MEMORANDUM

To: Jesse Row
From: Bruno Gobeil
Date: June 5th, 2015 (corrected version - September 24th, 2015)

Re: GHG Savings and Energy Efficiency High-Level Opportunity Analysis in Alberta

The following memo aims at providing a high-level assessment of what level of energy efficiency (EE) could be achieved in Alberta in the next 15 years, along with the associated costs and benefits for the province (jobs, GHG reductions, etc.).

We seek to answer the following research questions:

1. What level of EE savings, expressed as % load reduction, is realistic for Alberta?
2. What program investments will be required to achieve this EE level?
3. What will be the impact on carbon emissions and other economic indicators?

The memo summarizes the methodology and results from our high-level assessment. The analysis is based on the Acadia Center Canada-wide economic study, released in 2014, commissioned by Natural Resources Canada and co-authored by Dunsky Energy Consulting, entitled "*Energy Efficiency: Engine of Economic Growth in Canada. A Macroeconomic Modeling & Tax Revenue Impact Assessment*".

Methodology

The purpose of the Acadia Center study was to understand the overall macroeconomic spin-offs from EE programs. It quantifies a range of hypothetical levels of effort that are considered robust to aggressive, but realistic and achievable, based on cost-effective savings potential studies and experience in other jurisdictions.

The Acadia Center study projects three different scenarios: one that would require an incremental increase in savings over current levels of efforts in most jurisdictions in Canada (BAU+); a second that would place the province among current leaders (Mid); and a third that would put the province among the top two leaders in North America, essentially matching Massachusetts and Vermont (High).

The study considers electric, natural gas and liquid fossil fuel efficiency programs that generate energy savings in the residential and the commercial and industrial (C&I) market segments (the transportation sector was excluded from the study's scope).

Considering that the level of investment in EE programs in Alberta has historically been low, we considered the BAU+ scenario to be most realistic, though still ambitious.

In order to assess the achievable potential of EE in Alberta, we looked at what other Canadian jurisdictions have achieved in the past: Saskatchewan and Nova Scotia for electricity; and British Columbia and Manitoba for natural gas. No benchmarking was performed for the liquid fossil fuels since limited data are available on demand-side management (DSM) programs dedicated to this fuel.

Based on the level of savings achieved in the four Canadian regions scanned, we built two scenarios for Alberta:

1. The first scenario, based on Saskatchewan (electricity) and British Columbia (natural gas) savings, would require fairly limited investment and achieve modest energy and GHG savings (**BASE**) ;
2. The second scenario, modelled upon Nova Scotia (electricity) and Manitoba (natural gas), would need more aggressive investment and yield significant energy and GHG savings (**BASE+**).

The savings targets for the two scenarios are defined as follows:

Table 1: Energy savings targets for Alberta scenarios

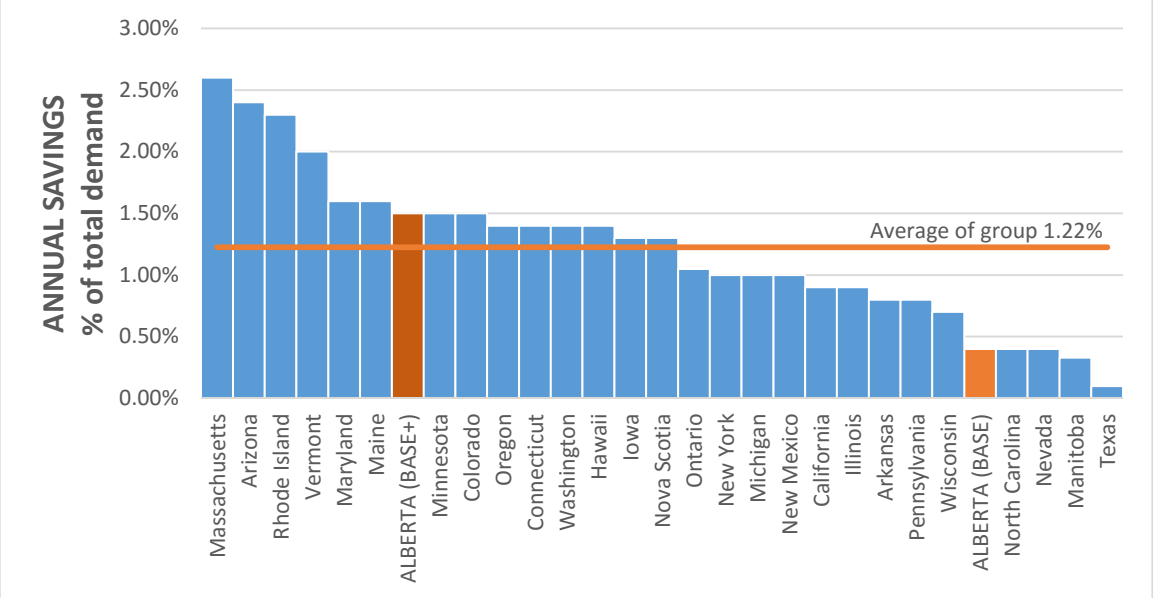
	BASE	BASE+
Electricity	**0.4%**	**1.5%**
Natural Gas	**0.4%**	**0.75%**
Liquid Fossil Fuels[1]	**0.7%**	**1.3%**

