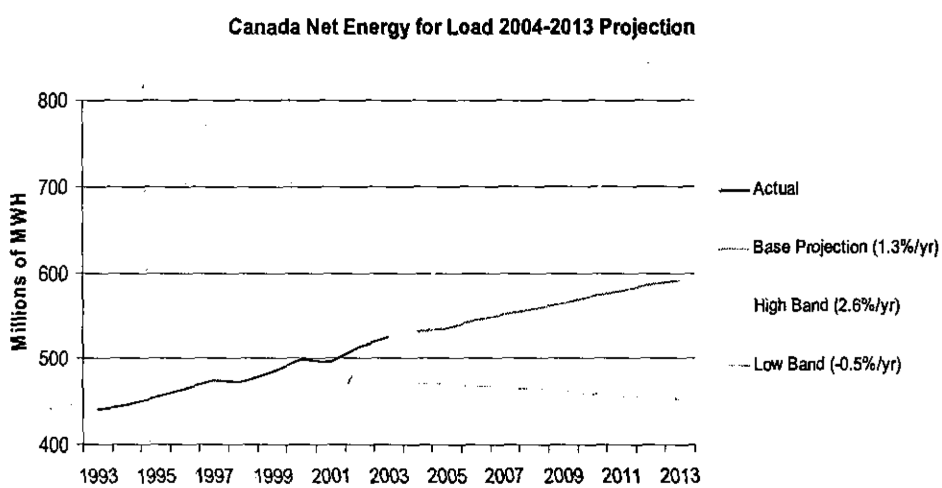


Figure 10. Canadian Net Energy for Load 2004–2013

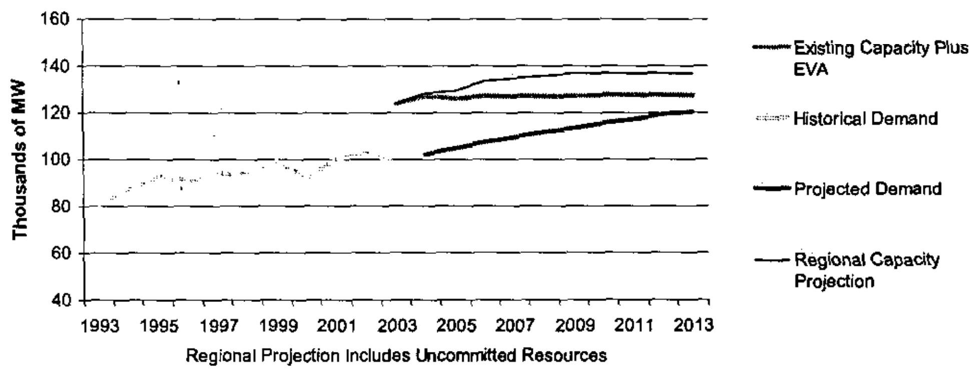


Capacity and Demand Projections

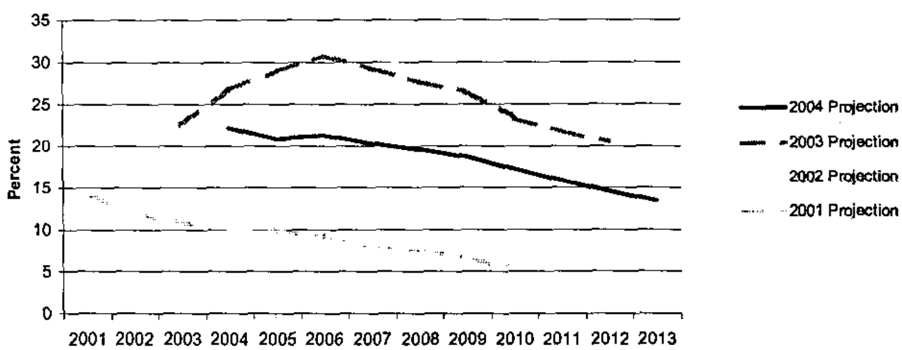
The figures on the following pages show the regional historical demand, projected demand growth, capacity margin projections, and generation expansion projections reported by the regions. These data are augmented by generation expansion data from EVA. Also included are pie charts comparing the projected change in the composition of capacity resources by fuel type from 1999 to 2009.

