



FUTURE DEMAND AND ENERGY REQUIREMENTS

(Period: 2004 – 2024)

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TABLE OF CONTENTS

	<u>Page</u>
1.0 Background	1
2.0 Introduction	1
3.0 Economic Outlook.....	2
3.1 United States	2
3.2 Canada.....	4
3.3 Alberta.....	7
4.0 Methodology	10
5.0 Definitions.....	13
5.1 Alberta Grid Demand.....	13
5.2 Alberta Total Demand.....	13
6.0 Future Market Outlook.....	13

TABLE OF FIGURES

	<u>Page</u>
Figure 1: Growth in United States Gross Domestic Product	2
Figure 2: Growth in Canadian Gross Domestic Product	4
Figure 3: United States / Canada Exchange Rate	5
Figure 4: Growth in Alberta Gross Domestic Product.....	7
Figure 5: Crude Oil Price (WTI \$US)	8
Figure 6: Methodology Flow Diagram.....	10
Figure 7: Alberta Future Market Outlook.....	14

1.0 **BACKGROUND**

The Electric Utilities Act, S.A. 2003 c.E-5.1 requires the Independent System Operator to (i) assess the current and future needs of market participants; and (ii) to collect and disseminate information relating to the current and future electricity needs of Alberta. The proposed transmission regulation provides additional clarity around this responsibility requiring the Independent System Operator to make assumptions about future load growth and anticipate future electricity demand.

In fulfilling its role as the ISO, the Alberta Electric System Operator (“AESO”) annually updates its outlook for market participant’s demand and energy requirements. This outlook is an important input into the ten year system plan, the twenty year system outlook (‘strategic plan’), and regulatory filings (trading charges, Ancillary Services costs, transmission losses). This estimated future need of the market participants helps facilitate Alberta’s competitive market.

2.0 **INTRODUCTION**

This document describes the assumptions, methodology and processes the AESO employed to assess the future demand and energy requirements. This document contains a most likely estimate of future Alberta demand and energy requirements from 2004-2024 to provide a sufficient timeline for transmission planning. The report contains several sections including:

Economic Outlook: Overview of economic and demographic conditions that impact electrical consumption in Alberta.

Methodology: High-level process methodology map used in preparation of the outlook.

Forecasts: The final sections detail the energy requirements and demand forecast. This document contains two aggregate Alberta level forecasts: i) grid demand; and ii) total demand (as defined later in this document).

In this document, ‘Peak Demand’ represents the highest electrical demand over a certain period of time. Historically, peak demand usually occurs during the winter months from November to February. Knowing when the peak demand may occur is important for planning purposes since electricity can not be economically produced and stored for use during times of maximum consumption.

3.0 ECONOMIC OUTLOOK

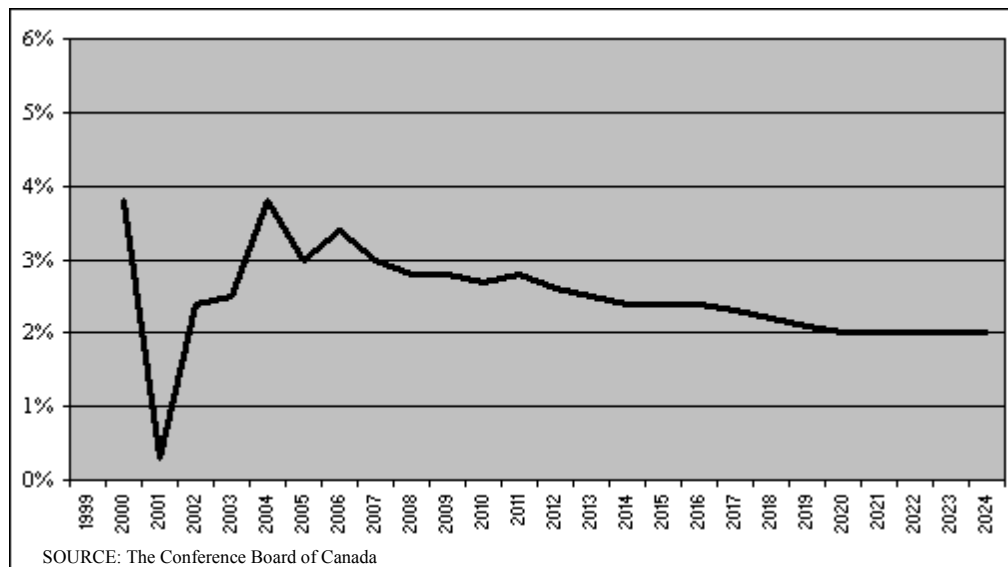
The *AESO* uses external sources to formulate its economic outlook. These sources include The Conference Board of Canada (“Conference Board”), Statistics Canada, Canadian Mortgage and Housing Corporation, Alberta Economic Development, trade journals, and others. The *AESO* uses external agencies as they represent: i) subject-matter experts with respect to economic forecasting; and ii) independent, objective sources.