Note: Savings are expressed as annual incremental % load reduction of demand forecast. BASE savings targets are achieved after a 4-year ramp-up while BASE+ targets are modelled with a 6-year ramp-up.

Figure 1 compares the two electric scenarios for Alberta against other North American jurisdictions' savings targets. The BASE+ scenario would place Alberta slightly above average, while the BASE scenario would place Alberta among states that have only achieved modest EE savings.

[1] Due to lack of data, "Liquid Fossil Fuels" scenarios were defined based on the Acadia Center study results with some adjustments. The "Liquid Fossil Fuels" BASE scenario corresponds approximately to half of Acadia Center's BAU+ savings target and the BASE+ scenario almost matches Acadia Center's BAU+ savings target. These savings levels were chosen to reflect the fact that electric and natural gas scenarios built from other jurisdictions correspond approximately to half of Acadia Center's BAU+ (BASE) and BAU+ (BASE+) scenarios respectively.

Figure 1: Annual electricity savings targets across North America (2014-2020), including scenarios for Alberta[2]



Based on the savings targets above (Table 1), the following outputs are calculated:

- Energy savings = % Load reduction x Load forecast[3]
- GHG savings = Energy savings x GHG emissions factor[4]
- Bill savings = Energy savings x Marginal rates[5]
- Program costs = Energy savings x Unit program costs[6]
- Jobs, GDP and tax revenues increases[7]

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[2] Based on ACEEE 2014 State Energy Efficiency Scorecard for U.S. jurisdictions and EE Plans for Canadian jurisdictions.

[3] Alberta load forecasts are based on National Energy Board, End-use Energy Demand, available at: https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2013/ppndcs/pxndsdmnd-eng.html. These forecasts were adjusted to account only for the energy consumption that is amenable to DSM, which means that natural gas use for the oil & gas sector was excluded, as assumed in the Acadia Center study.

[4] GHG emissions factors come from the Acadia Center study: Electricity: 0.40 tCO_2e/MWh (displaces natural gas power plants), Natural Gas: 1.918 tCO_2e/Mm^3, Light Fuel Oil: 70,300 tCO_2e/PJ, Heavy Fuel Oil: 74,000 tCO_2e/PJ.

[5] Energy rates for Alberta, from the Acadia Center study.

[6] Unit Program costs for Alberta (BAU+ scenario, conservative approach), from the Acadia Center study.

[7] Job creation, GDP and tax revenues increases are calculated as a pro-rata of the Acadia Center study results, based on spending level.