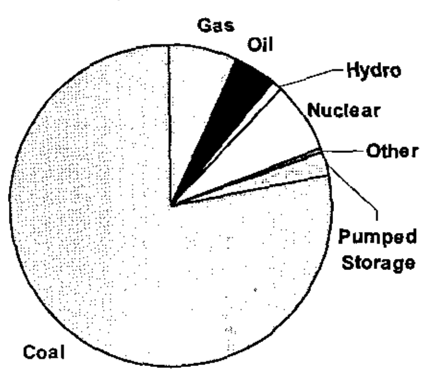
ECAR Capacity and Demand

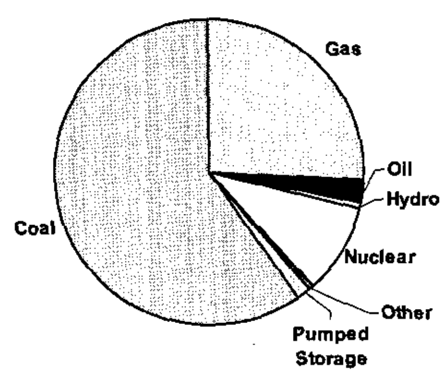
ECAR Capacity vs Demand - Summer



ECAR Capacity Margins - Summer

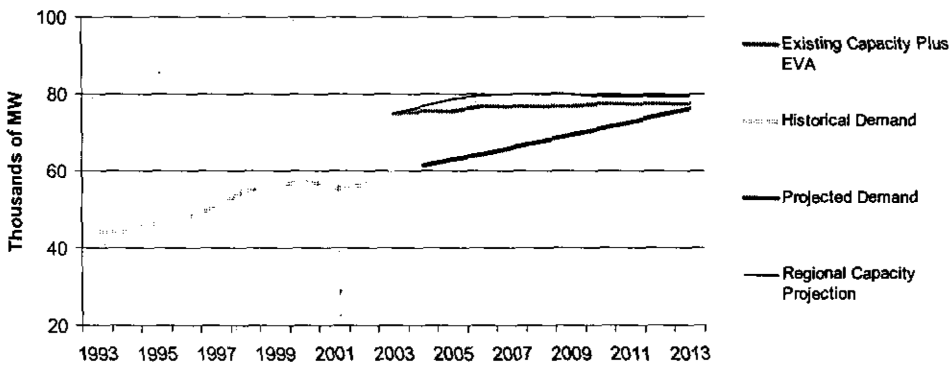




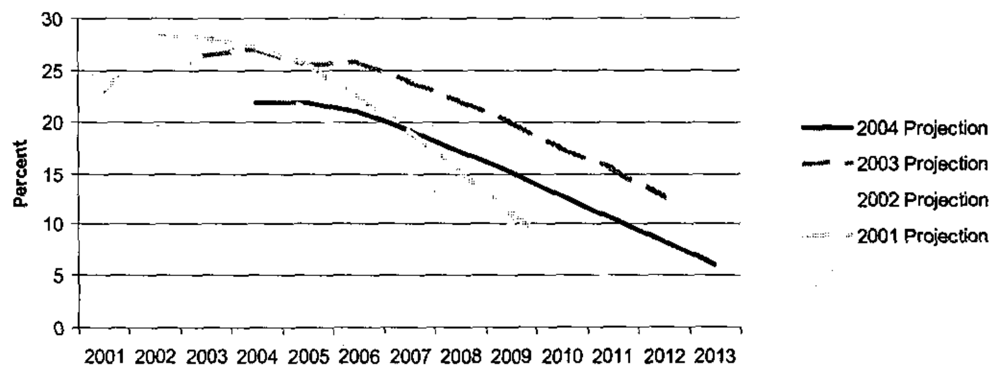


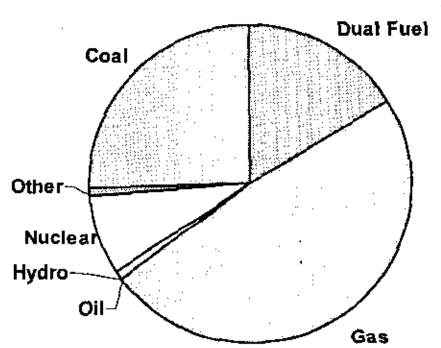
ERCOT Capacity and Demand

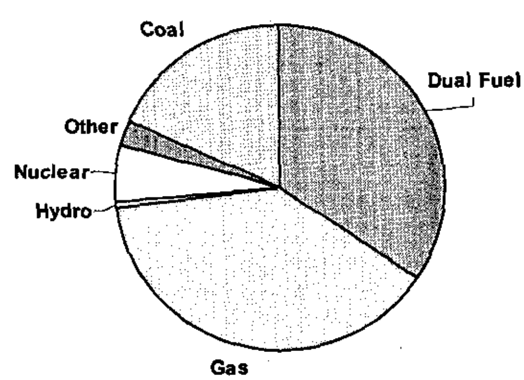
ERCOT Capacity vs Demand - Summer



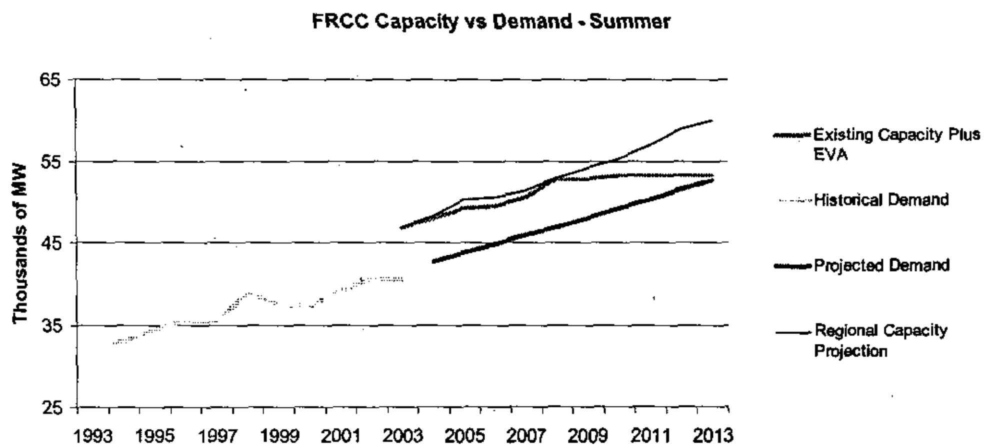
ERCOT Capacity Margins - Summer

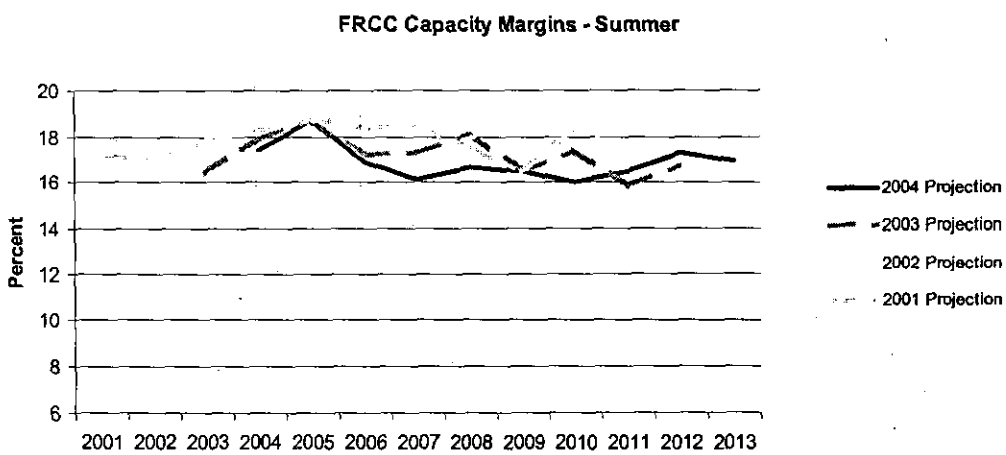


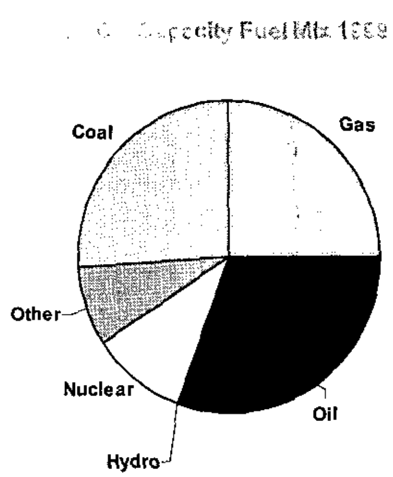


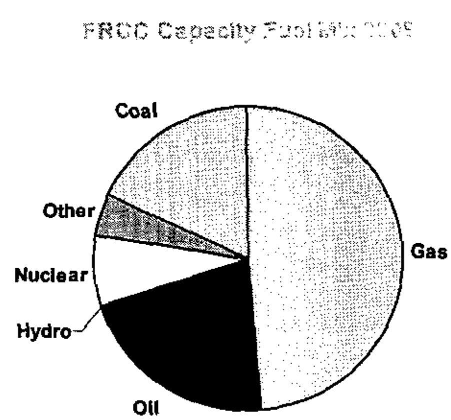


FRCC Capacity and Demand

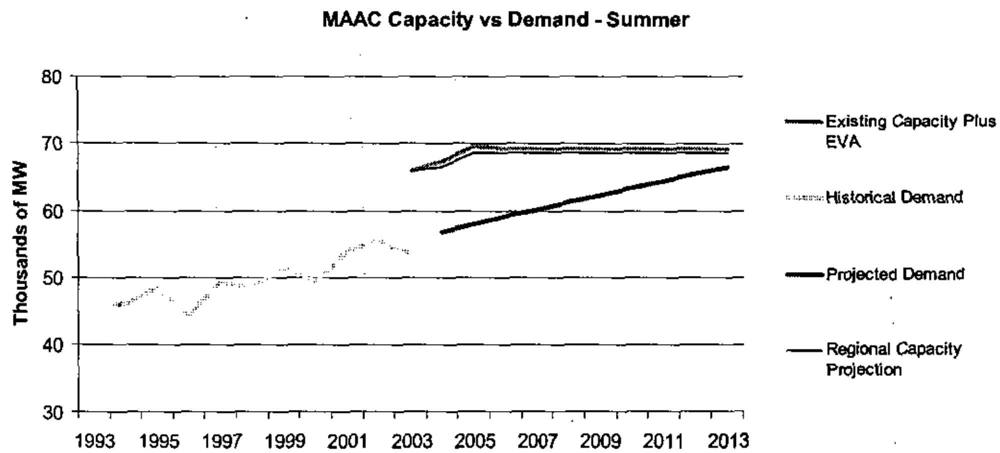


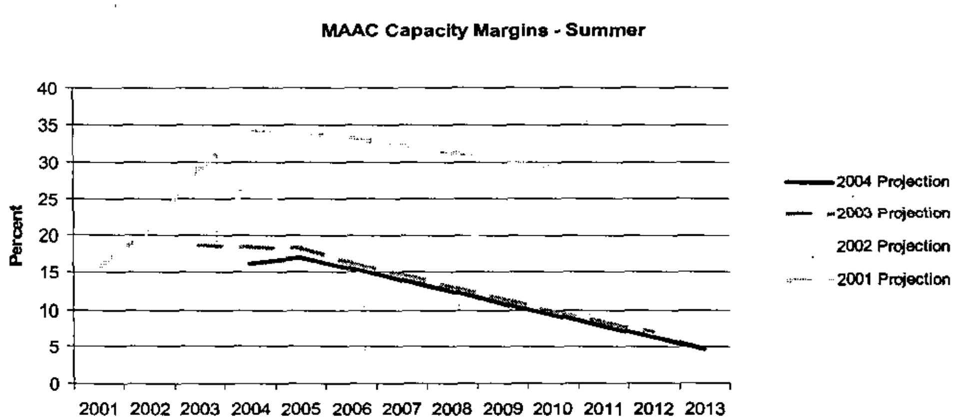


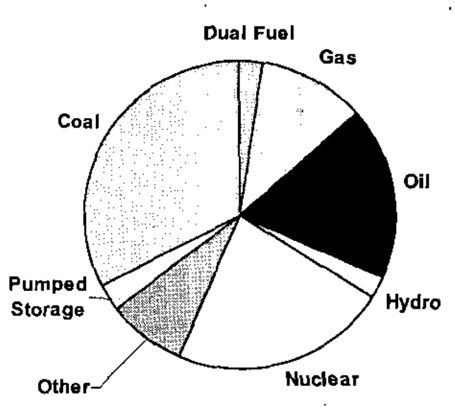


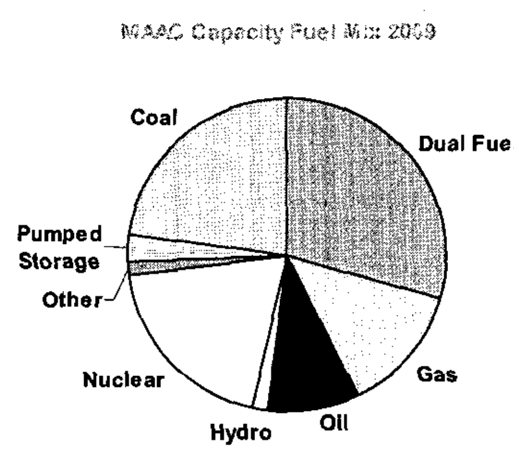


MAAC Capacity and Demand

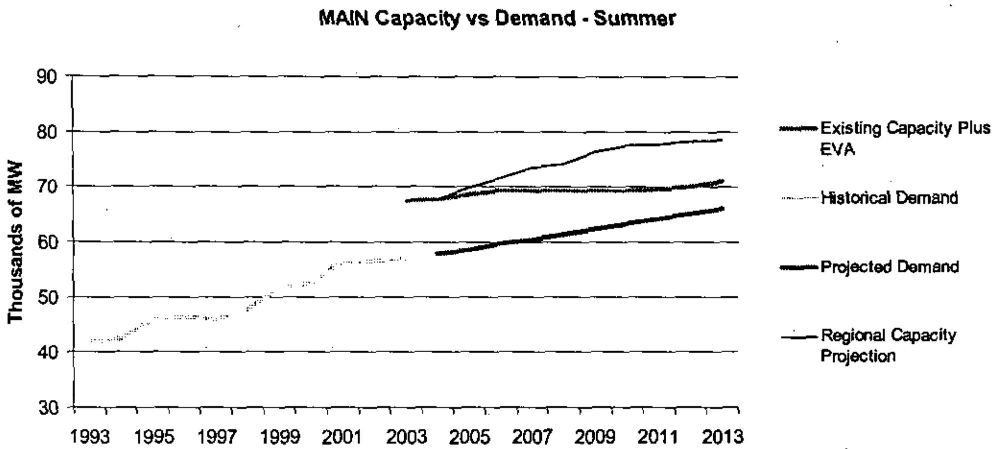


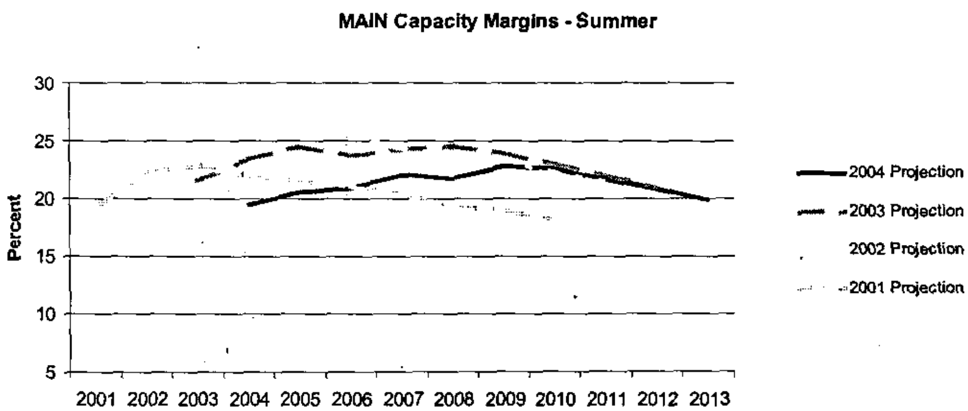


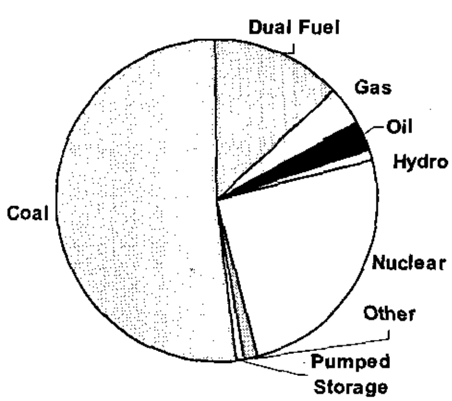


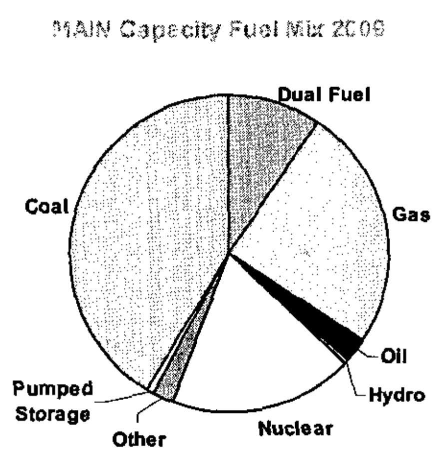


MAIN Capacity and Demand

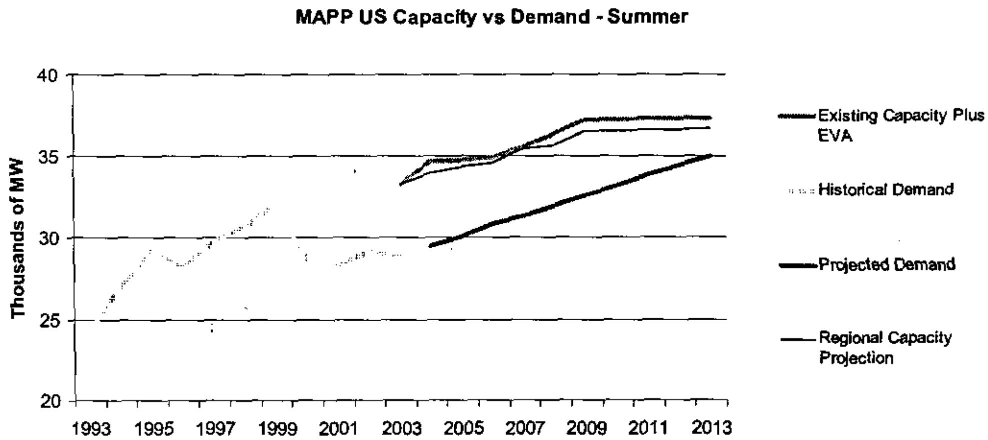


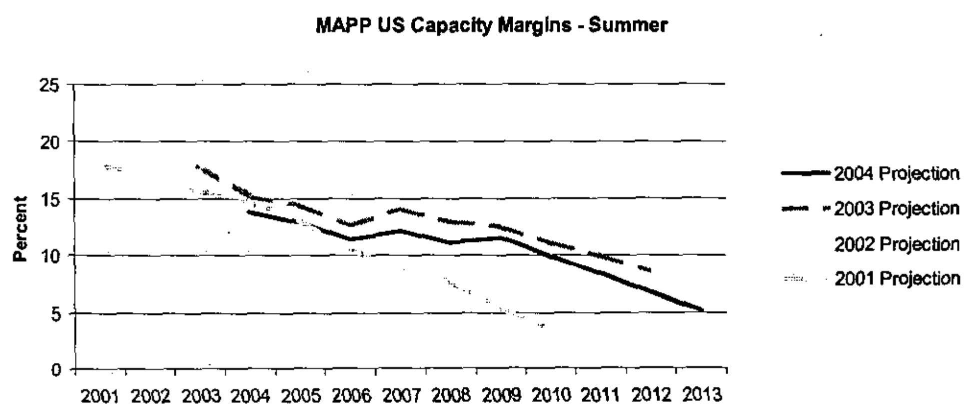


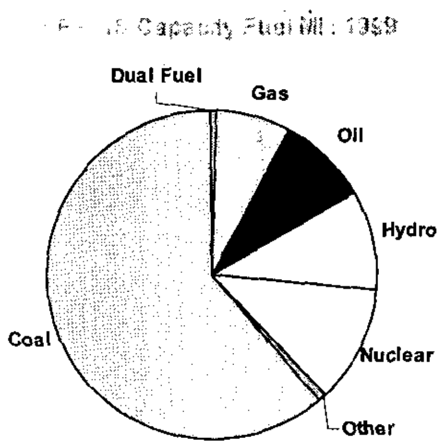