The *AESO* relies largely on composite forecasts produced by the Conference Board¹ to ensure consistency of assumptions. Although the outlook contains significant complexity and detail, the following sections only addresses key drivers relating to Alberta’s electric needs.

3.1 United States

The United States economic growth rate slowed in the last few years after driving the global economy throughout the last decade. In late 2003, the United States economy began expanding with solid growth in all areas except job creation, and in the first quarter of 2004, job growth finally materialized. The United States economy appears poised for good economic expansion and the Conference Board forecasts Gross Domestic Product (“GDP”) to grow by 3.8% growth in 2004.

Figure 1: Growth in United States Gross Domestic Product



¹ Conference Board documents include: [Canadian Outlook 2004, Long-term Economic Forecast](#); [Provincial 2004, Long-term Economic Forecast](#); and [Metropolitan Outlook 1 Spring 2004, Economic Insights into 25 Canadian Metropolitan Economies](#)

In the medium term, growth expectations should exceed the economy's non-inflationary potential as the markets exhaust the surplus capacity created early in this decade. In the longer term, United States growth should trend about its long term potential with annual GDP growth expectations between 2.1% - 2.7%. There are a number of economic factors supporting this outlook including:

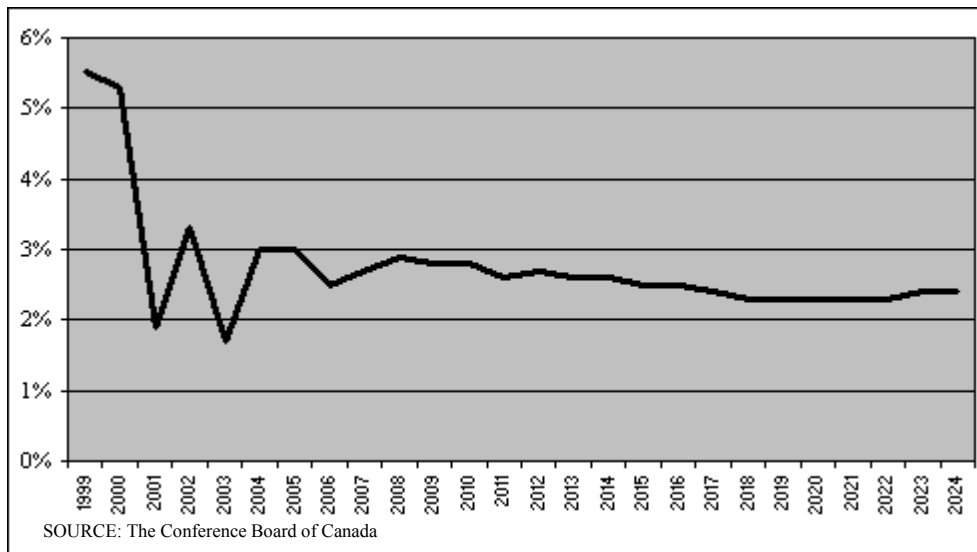
- Stronger export growth from a lower United States dollar and the benefits of trade liberalization particularly in East Asia and Latin America.
- Long-term domestic demand growth constrained by an aging population (common issue in the United States and Canada). An aging population: i) constrains demand for housing and consumer durables (new cars, household furnishings, and other large purchases); and ii) reduces the labor force.
- Elevated energy and commodity prices are potential major drags on the United States economy. The uncertainty in the Persian Gulf, strong Asian demand, and an expanding United States economy should increase oil price volatility.
- Recent weak economic activity, major spending on security measures and in Iraq, and significant tax cuts will produce large deficits. This may affect the governments operating flexibility going forward.
- Business investment is slowing after average annual growth near 14% per year in the late 1990s. In the near term, growth should remain solid at about 3.4%, but will slow as computer innovation declines.