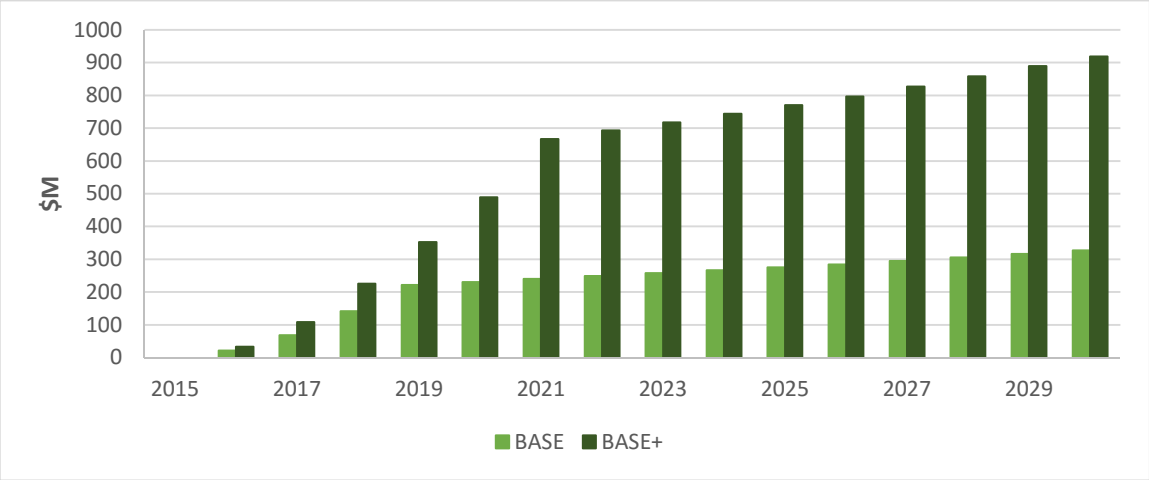
Results

Based on the assumptions stated above, the model generates the following results.

Figure 2 illustrates the scale of program costs that would be required to achieve the projected targets for the three fuel types. Programs are modelled to start in 2016 with minimal investment ($20M to $30M) and to ramp-up from 2017 to 2019 (BASE), or from 2017 to 2021 (BASE+), to reflect the time required to set up a delivery infrastructure, establish funding mechanisms, adopt DSM-related legislation and/or regulations, and develop and implement DSM programs.

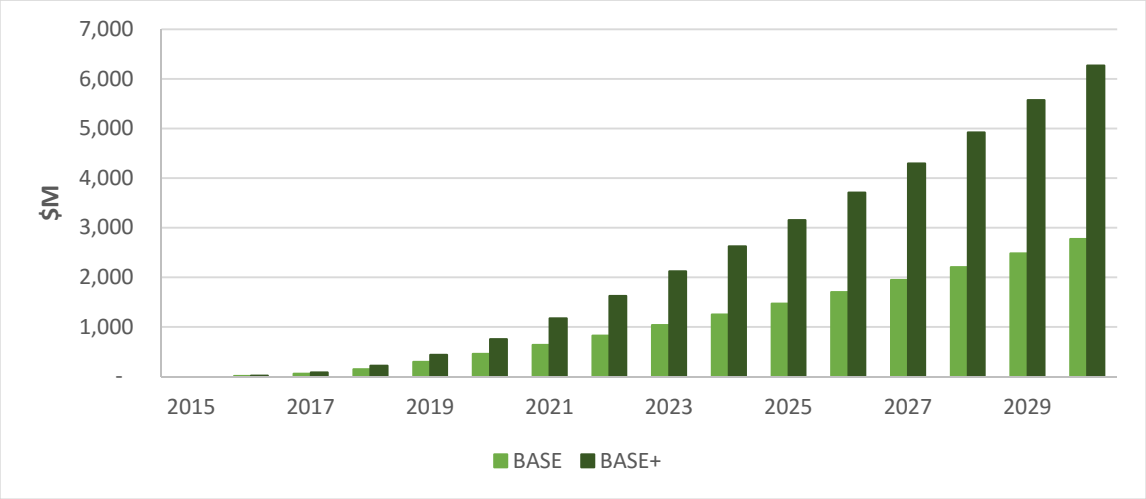
Under the BASE scenario, program costs ramp up to $220M/year by 2019. Under the more ambitious BASE+ scenario, program costs ramp up to $670M/year by 2021.

Figure 2: Annual program costs (all fuels)