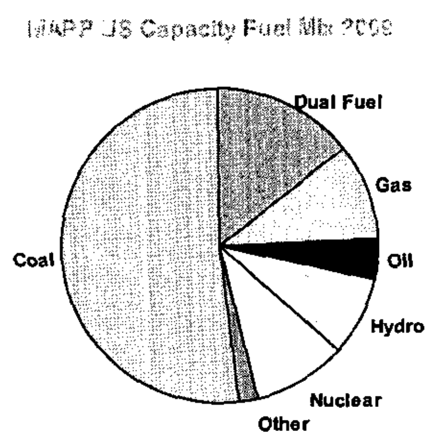


MAPP-U.S. Capacity and Demand

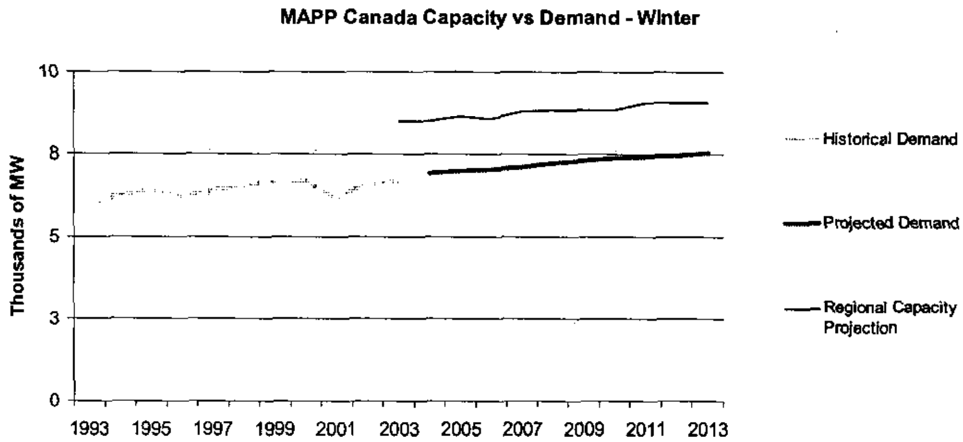


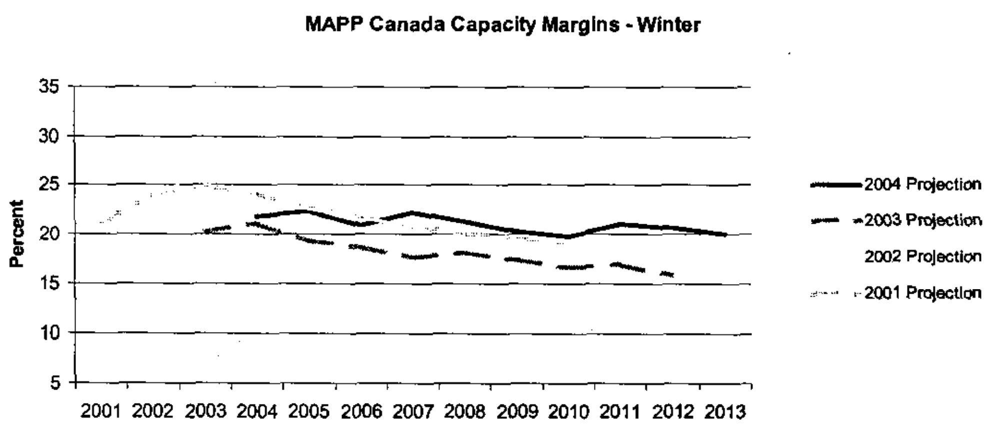


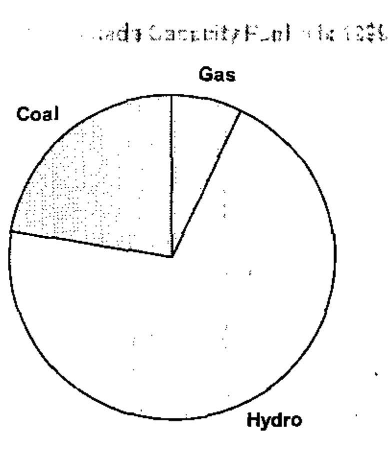


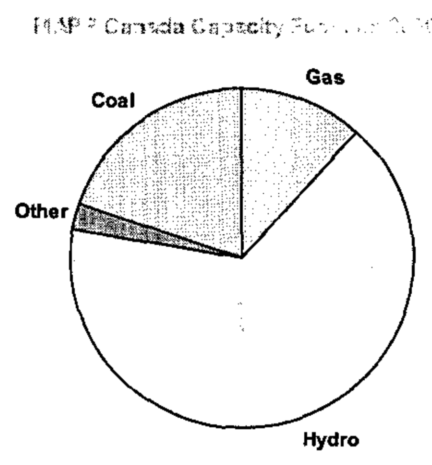


MAPP-CANADA Capacity and Demand

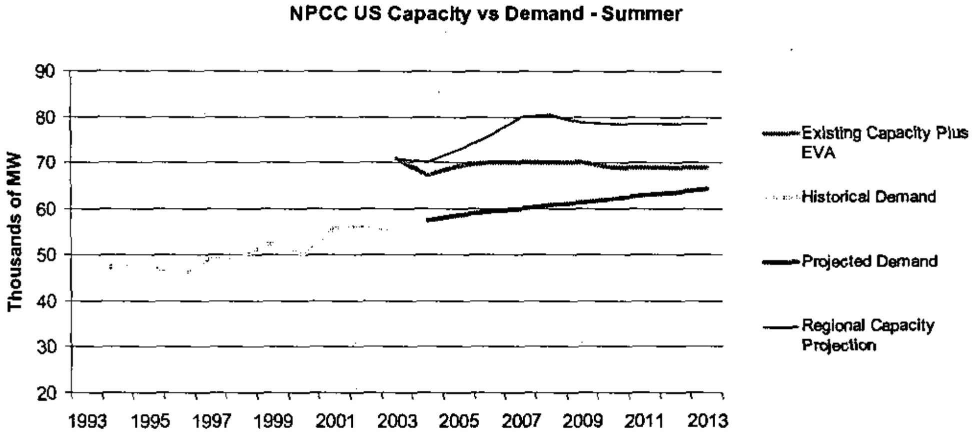


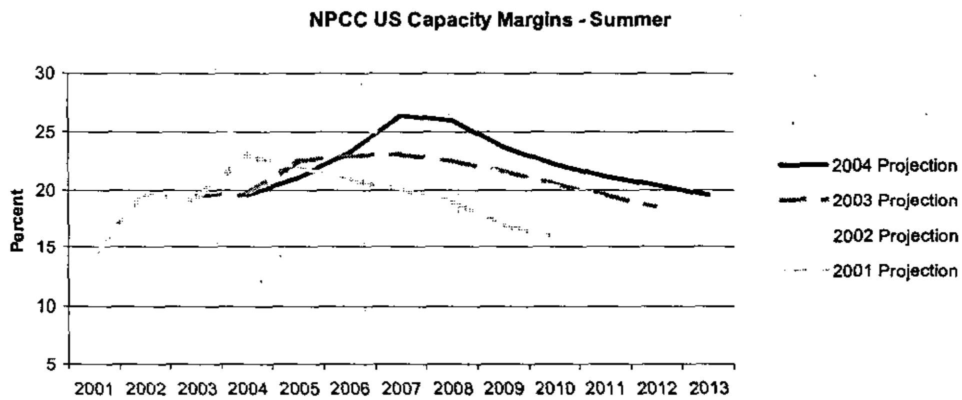


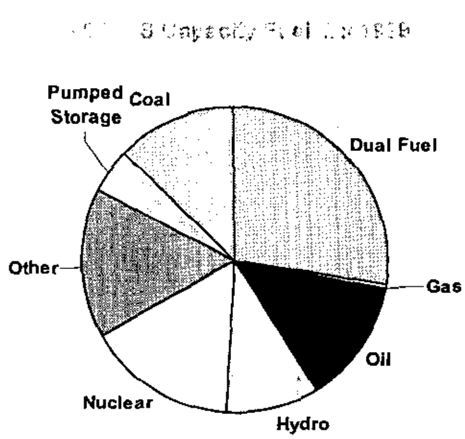


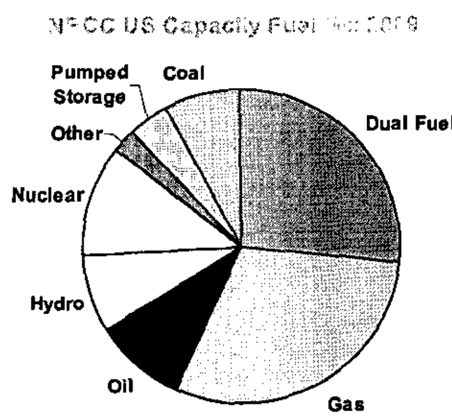


NPCC-U.S. Capacity and Demand

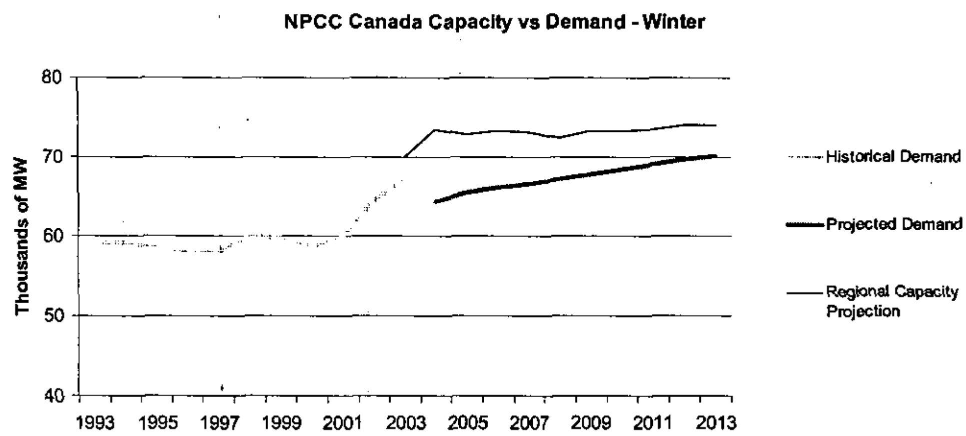


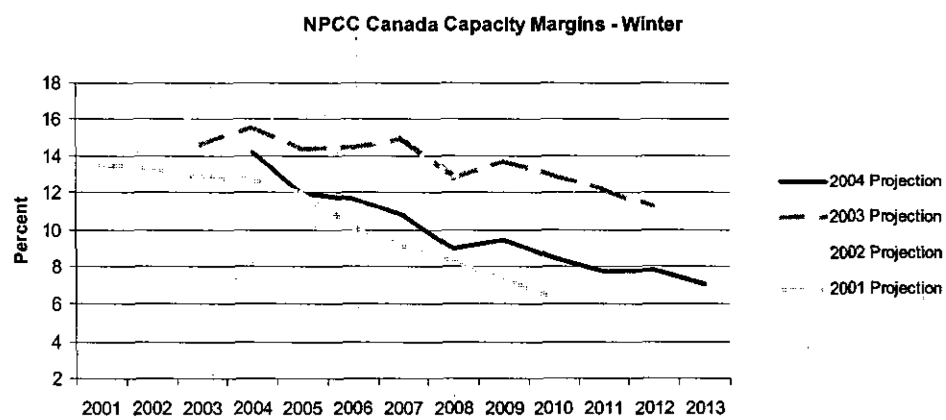


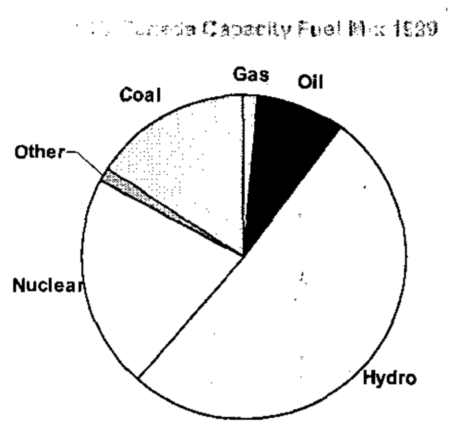


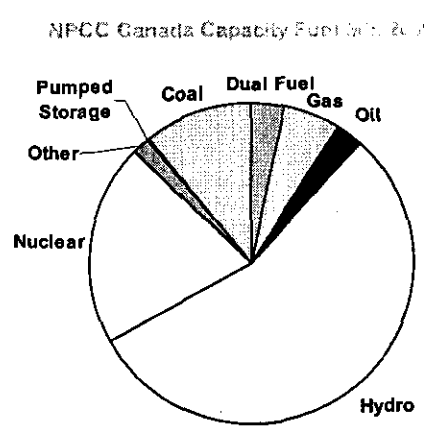


NPCC-Canada Capacity and Demand

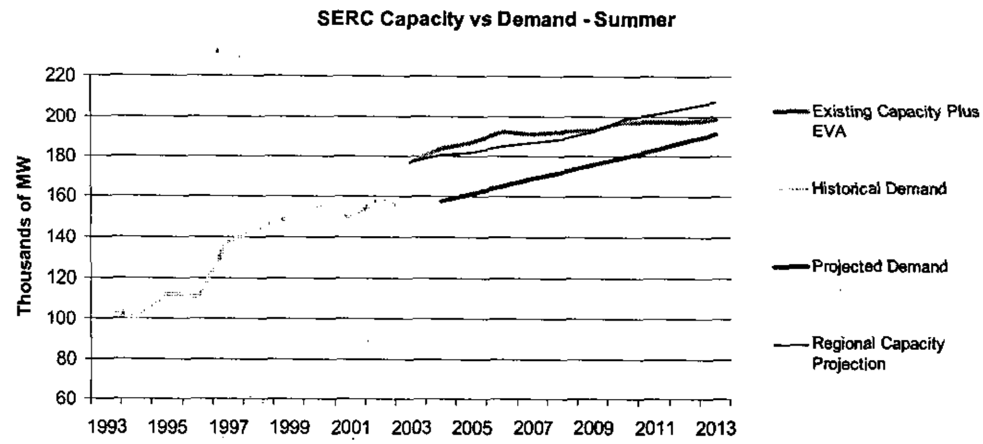


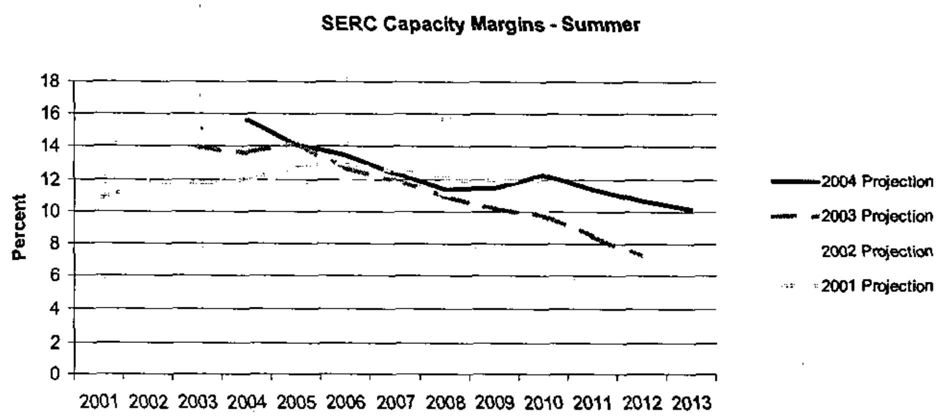


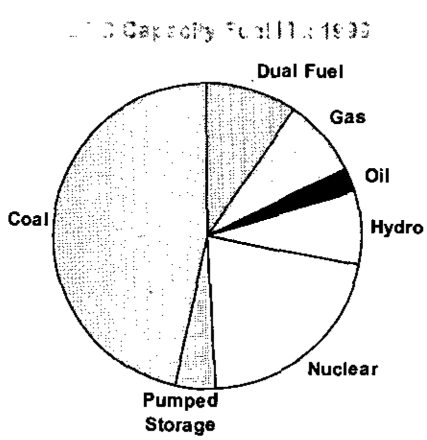


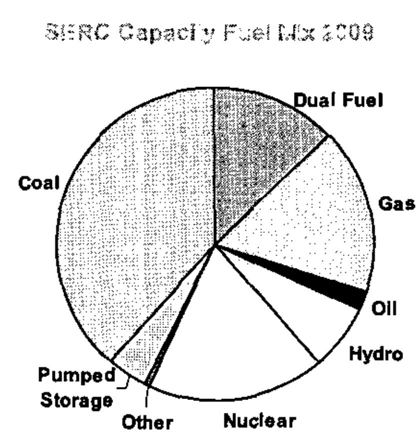


SERC Capacity and Demand

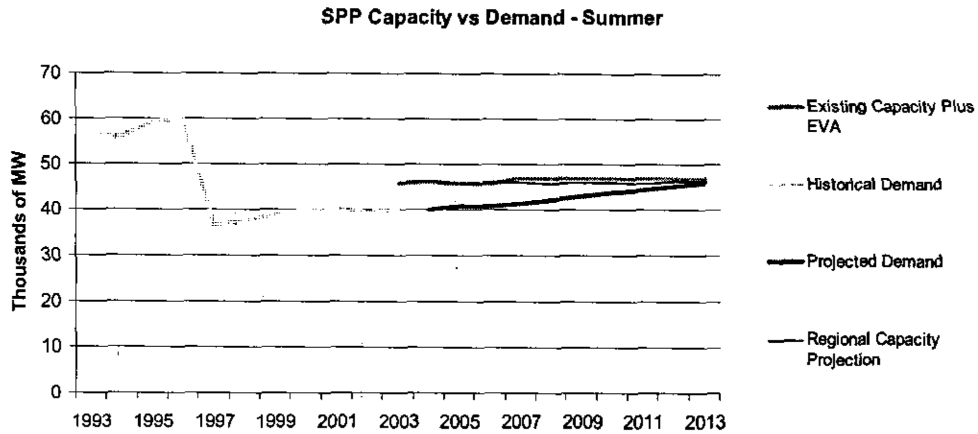


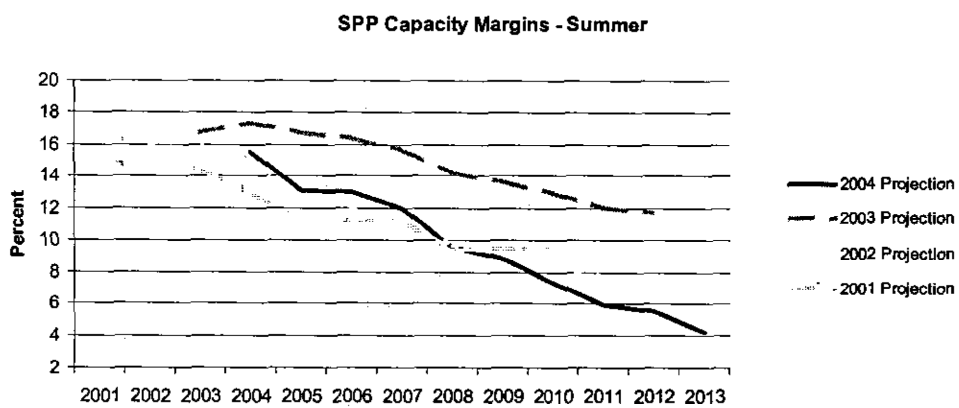


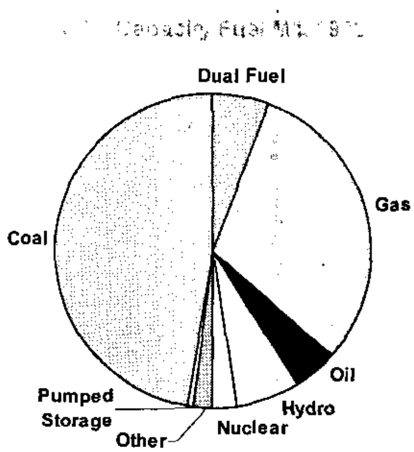


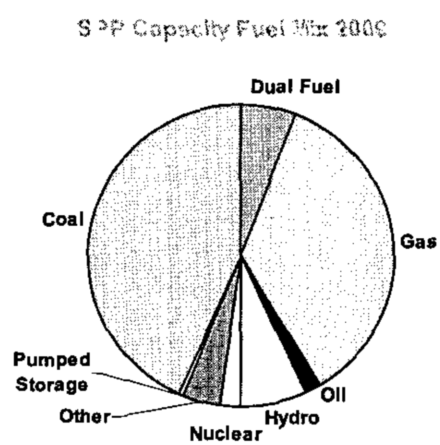


SPP Capacity and Demand

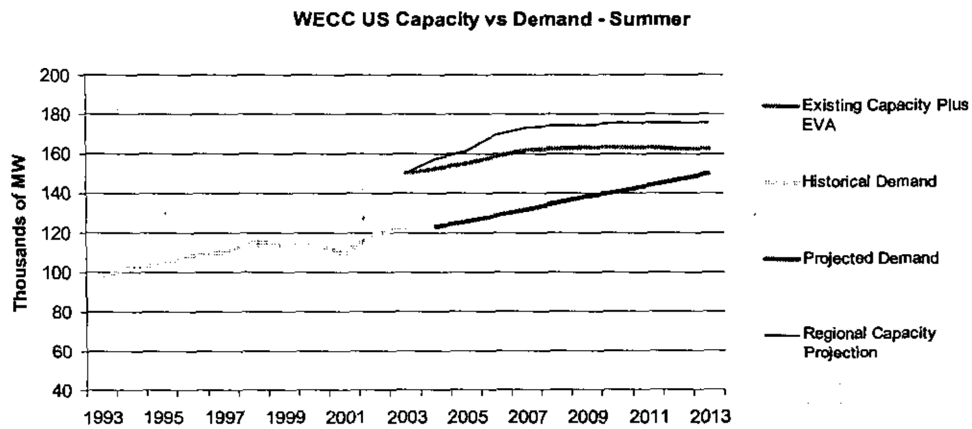


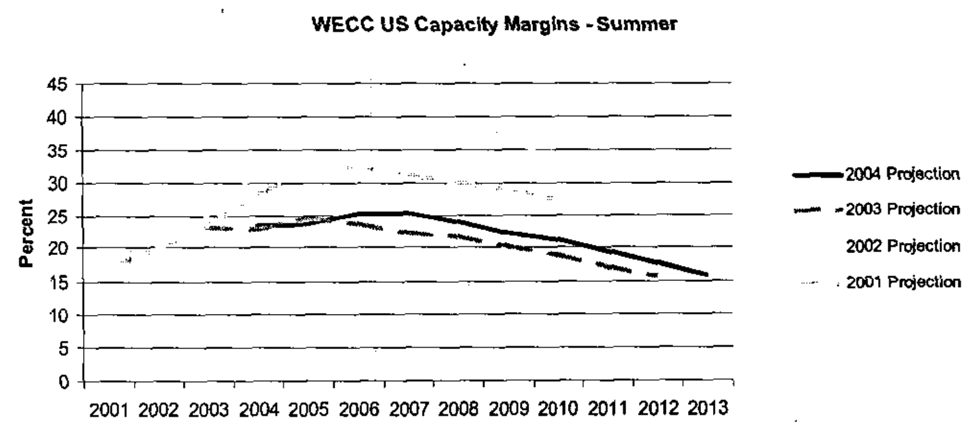