3.2 Canada

The strong growth in the second half of the last decade slowed in the new millennium. In 2003, a rising currency, several economic disruptions (SARS, BSE, forest fires, black out) and sluggish United States economic growth hobbled Canada's economy. Although the Canadian economy did not reach a 'traditional' recessionary phase, the economy slowed and the absence of a typical boom-recession cycle increases the difficulty in predicting future economic conditions.

In the near term, Canada's economic performance should improve. Canada's economy is highly dependent on the United States, and the optimistic United States forecasts should provide a positive stimulus for Canada. The Canadian dollar's strong appreciation will dampen exports, and as such, the forecast is for modest GDP growth in the Canadian economy over the next few years (2004 = 3.0%, 2005 = 3.0%).

Figure 2: Growth in Canadian Gross Domestic Product

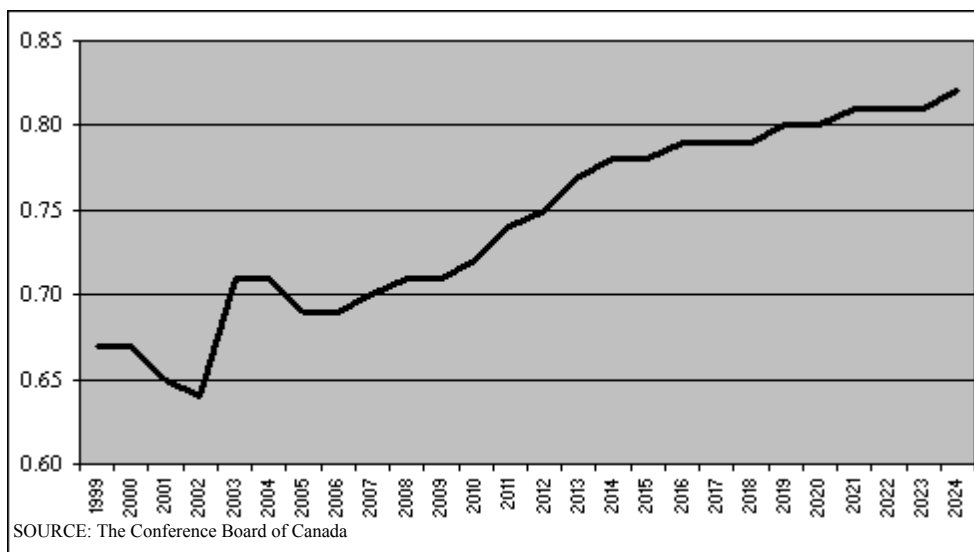


The sharp appreciation in the Canadian dollar will reduce exports, profit margins and pressure business to increase productivity. Despite improvements in certain sectors, the majority of small businesses do not have the financial resources to acquire capital intensive productivity enhancing technologies. A stronger Canadian exchange rate will reduce the costs for these technologies, but will not offset impacts from decreasing exports.