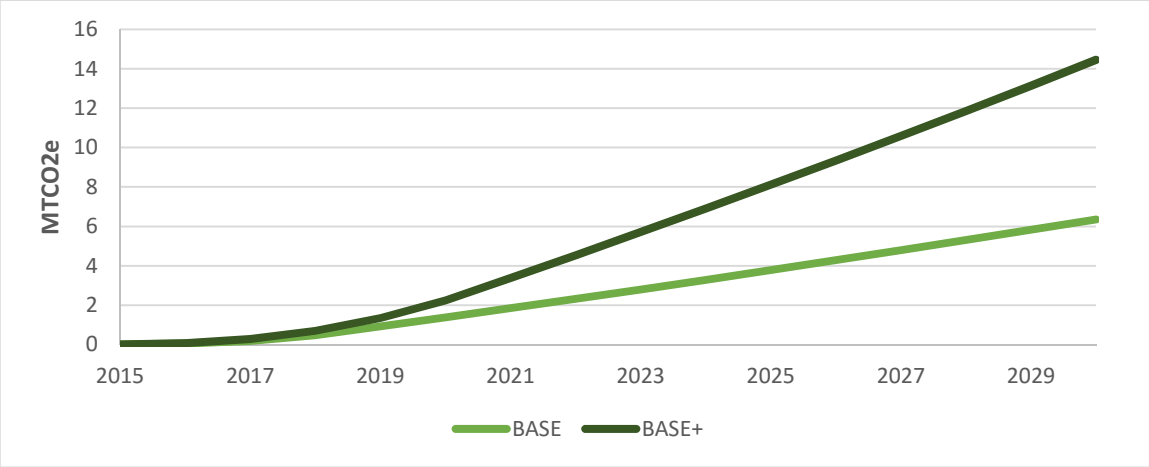
Direct benefits of EE include maximum annual energy savings ranging from **90 PJ** to **190 PJ** (Table 2), resulting in bills savings reaching **$2.8B** to **$6.3B** in 2030 (Figure 3).

Figure 3: Annual Energy Bill Savings (all fuels)



Meanwhile, greenhouse gas emissions reduced or avoided are approximately **6** to **14 Mt CO_2e** (Figure 4), or 3 to 6% of Alberta's total GHG emissions in 2012. Note that for electricity savings, we have assumed a gas-fired power plant at the margin; GHG reductions would be significantly higher if DSM offsets coal plant emissions.

Figure 4: Annual GHG reductions



Energy efficiency also significantly stimulates economic growth and employment. Under the "all fuels" scenarios, the average annual spending of $230M (BASE scenario) and $600M (BASE+) over 15 years results in a maximum annual net increase of **7,000** to **15,000 jobs**. The maximum annual net increase in GDP is estimated to range from **$1.3B** to **$3B**.

According to the original Acadia Center study, the greatest job increases will be in sectors related to EE programs such as construction, retail sales, professional services and manufacturing. However, every sector of the economy will eventually benefit from EE as it lowers people's and businesses' energy bills – the equivalent of a tax break.

Energy efficiency investments also increase government revenue. While efficiency programs tend to reduce the amount of tax paid by consumers through reduced fuel purchases, the Acadia Center study found that the net increase in economic output generates additional tax revenue that more than compensates for the loss. In Alberta, EE would generate an increase in net provincial revenue as high as **$80M** to **$200M** annually (in personal income tax and corporate income tax).

Table 2 provides detailed results by type of fuel, for the two scenarios and for three select years.

Table 2: Summary Results per Fuel and per Scenario (select years)

	Program Costs ($M/yr)					
	BASE			BASE+		
	2017	*2021*	*2030*	*2017*	*2021*	*2030*
Electricity	28	102	144	64	408	577
Natural Gas	24	83	108	27	155	202
Liquid Fossil Fuel	16	56	75	18	104	139
TOTAL	**68**	**240**	**327**	**108**	**667**	**919**

	Energy Savings PJ/yr (cumulative annual)					
	BASE			BASE+		
	2017	*2021*	*2030*	*2017*	*2021*	*2030*
Electricity	1	5	18	1	14	62
Natural Gas	1	12	40	2	17	69
Liquid Fossil Fuel	1	9	32	1	13	56
TOTAL	**3**	**26**	**90**	**4**	**44**	**187**

	GHG Savings ($ktCO_2e$/yr (cumulative annual)					
	BASE			BASE+		
	2017	*2021*	*2030*	*2017*	*2021*	*2030*
Electricity	58	561	1,974	120	1,568	6,866
Natural Gas	64	603	2,047	78	853	3,561
Liquid Fossil Fuel	65	682	2,333	77	956	4,022
TOTAL	**187**	**1,846**	**6,354**	**274**	**3,377**	**14,448**

	Bill Savings ($M/yr)					
	BASE			BASE+		
	2017	*2021*	*2030*	*2017*	*2021*	*2030*
Electricity	19	201	845	40	561	2,938
Natural Gas	15	182	818	18	257	1,423
Liquid Fossil Fuel	21	254	1,108	25	355	1,909
TOTAL	**55**	**636**	**2,770**	**83**	**1,174**	**6,270**

In order to facilitate a comparison of results for these two scenarios with the original Acadia scenarios, we reproduce our results in Tables 3 and 4 below. These use the same format as the original Acadia study.

