



Future Demand and Energy Outlook 2007 – 2027

FC2007-1

21 December 2007

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
1.0 INTRODUCTION	1
2.0 ALBERTA'S ECONOMIC OUTLOOK	1
2.1 Alberta's GDP Growth	2
2.2 Alberta's Population Growth	3
3.0 DETAILED RESULTS	4
3.1 AIES and AIL Forecasts	4
3.2 Selected Regional Results	6
4.0 FORECAST METHODOLOGY	9
4.1 Industrial and Commercial Sector	10
4.2 Residential Electricity	11
4.3 Farm Electricity	12
5.0 HISTORICAL FORECAST RESULTS	13
6.0 CHALLENGES	14
6.1 Challenge - Large Number of Oilsands and Upgrader Projects	14
6.2 Challenge - Areas Outside of the Northeast Have Optimistic Growth Future .	16
6.3 Challenge – Weather As A Factor In Future Load Assumptions	17
6.4 Challenges on the Horizon	17
LIST OF REFERENCE DOCUMENTS	19

EXECUTIVE SUMMARY

The *Future Demand and Energy Outlook, 2007-2027* (“FC2007”) is the Alberta Electric System Operator’s (“AESO”) long-term load forecast. FC2007 describes the assumptions, methodology, and processes that the AESO uses to assess Alberta’s future demand and energy requirements.

This report is prepared annually in accordance with the duties of the AESO as outlined in Alberta’s *Electric Utilities Act* (“EUA”) and the *Transmission Regulation* (AR 86/2007) and will be used in filings with the Alberta Energy and Utilities Board.

FC2007 includes a 20 year peak load and electricity consumption forecast for Alberta. The load forecast is generated from economic growth (GDP) and population projections, with regional adjustments based on historical results and customer-driven growth expectations.

In the past five years (2001–2006), Alberta’s Internal Load (AIL) peak demand has grown by an average of 345 MW (4%) per year from 7,934 MW to 9,661MW. Electricity consumption has grown by an average of 5% per year from 54,467 GWh to 69,370 GWh.

The AESO forecasts the peak AIL demand to grow by an average 3.1% per year for the next 20 years. Electricity consumption is expected to grow by 3.2% per year.

In addition to reporting the detailed forecast results, this report includes a review of the AESO’s load forecasting methodology. The energy and demand forecast is prepared based on an examination of three sectors: industrial and commercial, residential, and farm. The results are organized by the AESO’s five planning regions.

FC2007 concludes with a brief discussion of the challenges faced in preparing a load for Alberta. The foremost of these challenges is the rapid development of the oilsands in the Province’s northeast. Although the AESO does not forecast oil production, the energy forecast for the northeast accommodates oil production forecasts from the Canadian Association of Petroleum Producers and the National Energy Board.

1.0 INTRODUCTION

The *Future Demand and Energy Outlook, 2007-2027* (“FC2007”) describes the assumptions, methodology, and processes that the Alberta Electric System Operator (“AESO”) employs to assess Alberta’s the future demand and energy requirements.

This report is prepared annually in accordance with the duties of the AESO as outlined in Alberta’s *Electric Utilities Act* (“EUA”). With respect to load forecasting, the EUA states that the AESO is to, “...collect, store and disseminate information relating to the current and future electricity needs of Alberta and the capacity of the interconnected electric system to meet those needs....”

This duty is further defined in the *Transmission Regulation* (AR 86/2007) where the AESO is mandated to “...anticipate future demand for electricity...”, and “...make assumptions about future load growth....” The *Transmission Regulation* also indicates that a load forecast must be included as part of the AESO’s 10-Year Transmission System Plan, the 20-Year Transmission System Outlook, and all need identification documents. Therefore FC2007 is to be used in filings with the Alberta Energy and Utilities Board.

The remainder of FC2007 is comprised of five main sections:

- 2.0 Alberta’s Economic Outlook
- 3.0 Detailed Results
- 4.0 Methodology
- 5.0 Historical Forecast Results
- 6.0 Challenges

In addition to being prepared as an input into the transmission planning process, FC2007 is also used by the AESO for generation adequacy assessments, revenue projections, losses calculations, and transmission tariff development. In-keeping with the direction of the EUA and the *Transmission Regulation*, this report is made available to all stakeholders.

2.0 ALBERTA’S ECONOMIC OUTLOOK

The backdrop for the AESO’s electricity demand and energy forecast is Alberta’s economic outlook, which continues to remains strong. In 2006 Alberta experienced a 6.8% increase in real GDP. According to the Conference Board of Canada, economic growth will be more moderate in the coming decade, ranging from 2.6% to 4.6%.

The key factor driving the economy is strong oil prices which results in continued investment in the oilsands. This investment creates jobs that ensure a

continuation of large annual increases in retail sales. Economic growth is tempered by the cost of living and basic infrastructure which has caused a slow-down of net migration and immigration.

For the purpose of forecasting electricity load, there are two aspects of the provincial economy that are examined in detail: economic growth, as measured by GDP, and population growth.

2.1 Alberta's GDP Growth

GDP is a function of consumer spending, private and public investment, exports and imports. In Alberta, these fundamental economic characteristics continue to be strong:

- *Consumer Spending:* From 2004 to 2006, retail sales grew by more than 10% per year. The forecast for 2007 is 8.5%, but during the first half of 2007, retail sales have grown 11%.
- *Investment:* Capital investment in 2006 was \$75 billion. This is expected to grow by 5% in 2007. Since 2000, investment in the oilsands has been over \$30 billion and proposed projects total more than \$70 billion. At \$22,296 in 2006, Alberta has the highest investment per capita in Canada. In 2007, the Alberta Government announced a three year, \$18.2 billion infrastructure development program.
- *Exports and Imports:* Exports continue to increase, with energy leading the way, followed by industrial goods and agricultural products. These are up 9% in 2007 thanks to high oil prices, large natural gas volumes, and manufactured goods.

As shown in Figure 1, Change in Alberta's GDP, the real economic growth (% change in real GDP) in 2006 was 6.8%.