Over the longer term, a gradual slowing in growth will characterize the Canadian economy. The constraints are similar to the United States as slower population growth and an aging population moderate Canada's economic capacity. Some additional factors include:

- Price stability will likely remain the Bank of Canada's focus. Inflation should remain within the target range of 1% - 3% as expected output is close to potential over the forecast period.
- Widening interest rate spreads between United States and most major economies depreciated the United States dollar against most currencies - Canadian dollar 'ran-up' almost 20% between 2002 and 2003. In the next few years, a narrowing in the Canada / United States short-term interest rate spread should devalue the Canadian dollar. Beyond the near term correction, the Canadian dollar should appreciate modestly based on interest rate differentials, capital flows, commodity prices, and relative purchasing power. By the forecast horizon, Canadian dollar expectations are near \$0.82.

Figure 3: United States / Canada Exchange Rate



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- An aging population's shifting spending patterns will impact business sector growth. Tightening labor markets from an aging population and high real wage growth should lead large business to substitute capital for labor. As a result, business investment should remain robust over the next twenty years.
 - Over the past five years, the federal government created significant surpluses to facilitate tax cuts and increased program spending. In the longer term, Canada's changing demographics will increase spending pressure, especially to meet the needs of an aging population. The federal government should continue surpluses throughout the horizon period.
 - A major concern for Canada's economy is the fiscal situation of the Provinces. Collectively, the Provinces will run deficits beyond this decade and the situation may not be sustainable given the significant debt levels of some Provinces. There may be increasing pressure for federal transfers to support the Provinces' finances – although Alberta's debt free status lessens this risk.

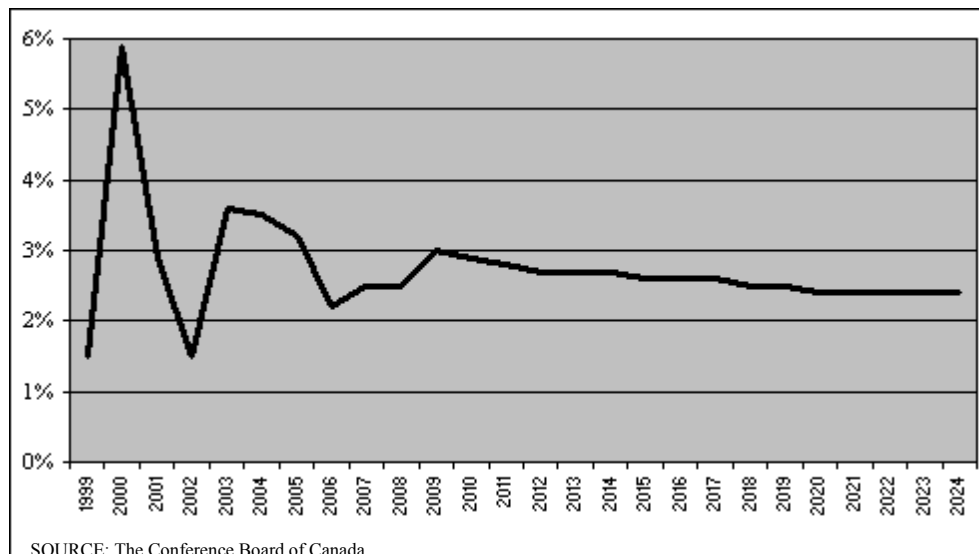
3.3 Alberta

Over the last ten years, Alberta created an ‘Alberta Advantage’ with the strongest economy, fastest growing population, lowest overall taxes, and nine consecutive balanced budgets. This creates a more optimistic outlook for Alberta than for many of the other Provinces.

In the short term, a positive employment outlook and strong immigration continue to provide the foundation for the economy. Alberta’s solid economic prospects will continue and the Conference Board forecasts gross domestic product to grow by 3.5% in 2004 and 3.7% in 2005.

For the remainder of the decade, economic growth should remain strong and average 3.1% per year. Over the forecast horizon, Alberta’s economy should show good GDP growth and expand at an average annual rate of 2.7%. The energy sector should remain the primary economic drivers with sustained high commodity prices, an enormous non-conventional oil supply, and extraction technology improvements.