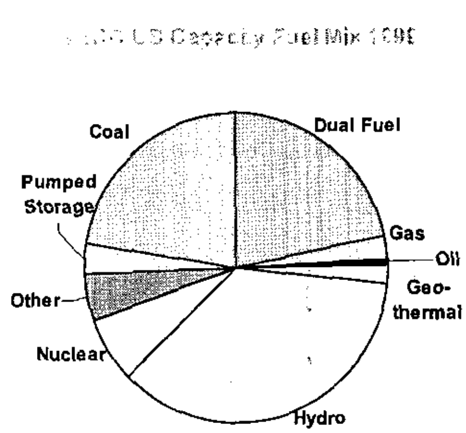


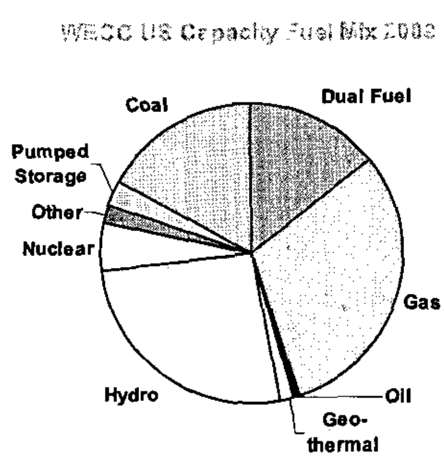


WECC-U.S. Capacity and Demand

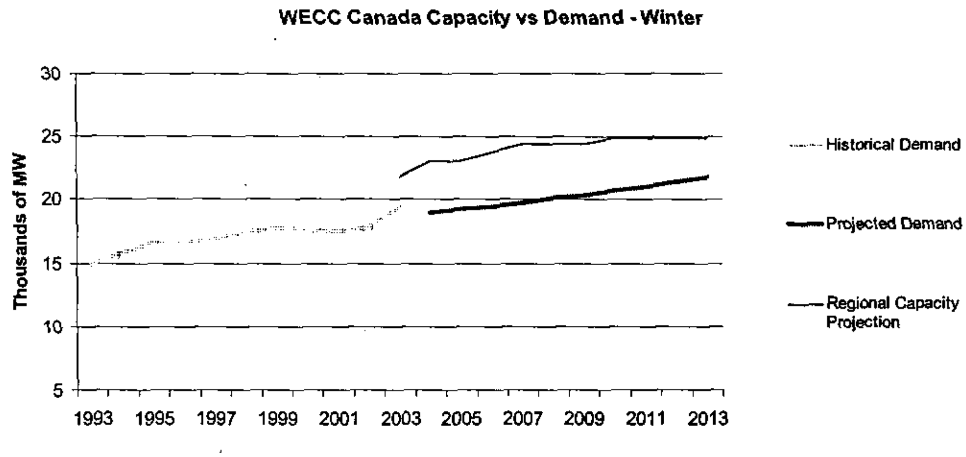


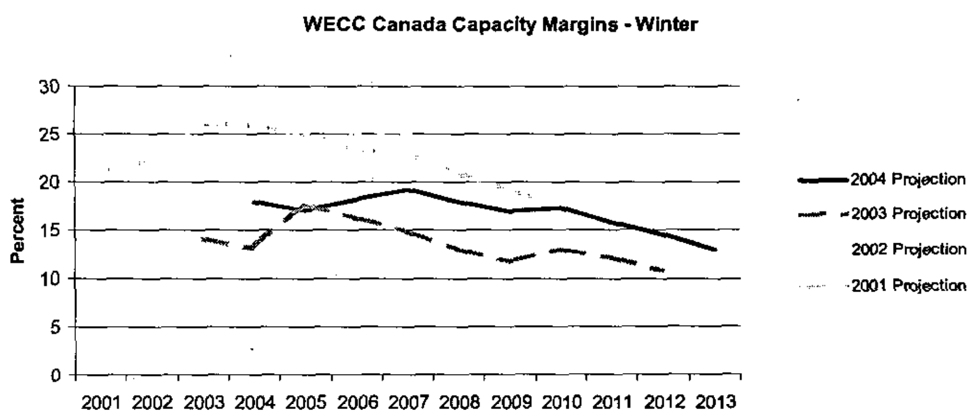


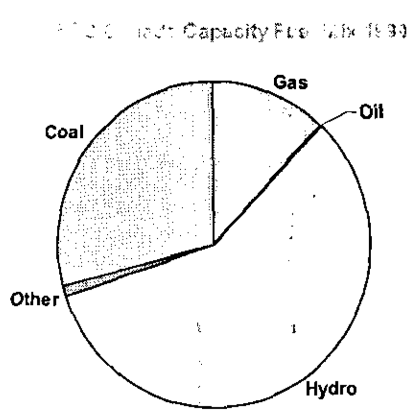




WECC-Canada Capacity and Demand







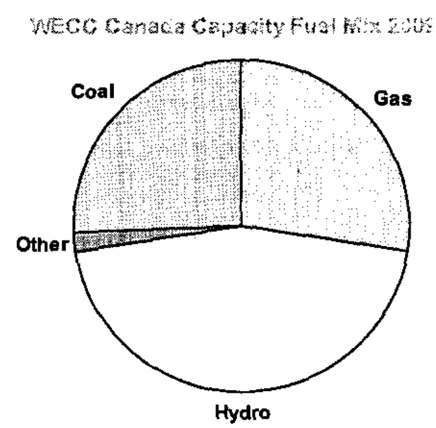


Table 2: Demand and Capacity as Reported by the NERC Regions

Region	Total Internal Demand (MW)	Net Internal Demand (MW)	Projected Capacity Resources (MW)	Reserve Margins (% of Net Internal Demand)	Capacity Margins (% of Capacity Resources)
		Summer – 2005			
ECAR	104,765	102,132	128,943	26.3	20.8
FRCC	43,753	40,926	50,341	23.0	18.7
MAAC	58,056	56,984	68,591	20.4	16.9
MAIN	58,667	55,494	69,817	25.8	20.5
MAPP-U.S.	30,116	29,886	34,308	14.8	12.9
MAPP-Canada	5,717	5,455	8,582	57.3	36.4
NPCC-U.S.	58,624	57,483	72,780	26.6	21.0
NPCC-Canada	48,646	47,793	63,788	33.5	25.1
SERC	161,634	156,079	181,990	16.6	14.2
SPP	40,813	39,812	45,900	15.3	13.3
Eastern Interconnection	610,791	592,044	725,040	22.5	18.3
WECC-U.S.	125,687	123,221	161,393	31.0	23.7
WECC-Canada	15,996	15,877	22,465	41.5	29.3
WECC-Mexico	1,845	1,845	2,634	42.8	30.0