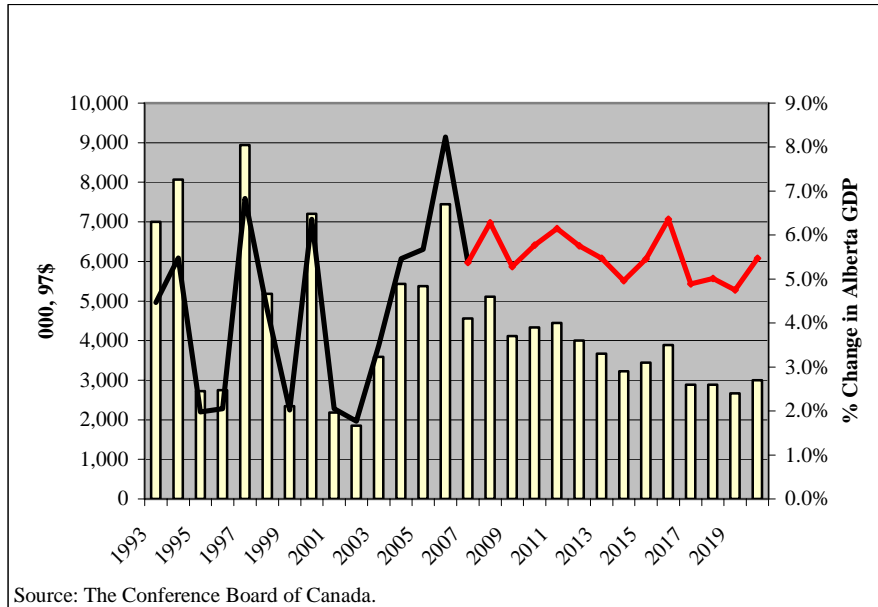


Figure 1: Change in Alberta's GDP

According to the Conference Board of Canada, Alberta's real GDP will grow by 3.4% compound annually forecasted to 2020. Over the last two decades, Alberta had the highest rate of GDP growth in Canada, at 3.8% per year.

The main factors influencing Conference Board of Canada's GDP forecast are:

- Sustained high oil prices
- Immense non-conventional oil reserves
- Declining natural gas production
- Fluctuating productivity as the aging workforce is revitalized with migration and immigration and the province continues to attract business and job seekers

Potential economic complications include:

- labour shortages
- low natural gas prices
- the rising Canadian dollar
- increasing interest rates
- escalating construction and housing costs

2.2 Alberta's Population Growth

In 2006, Alberta's population grew by over 100,000 people (3.2%). As depicted in Figure 2, the forecast for population growth is expected to remain steady. This is largely due to the steady demand for skilled-labour.

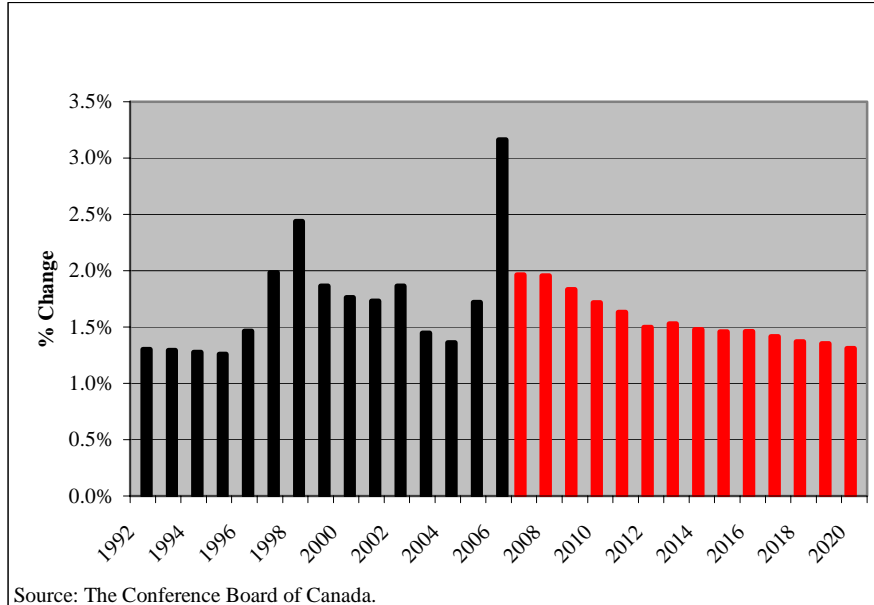


Figure 2: Population Growth in Alberta (%)

The prospect of employment will continue to attract workers from across Canada and around the world. Since 2004, the unemployment rate has steadily fallen from 4.6% to 3.3%.

3.0 DETAILED RESULTS

This section provides detailed forecast results for the period from 2007 to 2027 for both the Alberta Interconnected Electric System (AIES) and the Alberta Internal Load (AIL).

3.1 AIES and AIL Forecasts

AIES is the sum of all electricity sales (residential, commercial, industrial, and farm) and losses (both transmission and distribution).

AIL includes AIES plus behind-the-fence load (BTF). BTF is an industrial load that is characterized by being served in whole, or in part, by on-site generation. However, the forecast is for gross demand and energy.

Table 1 shows the growth in AIES demand and electricity consumption comparing FC2007 with FC2006. Since 2001 average annual demand growth has been 1.7% and energy has grown 1.8%. FC2007 shows an average growth rate of 3.1% for AIES load and a growth rate for energy of 3.0% for the period 2007 to 2027.

Table 1: Alberta Interconnected Electrical Load (AIES)

Year	fc2006 (MW)	fc2007 (MW)	Growth	Forecasts Difference	Year	fc2006 (GWh)	fc2007 (GWh)	fc2007 Growth	Forecasts Difference
2000/01 A		7,666			2000 A		52,914		
2001/02 A		7,527	-1.8%		2001 A		52,480	-0.8%	
2002/03 A		7,552	0.3%		2002 A		53,673	2.3%	
2003/04 A		7,650	1.3%		2003 A		53,169	-0.9%	
2004/05 A		7,910	3.4%		2004 A		54,669	2.8%	
2005/06 A		8,066	2.0%		2005 A		55,697	1.9%	
2006/07 A	8,286	8,177	1.4%	-108.6	2006 A	56,825	57,315	2.9%	489.8
2007/08 F	8,369	8,625	5.5%	256.2	2007 F	57,589	58,615	2.3%	1,026.3
2008/09 F	8,620	8,983	4.1%	363.3	2008 F	59,012	61,461	4.9%	2,448.5
2009/10 F	8,725	9,148	1.8%	423.4	2009 F	60,539	63,054	2.6%	2,514.5
2010/11 F	8,865	9,456	3.4%	590.4	2010 F	61,198	64,766	2.7%	3,568.6
2011/12 F	8,910	9,750	3.1%	840.1	2011 F	62,262	66,737	3.0%	4,475.0
2012/13 F	8,951	10,064	3.2%	1112.9	2012 F	62,504	69,271	3.8%	6,767.7
2013/14 F	9,156	10,425	3.6%	1268.2	2013 F	63,479	71,787	3.6%	8,308.5
2014/15 F	9,349	10,719	2.8%	1370.1	2014 F	64,579	73,940	3.0%	9,361.0
2015/16 F	9,560	11,005	2.7%	1444.5	2015 F	66,049	76,278	3.2%	10,228.5
2016/17 F	9,843	11,328	2.9%	1484.9	2016 F	67,880	78,841	3.4%	10,960.4
2017/18 F	10,075	11,647	2.8%	1572.0	2017 F	69,448	80,962	2.7%	11,513.2
2018/19 F	10,300	11,909	2.3%	1609.2	2018 F	70,902	82,784	2.3%	11,882.6
2019/20 F	10,527	12,188	2.3%	1661.8	2019 F	72,364	84,737	2.4%	12,373.0
2020/21 F	10,831	12,560	3.0%	1728.9	2020 F	73,796	87,614	3.4%	13,817.3
2021/22 F	10,999	13,000	3.5%	2001.5	2021 F	75,382	90,264	3.0%	14,882.7
2022/23 F	11,379	13,422	3.2%	2042.6	2022 F	77,213	92,948	3.0%	15,734.9
2023/24 F	11,681	13,856	3.2%	2175.9	2023 F	78,802	95,695	3.0%	16,892.6
2024/25 F	11,808	14,250	2.8%	2442.3	2024 F	80,427	98,517	2.9%	18,090.1
2025/26 F	12,110	14,758	3.6%	2648.3	2025 F	82,046	101,461	3.0%	19,414.8
2026/27 F	12,377	15,223	3.2%	2846.5	2026 F	83,716	104,424	2.9%	20,707.7
2027/28 F	12,664	15,703	3.2%	3039.0	2027 F	85,537	107,501	2.9%	21,964.7