Figure 4: Growth in Alberta Gross Domestic Product

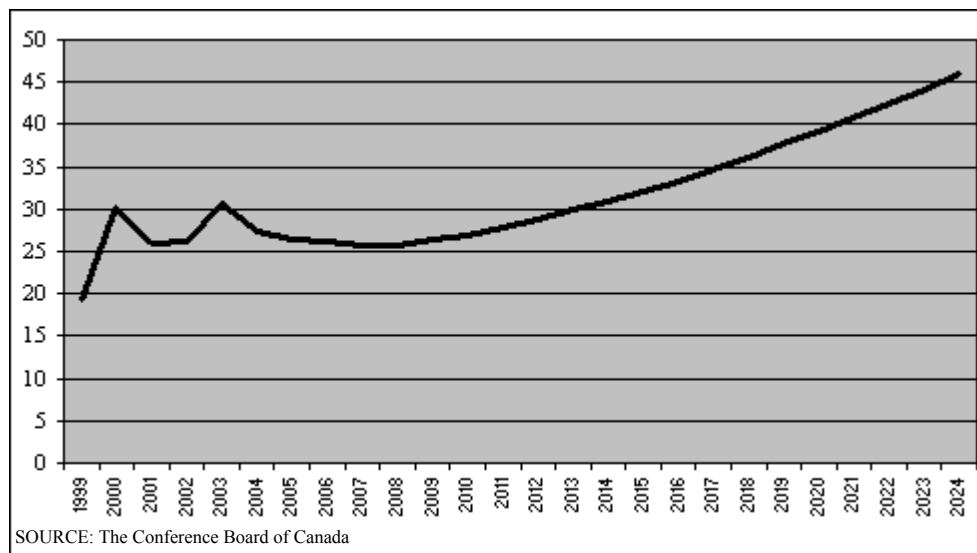


Population growth is forecast to slow from the record highs in the last ten years. The government's sound fiscal position and Alberta's positive job market will continue attracting labour and businesses migration - boosting population growth. A continued decline in the natural growth rate (births minus deaths) will offset this inflow. Over the next twenty years, Alberta's population is forecast to increase by nearly 21% to almost 3.9 million.

Although the long-term outlook is favorable, an aging population may constrain future growth. Over the next twenty years, the share of Alberta's population in the over 65 demographic will increase significantly. The aging population will weaken consumer spending as baby boomers move into their retirement years, thereby requiring more services and lower demand for consumer durables.

In the longer term, market fundamentals should drive oil prices higher as growing world demand increase pressure on world supply. In Alberta, conventional reserves should continue to decline although total provincial production should rise with huge investments in non-conventional extraction. The Conference Board expects an additional \$60 billion of investment in western Canada's tar sands.

Figure 5: Crude Oil Price (WTI \$US)



The natural gas outlook is optimistic as supply and demand fundamentals helps maintain historically high natural gas prices. Even with recent strong natural gas drilling, production should decline over the forecast horizon as the Western Canada Sedimentary Basin matures. This supply reduction should create a situation of continued higher prices. A potential downward price risk for natural gas is a rapid acceleration of Liquefied Natural Gas (“LNG”) terminals and associated infrastructure in North America.

With positive economic growth forecasts, job creation should advance well throughout the long term – above the national average for most of the forecast. In the near term, employment opportunities should be abundant with strong customer demand and an expanding energy sector.

The largest single risk factor for Alberta is the Kyoto Protocol. This outlook does not account for the impacts of the accord, but ratification could significantly impair Alberta’s economy.