Western Interconnection (a)	143,345	140,759	187,632	33.3	25.0
ERCOT Interconnection	62,906	61,505	78,725	28.0	21.9
U.S.	745,021	723,522	892,788	23.4	19.0
Canada	70,359	69,125	94,835	37.2	27.1
Mexico	1,845	1,845	2,634	42.8	30.0
NERC	817,225	794,492	990,257	24.6	19.8
		Summer – 2009			
ECAR	113,674	111,082	136,630	23.0	18.7
FRCC	47,990	45,214	54,113	19.7	16.4
MAAC	62,276	61,204	68,698	12.2	10.9
MAIN	62,236	59,042	76,446	29.5	22.8
MAPP-U.S.	32,548	32,313	36,527	13.0	11.5
MAPP-Canada	6,065	5,803	8,882	53.1	34.7
NPCC-U.S.	61,376	60,215	78,899	31.0	23.7
NPCC-Canada	52,430	51,570	64,727	25.5	20.3
SERC	175,730	170,598	192,876	13.1	11.6
SPP	43,297	42,271	46,232	9.4	8.6
Eastern Interconnection	657,622	639,312	764,030	19.5	16.3
WECC-U.S.	137,892	135,414	174,152	28.6	22.2
WECC-Canada	17,021	16,902	23,788	40.7	28.9
WECC-Mexico	2,258	2,258	3,096	37.1	27.1
Western Interconnection (a)	157,146	154,549	201,036	30.1	23.1
ERCOT Interconnection	69,166	67,765	79,853	17.8	15.1
U.S.	806,185	785,118	944,426	20.3	16.9
Canada	75,516	74,275	97,397	31.1	23.7
Mexico	2,258	2,258	3,096	37.1	27.1
NERC	883,959	861,651	1,044,919	21.3	17.5