Table 2 shows the growth in AIL demand and electricity consumption comparing FC2007 with FC2006.

In the last five years, AIL demand has grown by 4.0% per year and AIL energy has grown by 5.0% per year. For the next five years average annual demand is forecast to grow by 3.2% and energy is expected to grow by 3.7%. FC2007 shows an annual average growth rate of 3.1% for AIL load and a growth rate for energy of 3.2% for the period 2006 to 2027.

Table 2: Alberta Internal Load (AIL)

Year	fc2006 (MW)	fc2007 (MW)	Growth	Forecasts Difference
2000/01 A		7,785	---	
2001/02 A		7,934	1.9%	
2002/03 A		8,570	8.0%	
2003/04 A		8,967	4.6%	
2004/05 A		9,236	3.0%	
2005/06 A		9,580	3.7%	
2006/07 A	10,045	9,661	0.8%	-384.1
2007/08 F	10,262	10,028	3.8%	-234.2
2008/09 F	10,650	10,467	4.4%	-183.4
2009/10 F	10,911	10,793	3.1%	-118.4
2010/11 F	11,283	11,212	3.9%	-71.3
2011/12 F	11,467	11,662	4.0%	195.3
2012/13 F	11,684	12,062	3.4%	378.2
2013/14 F	11,986	12,519	3.8%	532.7
2014/15 F	12,308	12,929	3.3%	621.7
2015/16 F	12,560	13,312	3.0%	752.1
2016/17 F	12,859	13,711	3.0%	852.7
2017/18 F	13,148	14,155	3.2%	1,006.7
2018/19 F	13,431	14,566	2.9%	1,135.3
2019/20 F	13,667	14,971	2.8%	1,303.4
2020/21 F	14,071	15,355	2.6%	1,283.8
2021/22 F	14,316	15,852	3.2%	1,536.4
2022/23 F	14,705	16,323	3.0%	1,618.8
2023/24 F	15,087	16,808	3.0%	1,720.7
2024/25 F	15,226	17,241	2.6%	2,014.7
2025/26 F	15,548	17,796	3.2%	2,248.0
2026/27 F	15,878	18,304	2.9%	2,426.1
2027/28 F	16,237	18,824	2.8%	2,587.6

Year	fc2006 (GWh)	fc2007 (GWh)	fc2007 Growth	Forecasts Difference
2000 A		54,054	---	
2001 A		54,467	0.8%	
2002 A		59,437	9.1%	
2003 A		62,716	5.5%	
2004 A		65,259	4.1%	
2005 A		66,268	1.5%	
2006 A	68,550	69,370	4.7%	819.8
2007 F	70,727	70,481	1.6%	-246.5
2008 F	73,534	73,696	4.6%	162.7
2009 F	76,204	76,792	4.2%	587.8
2010 F	77,886	79,478	3.5%	1,591.5
2011 F	80,419	82,710	4.1%	2,290.3
2012 F	82,371	85,978	4.0%	3,606.4
2013 F	84,315	89,205	3.8%	4,890.3
2014 F	86,462	92,312	3.5%	5,849.6
2015 F	88,363	95,420	3.4%	7,057.0
2016 F	90,654	98,629	3.4%	7,975.8
2017 F	92,728	101,715	3.1%	8,986.4
2018 F	94,637	104,706	2.9%	10,069.0
2019 F	96,584	107,645	2.8%	11,061.7
2020 F	98,520	110,692	2.8%	12,171.7
2021 F	100,553	113,744	2.8%	13,191.4
2022 F	102,890	116,836	2.7%	13,945.7
2023 F	104,995	119,980	2.7%	14,984.4
2024 F	107,180	123,176	2.7%	15,995.8
2025 F	109,298	126,436	2.6%	17,138.5
2026 F	111,511	129,759	2.6%	18,248.5
2027 F	113,884	133,158	2.6%	19,273.3

3.2 Selected Regional Results

From a transmission planning perspective there are five primary regions in Alberta. There are also two large urban centers: Calgary and Edmonton.

Figure 3 shows the regional winter peaks for 2006 and 2020 and Figure 4 shows the regional summer peaks for the same periods.

Both figures provide an indication of the associated seasonal load factors (lf). In this case, the winter season is the period from November 1st to April 30th and the summer season is from May 1st to October 31st.