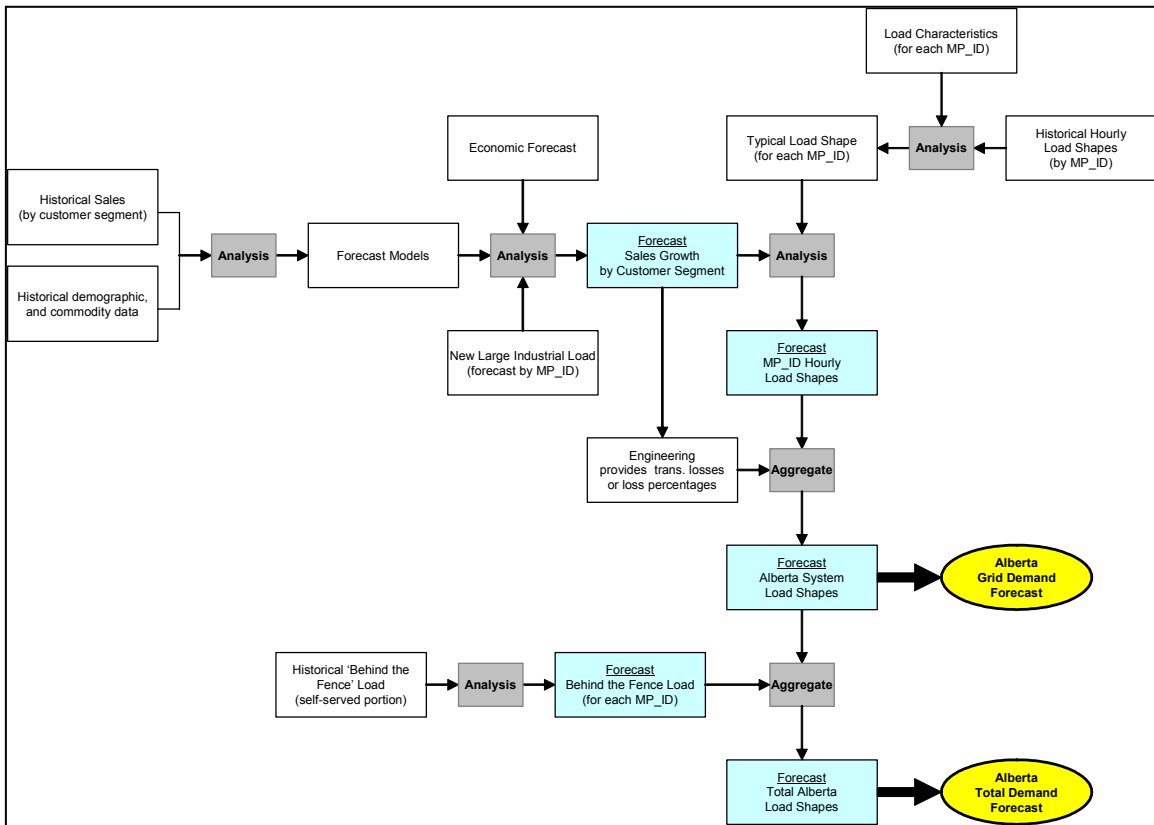
4.0 METHODOLOGY

There are several methodologies employed in the electric industry to estimate future demand and energy requirements. The more prevalent approaches include econometric top-down modeling, system-wide customer segment projections, and bottom-up 'regional' approaches.

In the fall of 2003, the *AESO* reviewed its demand and energy requirements forecast needs and found a critical need for much finer granularity to support transmission planning. Specifically, the *AESO*'s planners require detailed forecasts at the Metering Point Identifier ("MP_ID") load level to analyze non-coincident load conditions for various geographical areas of the Province. To meet these needs, the *AESO* introduced a new bottom-up, MP_ID forecasting methodology to replace its previous top-down econometric and allocation approach.

The following diagram provides a high level overview of the *AESO* approach to create a future demand and energy requirements outlook. A larger version of this diagram appears in Appendix A.