Region	Total Internal Demand (MW)	Net Internal Demand (MW)	Projected Capacity Resources (MW)	Reserve Margins (% of Net Internal Demand)	Capacity Margins (% of Capacity Resources)
		Winter – 2005/2006			
ECAR	89,268	87,101	134,419	54.3	35.2
FRCC	46,546	43,094	53,944	25.2	20.1
MAAC	46,215	45,816	71,205	55.4	35.7
MAIN	43,336	41,324	72,014	74.3	42.6
MAPP-U.S.	25,035	24,931	34,181	37.1	27.1
MAPP-Canada	6,990	6,728	8,658	28.7	22.3
NPCC-U.S.	48,532	48,303	76,623	58.6	37.0
NPCC-Canada	65,455	64,088	72,787	13.6	12.0
SERC	143,675	139,138	185,642	33.4	25.1
SPP	28,824	28,156	45,946	63.2	38.7
Eastern Interconnection	543,876	528,679	755,419	42.9	30.0
WECC-U.S.	106,525	104,600	156,297	49.4	33.1
WECC-Canada	19,248	19,180	23,108	20.5	17.0
WECC-Mexico	1,417	1,417	2,366	67.0	40.1
Western Interconnection (a)	126,840	124,768	181,131	45.2	31.1
ERCOT Interconnection	44,427	43,034	82,609	92.0	47.9
U.S.	622,383	605,497	912,880	50.8	33.7
Canada	91,693	89,996	104,553	16.2	13.9
Mexico	1,417	1,417	2,366	67.0	40.1
NERC	715,493	696,910	1,019,799	46.3	31.7
		Winter – 2009/2010			
ECAR	97,073	95,029	142,441	49.9	33.3
FRCC	51,122	47,656	58,766	23.3	18.9
MAAC	49,160	48,761	70,755	45.1	31.1
MAIN	45,863	43,846	76,722	75.0	42.9