Figure 3: Winter Region Peaks

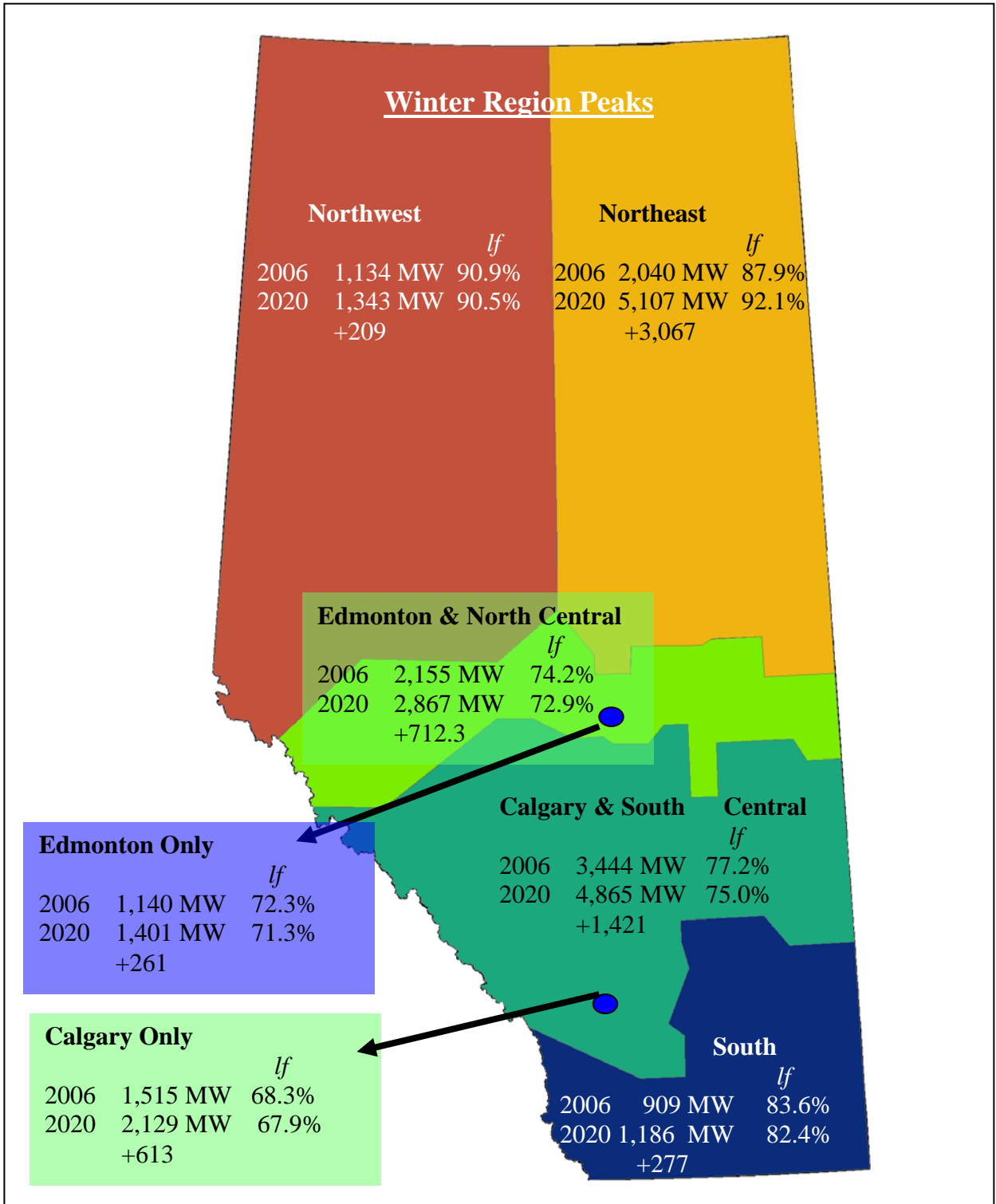
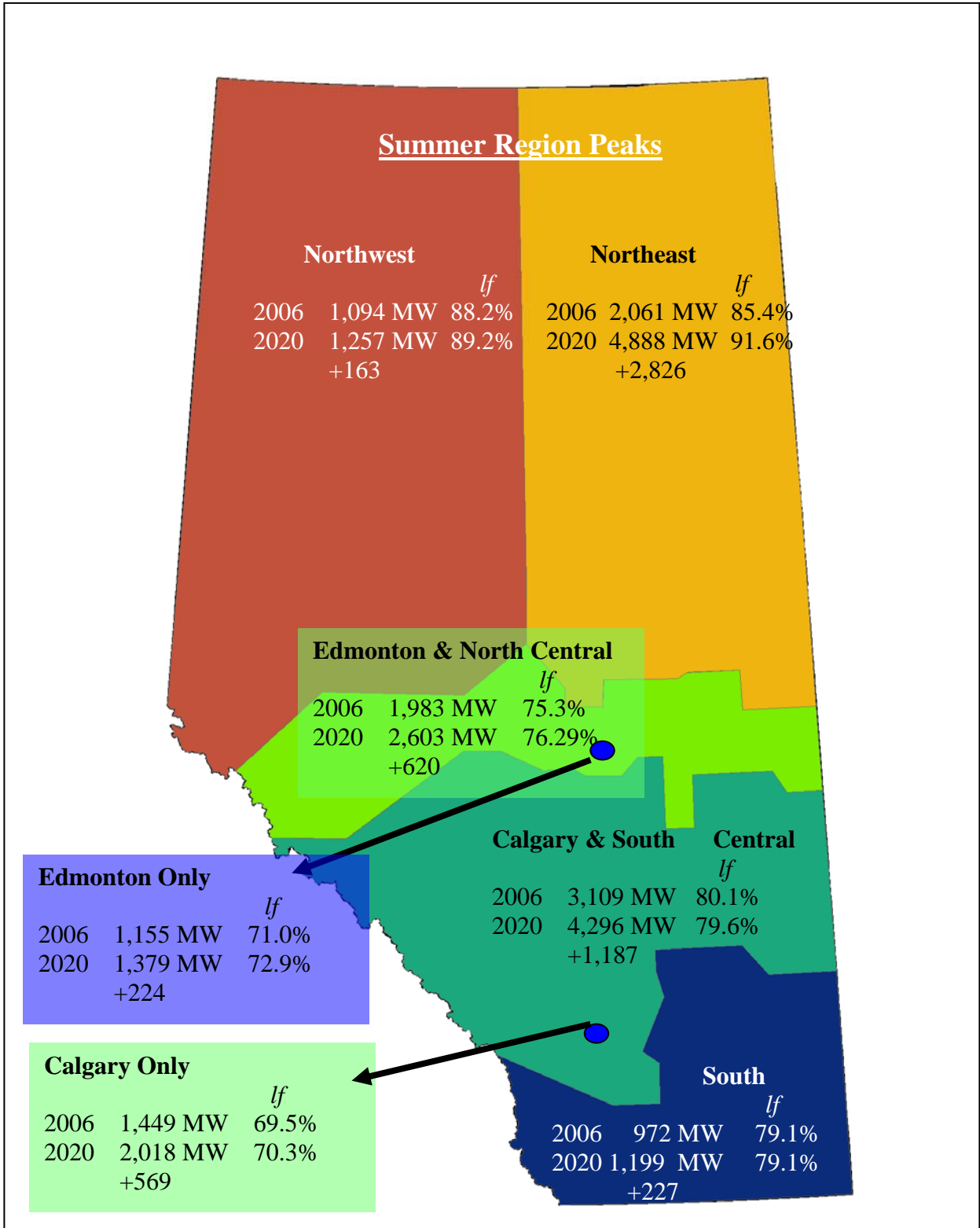