Figure 6: Methodology Flow Diagram



Process Description

1. The forecast process begins with analysis of historical load and customer consumption characteristics to identify drivers the *AESO* can use estimate future electrical needs. For each customer segment, the future needs forecast is a function of variables related to electrical consumption in that sector (economic or demographics variables). This analysis identifies relationships between customer segment electrical consumption and demographic or economic variables. For example, residential consumption is a function of the number of households (population and average persons per household) and the average use per household dwelling.
2. As previously outlined, the *AESO* develops an economic outlook including forecasts for economic and demographic variables that materially impact electrical consumption in Alberta. The estimate of future energy requirements by customer segment is a product of the economic outlook and the customer segment models.
3. The *AESO* uses the customer segment growth rates to develop 'geographical area' forecasts. The methodology uses the segment growth rates and customer characteristics in each geographical area to create a forecast for each Metering Point Identifier ("MP_ID") load in Alberta. This results in a twenty year energy requirements outlook for almost 500 MP_ID load points. The forecast includes any new, incremental industrial loads identified in a particular area (added based on available information regarding size and timing).
4. The *AESO* derives a unique 'typical' load shape for each MP_ID load in Alberta. This involves detailed analysis of the historical hourly load profiles for each point and results in an 8760 hour 'typical' load shape for each MP_ID.
5. The *AESO* applies the specific future MP_ID energy requirements estimate by year to the 'typical' load shape. The result is an 8760 hourly load profile for each year and each MP_ID until 2024. These shapes are critical elements to support technical planning and analysis. Since the *AESO* uses actual hourly data to create the typical load shapes, they represent more 'realistic' demand profiles with the inherent high load and low load days - not flat average values or a typical weekday and weekend approach.

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6. The summation of the MP_ID forecasts plus loss estimates (provided by the *AESO's* planning area) yields the aggregate Alberta Grid Demand forecast. This forecast represents the net load on the Alberta grid system. As a 'reasonableness' check, there is a comparison of the aggregated MP_ID plus losses forecast to a system level 'test' forecast.
 7. To forecast total Alberta demand, the *AESO* estimates 'behind the fence' load using typical operating characteristics of each self-served generation (and related load) based on actual historical data. The total Alberta demand outlook is the sum of the future Alberta grid demand outlook and the future 'behind the fence' outlook. This represents the total demand in the Province without regard for how the load is served.
 8. Weather is an important function in electrical consumption. The outlook contains an explicit relationship between load and weather conditions. The accuracy of weather forecasts is good in the short-term (i.e. up to five days), but no accurate long-term weather forecast is available. The *AESO* assumes weather conditions around the peak hours are similar to those present during previous 'peak conditions'. For example, the forecast assumes colder than average weather during winter peak periods and warmer than average conditions during summer peak periods. This is accomplished through the creation of 'typical' load shapes which better represent actual consumption patterns than would an average shape.

5.0 **DEFINITIONS**

5.1 **Alberta Grid Demand**

In this document, Alberta Grid Demand (“AGD”) is:

$$\text{AGD} = \text{Sales} + \text{Losses}$$

where:

Sales - total grid consumption by the residential, farm, commercial and industrial customer segments

Losses - total distribution and transmission losses

5.2 **Alberta Total Demand**

In this document, Alberta Total Demand (“ATD”) is:

$$\text{ATD} = \text{AGD} + \text{BFL}$$

where:

AGD - Alberta Grid Demand

BFL - behind the fence load

6.0 **FUTURE MARKET OUTLOOK**

The following table shows the *AESO* Alberta Grid Demand outlook for 2004-2024. As shown in the table, energy requirements are forecast to increase by 2.3% per year over the next five years, and 2.1% per year over the next ten years. Peak demand is forecast to increase by 2.1% per year over the next five years, and 2.0% per year over the next ten years.

The table also shows the *AESO* Alberta Total Demand outlook for 2004-2024. As shown in the table, energy requirements are forecast to increase by 3.0% per year over the next five years, and 2.6% per year over the next ten years. Peak demand is forecast to increase by 2.9% per year over the next five years, and 2.5% per year over the next ten years.

The higher growth rate (for both peak demand and energy requirements) in Alberta Total Demand results from an expectation for greater increase in large industrial load served by on-site generation.