MAPP-U.S.	26,598	26,489	36,406	37.4	27.2
MAPP-Canada	7,317	7,055	8,842	25.3	20.2
NPCC-U.S.	50,382	50,153	82,211	63.9	39.0
NPCC-Canada	67,818	66,444	73,340	10.4	9.4
SERC	155,266	150,907	194,698	29.0	22.5
SPP	30,757	30,081	46,378	54.2	35.1
Eastern Interconnection	581,356	566,421	790,559	39.6	28.4
WECC-U.S.	115,842	113,908	168,396	47.8	32.4
WECC-Canada	20,364	20,296	24,415	20.3	16.9
WECC-Mexico	1,680	1,680	2,652	57.9	36.7
Western Interconnection (a)	137,579	135,498	194,841	43.8	30.5
ERCOT Interconnection	48,089	46,696	82,946	77.6	43.7
U.S.	670,152	653,526	959,719	46.9	31.9
Canada	95,499	93,795	106,597	13.6	12.0
Mexico	1,680	1,680	2,652	57.9	36.7
NERC	767,331	749,001	1,068,968	42.7	29.9

(a) The sum of WECC-U.S., Canada, and Mexico peak hour demands or planned capacity resources do not necessarily equal the coincident Western Interconnection total because of subregional and country peak load diversity.

Transmission Additions

More than 5,600 miles of new transmission (230 kV and above) are proposed for construction through 2008, with a total of 10,275 miles added over the 2004–2013 timeframe. The 10,275-mile increase represents a 4.9 percent increase in the total amount