Figure 4: Summer Region Peaks



4.0 FORECAST METHODOLOGY

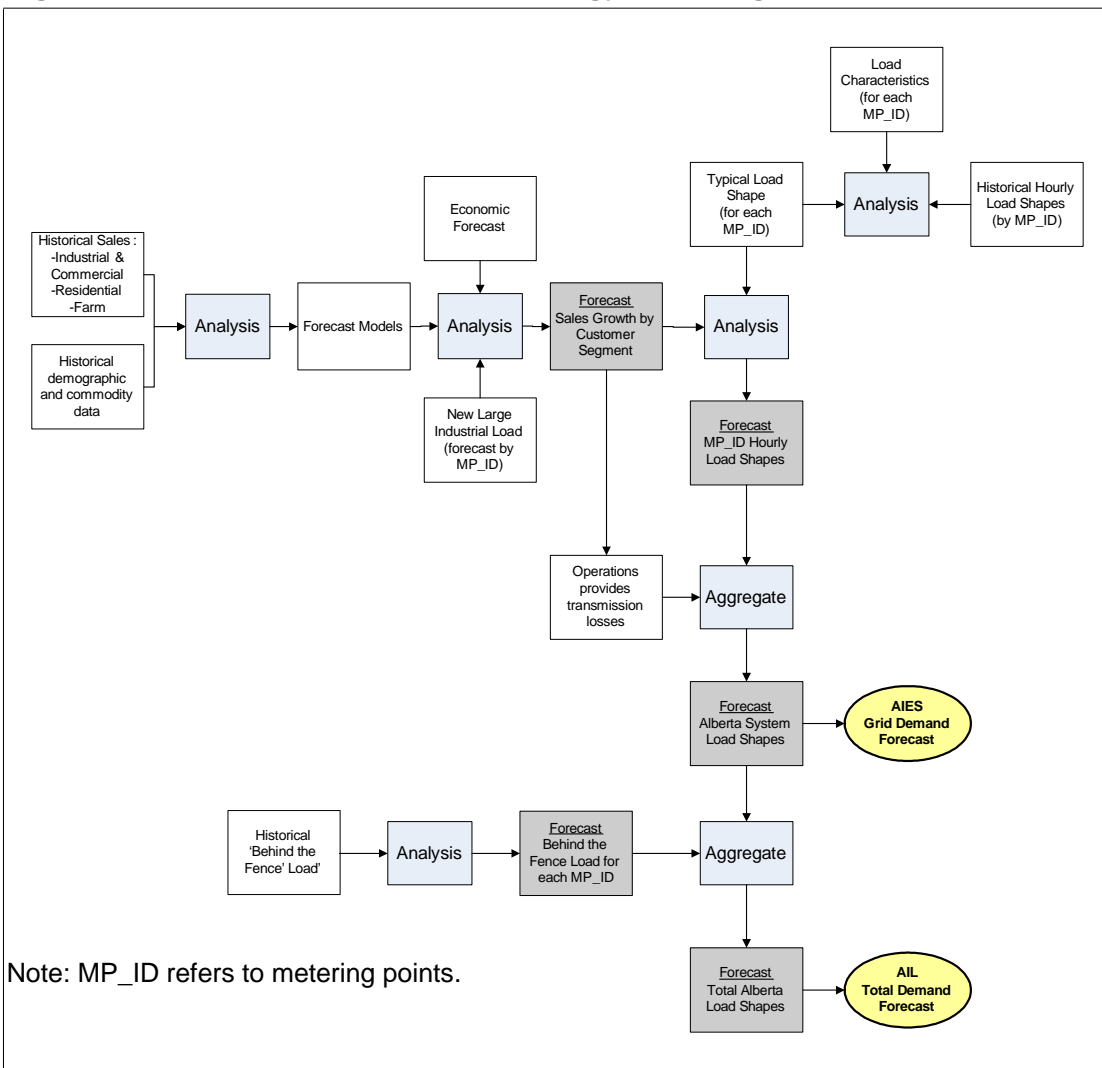
The AESO continues to take a standard econometric approach to estimating future demand and electricity usage. This methodology provides a consistent approach to load forecasting through the use of a combination of fitted statistical models, historical data, third-party economic forecasts, and customer-specific information.

The long-term load forecast is developed in three broad categories:

- Industrial and Commercial
- Residential
- Farm

A high-level overview of the AESO's load forecasting methodology is found in Figure 5 and the details for each sector are discussed in the following three sections. In this section the figures only cover the period to 2020.

Figure 5: AESO Load Forecast Methodology Flow Diagram



4.1 Industrial and Commercial Sector

The industrial and commercial sector is the largest in terms of load and energy consumption. The forecast for this sector is a function of real economic growth and historical usage.

The AESO's industrial and commercial energy forecast relies on the historical relationship between Alberta's economic growth and electricity energy growth. This relationship (in Figure 6) is analyzed and along with a forecast of Alberta's future economic growth is used to determine the future electricity energy growth.