Figure 7: Alberta Future Market Outlook

Table A: Alberta Grid Demand

Year	Peak Demand (MW)*	Year	Energy (GW.h)
1999/00 A	7,202	1999 A	50,174
2000/01 A	7,651	2000 A	52,460
2001/02 A	7,606	2001 A	52,376
2002/03 A	7,558	2002 A	53,628
2003/04 A	7,733	2003 A	53,248
2004/05 F	7,877	2004 F	55,321
2005/06 F	8,113	2005 F	56,636
2006/07 F	8,389	2006 F	58,606
2007/08 F	8,573	2007 F	59,898
2008/09 F	8,794	2008 F	61,686
2009/10 F	8,826	2009 F	61,845
2010/11 F	8,995	2010 F	63,028
2011/12 F	9,176	2011 F	64,264
2012/13 F	9,365	2012 F	65,816
2013/14 F	9,531	2013 F	66,788
2014/15 F	9,757	2014 F	68,008
2015/16 F	9,899	2015 F	69,311
2016/17 F	10,105	2016 F	71,017
2017/18 F	10,303	2017 F	72,211
2018/19 F	10,483	2018 F	73,484
2019/20 F	10,661	2019 F	74,725
2020/21 F	10,851	2020 F	76,305
2021/22 F	11,037	2021 F	77,402
2022/23 F	11,227	2022 F	78,748
2023/24 F	11,420	2023 F	80,113
2024/25 F	11,617	2024 F	81,757

*Note: Demand is winter peak demand (Nov. - Feb.)

Table B: Alberta Total Demand⁺

Year	Peak Demand (MW)*	Year	Energy (GW.h)
1999/00 A	7,408	1999 A	50,851
2000/01 A	7,785	2000 A	54,052
2001/02 A	7,934	2001 A	54,464
2002/03 A	8,570	2002 A	59,428
2003/04 A	8,967	2003 A	62,714
2004/05 F	9,321	2004 F	64,756
2005/06 F	9,594	2005 F	67,207
2006/07 F	9,974	2006 F	69,453
2007/08 F	10,315	2007 F	71,486
2008/09 F	10,597	2008 F	74,468
2009/10 F	10,738	2009 F	75,044
2010/11 F	11,002	2010 F	77,136
2011/12 F	11,259	2011 F	79,159
2012/13 F	11,493	2012 F	81,324
2013/14 F	11,694	2013 F	82,574
2014/15 F	11,946	2014 F	84,059
2015/16 F	12,117	2015 F	85,586
2016/17 F	12,355	2016 F	87,594
2017/18 F	12,588	2017 F	88,994
2018/19 F	12,798	2018 F	90,519
2019/20 F	13,005	2019 F	92,004
2020/21 F	13,224	2020 F	93,879
2021/22 F	13,440	2021 F	95,171
2022/23 F	13,663	2022 F	96,762
2023/24 F	13,891	2023 F	98,373
2024/25 F	14,123	2024 F	100,316

*Note: Demand is winter peak demand (Nov. - Feb.)

+ 2002 redefinition added approx. 400 MW of 'behind the fence load'

Average Annual Growth Rates

99/00-03/04	1.4%
04/05-09/10	2.3%
04/05-14/15	2.2%
04/05-24/25	2.0%

1999-2003	1.2%
2004-2009	2.3%
2004-2014	2.1%
2004-2024	2.0%

Average Annual Growth Rates

99/00-03/04	3.9%
04/05-09/10	2.9%
04/05-14/15	2.5%
04/05-24/25	2.1%

1999-2003	4.3%
2004-2009	3.0%
2004-2014	2.6%
2004-2024	2.2%

Note: The average annual growth rates for the five year historical period 1999-2003 are lower for Alberta Grid Demand than Alberta Total Demand. This does not represent a slowing of the growth rate for grid demand, rather a reclassification of grid load to non-grid with the creation of industrial site designations. Evidence of the growth is energy distribution sales by customer class grew by an average of over two percent per year over the last ten years.

Appendix A - Methodology Flow Diagram