of installed transmission in North America over the assessment period. *Table 3* provides a projection of planned increases in transmission circuit miles for 230 kV and above.

Table 3: Planned Transmission
Transmission Circuit Miles — 230 kV and Above*

	2003 Existing	2004–2008 Additions	2009–2013 Additions	2013 Total Installed
ECAR[3]	16,439	156	17	16,612
FRCC	6,894	360	81	7,335
MAAC	7,057	134	0	7,191
MAIN	6,195	374	260	6,829
MAPP-U.S.	14,705	228	246	15,179
MAPP-Canada	6,660	94	963	7,717
NPCC-U.S.	6,406	376	0	6,782
NPCC-Canada	28,961	258	38	29,257
SERC	28,868	1,349	1,085	31,302
SPP	7,659	191	17	7,867
Eastern Interconnection	129,844	3,520	2,707	136,071
WECC-U.S.	58,400	1,573	1,582	61,555
WECC-Canada	10,969	270	252	11,491
WECC-Mexico	563	24	0	587
Western Interconnection	69,932	1,867	1,834	73,633
ERCOT Interconnection	8,081	290	110	8,481
U.S.	160,704	5,031	3,398	169,133
Canada	46,590	622	1,253	48,465
Mexico	563	24	0	587
NERC	207,857	5,677	4,651	218,185

* Note: Circuit miles of transmission are not an absolute indicator of the reliability of the transmission system or of its ability to transfer electricity.

[3] Update since ECAR's 2004 EIA-411 filing.