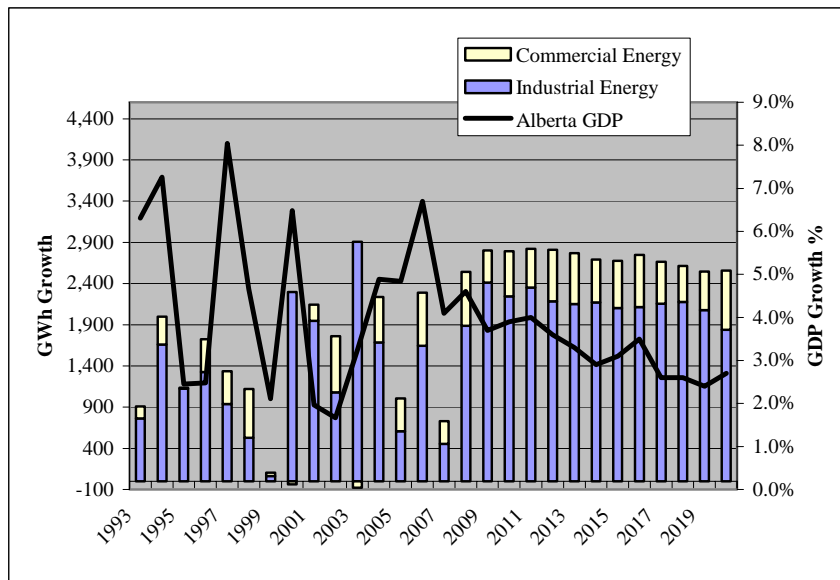


Figure 6: Industrial & Commercial Energy Growth & Alberta GDP Growth

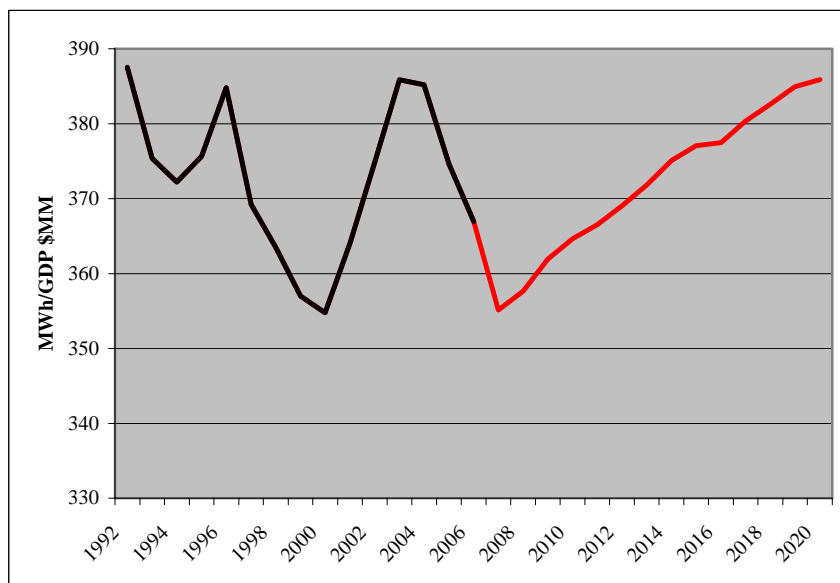


Figure 7: Industrial & Commercial Energy Intensity

Regression analysis is used to determine the relationship of Alberta GDP to industrial and commercial energy. The relationship between MWh and real GDP growth (\$ million) is plotted in Figure 7.

Since 1992 this relationship has been between a high of 390 MWh/\$million GDP and a low of 350 MWh/\$million. The energy forecast maintains the 390 MWh limit for the forecast period.

4.2 Residential Electricity

Future energy requirements for the residential sector are calculated by multiplying the forecast number of customers in the province by the historical 10-year average use by customer (approximately 6,900 kWh per customer).

In general, residential electricity consumption (kWh per customer) has been declining for the past decade (Figure 8).

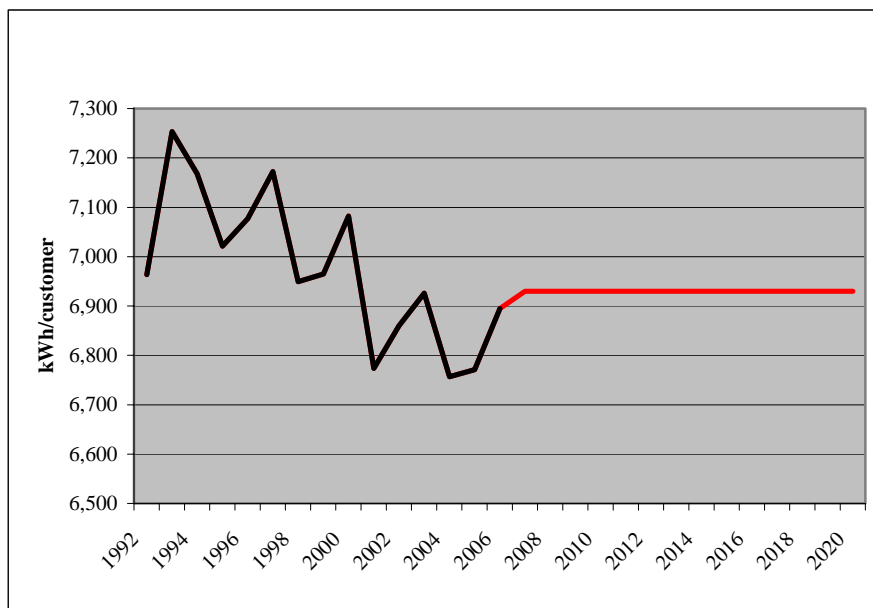


Figure 8: Average Residential Use

Although Figure 8 suggests that there might be a relationship between residential use and heating degree days, there is no statistically significant support. The most likely reason for this is the limited penetration electric space heating in the residential sector.

The AESO's Residential Customers forecast (Figure 9) is driven by the Conference Board of Canada's population forecast.

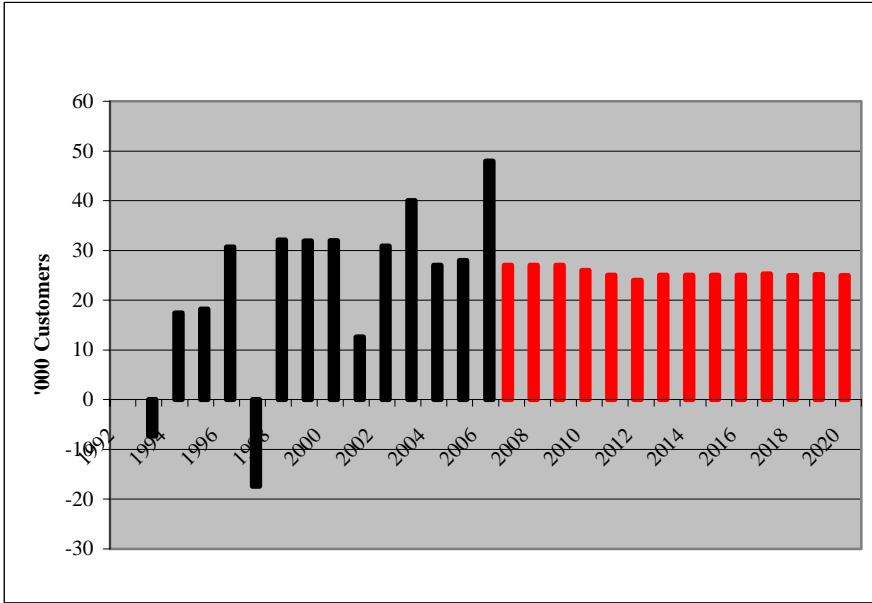


Figure 9: Annual Change in the Number of Residential Customers

4.3 Farm Electricity

The relationship between energy and the Agriculture portion of the Alberta GDP is analyzed through regression analysis to predict the farm energy component. This relationship is found in Figure 10.

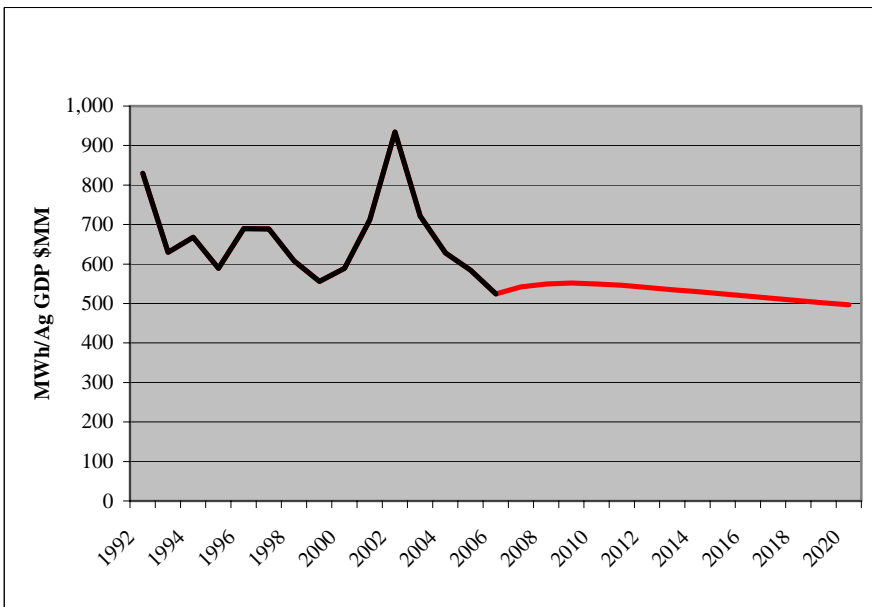


Figure 10: Farm Energy Intensity

Since 1992, electricity usage as a function of Agricultural GDP has been declining. The notable exception was in 2002. At that time, Agricultural GDP

dropped sharply due to export restrictions and soft commodity prices. This resulted in a large increase in the relationship with energy since the amount of electricity consumed on farms did not change significantly.