Table 3: New Alberta Scenarios: Macroeconomic Impacts Summary (using Acadia study format)

ALBERTA	BASE	BASE+
All Fuels - Simultaneous		
Total Efficiency Program Costs ($2015M)	2,533	6,462
Increase in GDP (2015$M)	**20,270**	**40,611**
Maximum Annual GDP Increase (2015$M)	1,301	2,927
GDP per $1 of Program Spending	7.79	6.47
Increase in Employment (Job-years)	**95,101**	**193,405**
Maximum Annual Employment Increase (Jobs)	6,620	14,835
Job-years per $M of Program Spending	38	32
Electricity		
Total Efficiency Program Costs ($2015M)	1,088	3,976
Increase in GDP (2015$M)	**5,548**	**16,769**
Maximum Annual GDP Increase (2015$M)	359	1,312
GDP per $1 of Program Spending	5.10	4.22
Increase in Employment (Job-years)	**26,109**	**80,714**
Maximum Annual Employment Increase (Jobs)	1,793	6,553
Job-years per $M of Program Spending	24	20
Natural Gas		
Total Efficiency Program Costs ($2015M)	860	1,484
Increase in GDP (2015$M)	**1,996**	**3,800**
Maximum Annual GDP Increase (2015$M)	144	249
GDP per $1 of Program Spending	2.32	2.56
Increase in Employment (Job-years)	**14,628**	**27,088**
Maximum Annual Employment Increase (Jobs)	1,055	1,819
Job-years per $M of Program Spending	17	17
Liquid Fossil Fuels		
Total Efficiency Program Costs ($2015M)	585	1,002
Increase in GDP (2015$M)	**12,726**	**20,043**
Maximum Annual GDP Increase (2015$M)	798	1,366
GDP per $1 of Program Spending	21.77	20.01
Increase in Employment (Job-years)	**54,364**	**85,603**
Maximum Annual Employment Increase (Jobs)	3,772	6,463
Job-years per $M of Program Spending	93	85

Table 4: New Alberta Scenarios: Economic, Energy and GHG Reductions 2016-2044 (using Acadia study format)

ALBERTA	Electricity	Natural Gas	Liquid Fossil Fuels	Total
Energy Benefits		**($2015M)**		
Lifetime Energy Benefits (15 years of programs)				
BASE	3,598	3,443	4,643	**11,684**
BASE+	11,644	5,621	7,496	**24,761**
Energy Benefits per $1 of Program Spending				
BASE	3.3	4.0	7.9	**-**
BASE+	2.9	3.8	7.5	**-**
Energy Savings		**(PJ)**		
Lifetime Energy Savings (15 years of programs)				
BASE	239	662	486	**1,386**
BASE+	830	1,151	837	**2,818**
Maximum Annual Energy Savings				
BASE	18	40	32	**90**
BASE+	62	69	56	**187**
Avoided Greenhouse Gas Emissions		**($ktCO_2e$)**		
Lifetime Avoided Emissions (15 years of programs)				
BASE	26,510	34,020	35,045	**95,574**
BASE+	92,209	59,181	60,406	**211,796**
Maximum Annual Avoided Emissions				
BASE	1,974	2,047	2,333	**6,354**
BASE+	6,866	3,561	4,022	**14,448**

Conclusion

This high-level analysis attempts to quantify the macroeconomic benefits that could accrue to Alberta if the provincial government were to invest in EE to a level that is in line with other provincial initiatives.

The results show that EE creates a win-win situation for all parties involved:

- households and businesses benefit from energy bill savings;
- the economy grows and more jobs are created;
- the government sees its revenues increase; and
- EE addresses climate change by reducing GHG emissions from electricity generation and fossil fuel combustion.

Energy efficiency is an opportunity for Alberta to address environmental concerns while creating over 15,000 new jobs across the province in one year. Going aggressive on energy performance would also add up to $3 billion to the province's annual GDP, and raise nearly $200 million/year in additional tax revenue as a result of increased economic activity. In summary, energy efficiency is a real low-hanging fruit for any government interested in GDP, jobs and revenue.