In 2006, Agricultural GDP grew sharply by almost 16%. For the period from 2007 to 2020, the average increase is expected to be 2%. Although the cultivated land area in Alberta is not increasing, more land is irrigated each year. This results in higher crop yields per acre.

5.0 HISTORICAL FORECAST RESULTS

In the process of preparing the long-term load forecast, the AESO assesses past forecasts, and Alberta's actual demand and electricity usage, in order to verify the methodology and to identify variances that could impact the current forecast.

The past three long-term load forecasts compare favorably to Alberta's actual demand and electricity usage experience. As represented in Table 3, all three electricity forecasts have been between -1.6% and +1.4% for the years 2005 and 2006. On a year-to-date (YTD) basis, all forecasts for 2007 are greater than the electricity consumed.

Table 3: Energy Forecast Variance History

Year of Actuals	Actuals (GWh)	Year over Year	fc2004	fc2005	fc2006	fc2007
2005	66,266.5	---	+1.4%	+1.0%		
2006	69,369.6	+3,103.1	-0.1%	-1.6%	+1.2%	
2007 YTD	46,125.1		-2.5%	-2.7%	-1.7%	-0.5%

Table 4 examines the variance between the actual peak load and the forecasted peak load. This table also highlights the convergence of summer and winter peaks since 2004. The winter peak in 2004/05 was higher than forecast, while the winter peak for both 2005/06 and 2006/07 were lower than forecast.

Table 4: Peak Forecast Variance History

Year of Actuals	Actuals (MW)	Year over Year	Season over Season	fc2004	fc2005	fc2006	fc2007
2004/05 Winter	9,236	---	---	-0.8%			
2005 Summer	8,566	---	-670	-3.1%	-3.3%		
2005/06 Winter	9,580	+344	+1,014	+0.7%	+0.5%		
2006 Summer	9,050	+484	-530	-0.9%	-2.4%	+2.3%	
2006/07 Winter	9,661	+81	+611	-1.3%	-4.0%	-3.8%	
2007 Summer	9,321	+271	-340	-0.4%	-2.6%	+2.4%	+1.0%

In 2006/07 the winter peak occurred in November. Although the weather was cold, the peak did not coincide with the sustained cold and festive lights of a typical December winter peak. Furthermore, the peak was impacted by the phasing out of some industrial loads and the inability of several projects to meet their originally scheduled in-service dates.

Summer peaks are getting higher in Alberta. To a large extent this is being driven by the population growth in southern Alberta, and Calgary in particular. As the population grows there are more users and, frequently, more users who are using more electricity. In a general sense, the increase in summer peaks is referred to as increased air conditioning load.

The FC2006 forecast for the summer of 2007 was lower than the actual peak by 2.4%. This volume, approximately 225 MW, coincides with the amount of price responsive load on the Alberta system. This summer, at the time of peak, there were no forced outages and the price of electricity remained stable at 55 \$/MWh.

6.0 CHALLENGES

Each year the *Future Demand and Energy Outlook* explores a select number of economic challenges that might impact load growth in Alberta. This year three such challenges are examined:

- The large number of oilsands and upgrader projects proposed by customers
- Optimistic growth outside of the northeast
- Weather as a factor in load growth assumptions

In addition, the AESO recognizes that there are other challenges on the horizon including demand-side management and greenhouse gas emission costs. These are briefly discussed in Section 6.4.

6.1 Challenge - Large Number of Oilsands and Upgrader Projects

According to information gathered on oilsands and upgrader projects (size, timing, phasing) provided by customers, the total growth in energy and demand exceeds the forecast for the industrial sector. Therefore careful analysis and judgment is required to place customer proposed projects in the context of the most-likely forecast. In order to respect the forecasted energy growth limits, the following criteria were established:

- An initial customer project list was generated from customer surveys, interconnection applications and customer meetings.
- All projects not yet under construction are delayed by one year or more to start-up on January 1st of the next + 1 year.

- All projects not yet under construction were ramped-up at slower rates than proposed. Ramp rates were used to reduce load rather than identifying and reducing the one (or more) projects that might face cancellation or delay.
- Lower than proposed ramp rates were also used for projects that are currently under construction.
- Existing and operating projects' future growth plans were adjusted last, and only if necessary.

The justification for applying the 1-2 year delay and the slower ramp-up to future projects lies in identifying and understanding the significant challenges facing oil sands developers. These include but are not limited to: labour costs, water availability, pipeline capacity, regulatory approval, and stakeholder concerns.

Although the AESO does not forecast oil production, it is possible to convert the energy forecast to a range of production numbers. Figure 11 shows this range in the context of several publicly available forecasts: Canadian Association of Petroleum Producers (“CAPP”), EUB, and National Energy Board (“NEB”).

The AESO’s estimated range non-upgraded bitumen (NUB) and synthetic crude oil (SCO) is derived by converting the energy forecast in the northeast to barrel per day (bpd) of NUB and SCO using 19 kWh/bbl and 25 kWh/bbl.

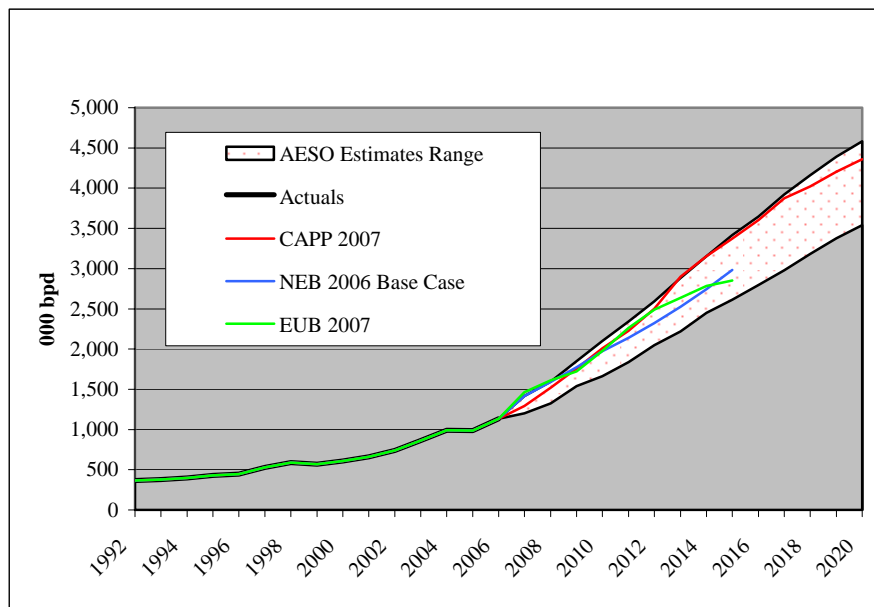


Figure 11: Oilsands Production (NUB + SCO)

The year-over-year production additions (Figure 12) were also analyzed to test for reasonable additions. The past four year average has been +95,000 bpd.

AESO's forecast calls for an average of +200,000 bpd for the next 10 years. CAPP 2007 calls for an average of +250,000 bpd for the next 10 years with +400,000 occurring in 2013.

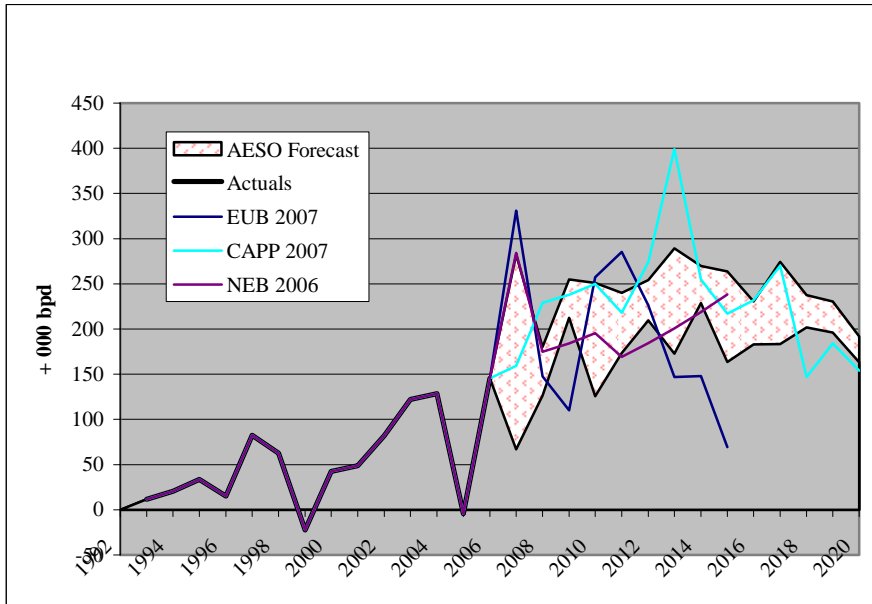


Figure 12: Oilsands Production (Year-over-year) (NUB + SCO)

Some oilsands developers are reviewing new technologies, such as gasification of syngas to reduce their natural gas consumption. This will increase their demand of electricity for each barrel of oil. This potential increase in electricity intensity may be countered as the percentage share of SAGD production increases. SAGD requires less electricity per barrel than mining does.

6.2 Challenge - Areas Outside of the Northeast Have Optimistic Growth Future

A second challenge faced in the production of FC2007 was to ensure the energy forecast for regions outside of the oilsands production and upgrading region reflects the optimistic economic outlook throughout the province.

Figure 13 shows the annual industrial energy growth outside of the northeast. This has been incorporated into FC2007. Non-project growth was arrived at by using as a guideline the past 5-year performance for each planning region.

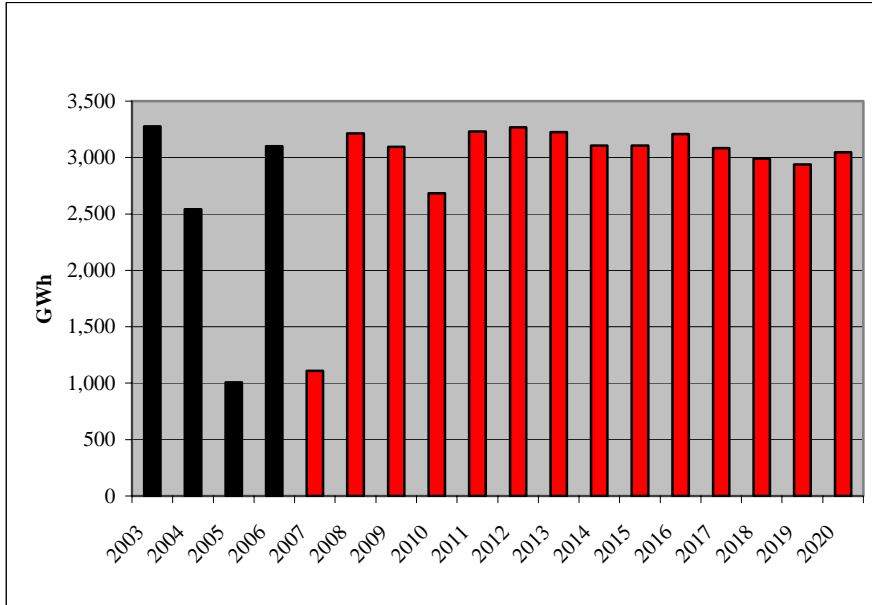


Figure 13: Non-Oil Sands Energy Growth (Year-over-year)

6.3 Challenge – Weather As A Factor In Future Load Assumptions

Since the primary determining factors for electricity demand are Alberta’s real GDP and population growth, the AESO does not employ a weather normalization scheme within the load forecasting process.

As noted in Section 4.2, there is no statistical support for applying weather normalization to the Alberta load forecast. The AESO does, however, examine this relationship on an annual basis.

The AESO captures weather variations implicitly through the conversion of the annual energy forecast into an hourly forecast by using the two previous years’ load shapes and averaging the values. This allows approximately 17,520 (8,760 hours x 2 years) different weather conditions to be incorporated into the hourly load forecast. In this way, a suitable range of weather conditions are captured in FC2007.

6.4 Challenges on the Horizon

Each year in the process of developing the load forecast, there are internal discussions about changes on the Alberta’s horizon that may have a material impact on the future load and energy requirements.

This year four such future challenges have been identified:

- New demand side management initiatives, including demand response programs
- New technology, with different electricity intensities
- New environmental regulations around greenhouse gases
- New exploration, particularly coal-bed methane extraction

Each of these challenges will be explored in the coming year to determine their significance with respect to the fundamental relationships that form the basis of the AESO's *Future Demand and Energy Outlook*.

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