

Working Draft

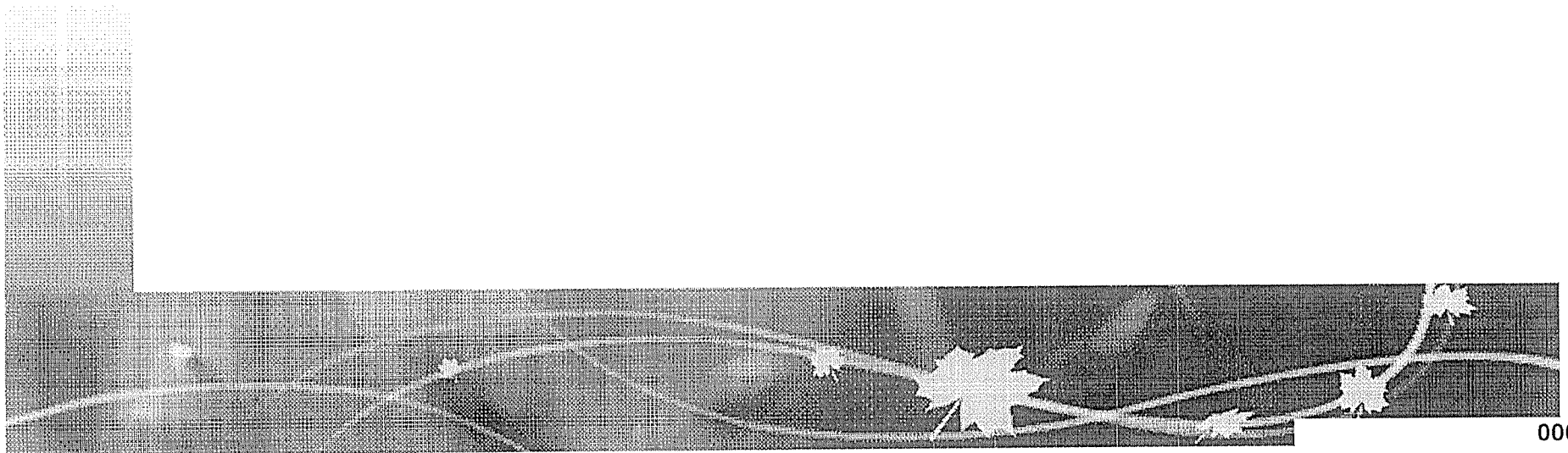


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Environment Canada's Interim Energy, Emissions and Economic Reference Cases



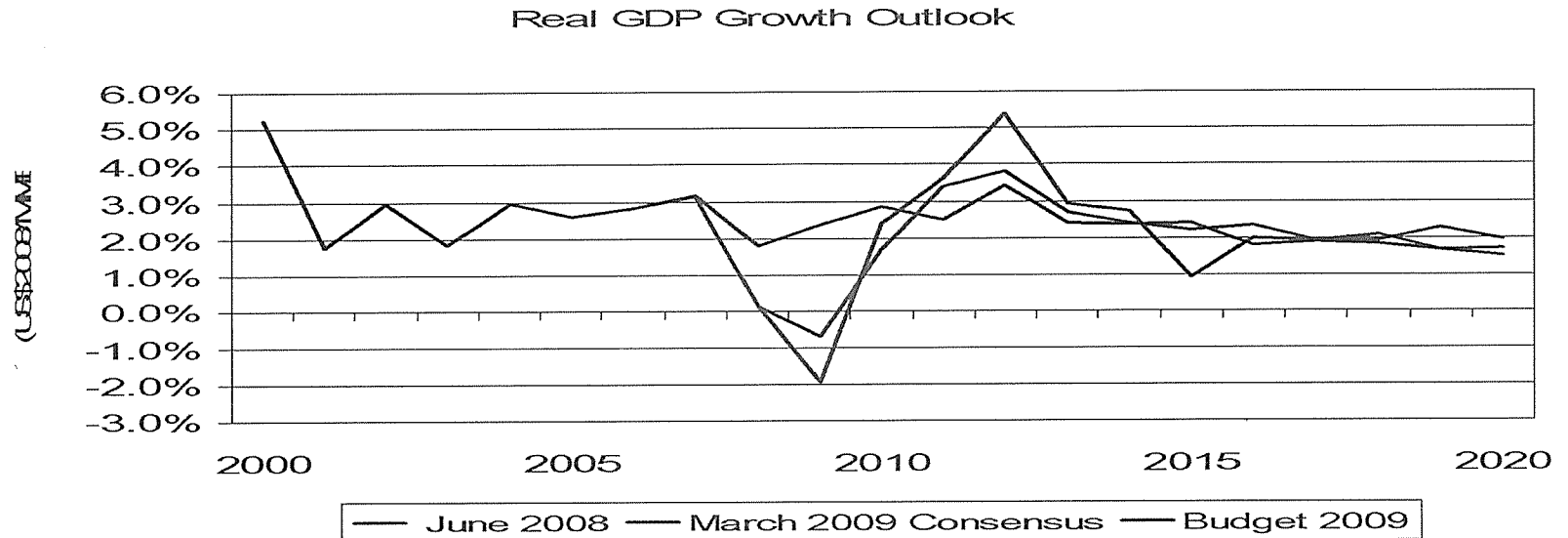
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The updated reference case reflects revisions in several major underlying drivers of greenhouse gas emissions in Canada

- Emissions projections under the updated reference case reflect significant changes to key economic and emissions drivers since the last major update done in June, 2008:
 - GDP Growth
 - Oil and Natural Gas Prices
 - Oil sands and conventional oil and gas production levels
 - NEB preliminary assumptions about:
 - energy mega-projects
 - roll-out of announced provincial government programs; and
 - certain methodological changes for estimating energy demand growth

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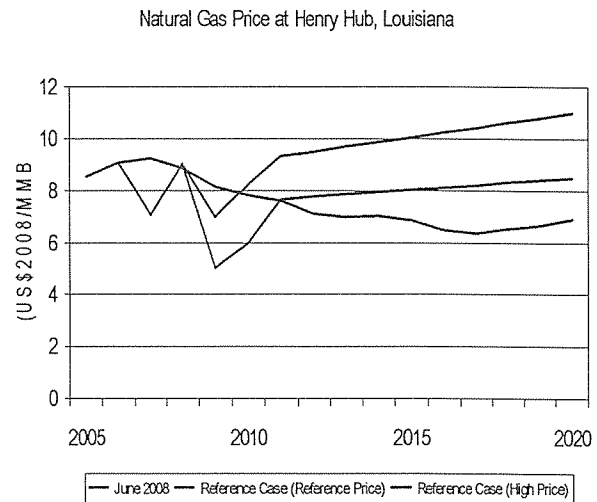
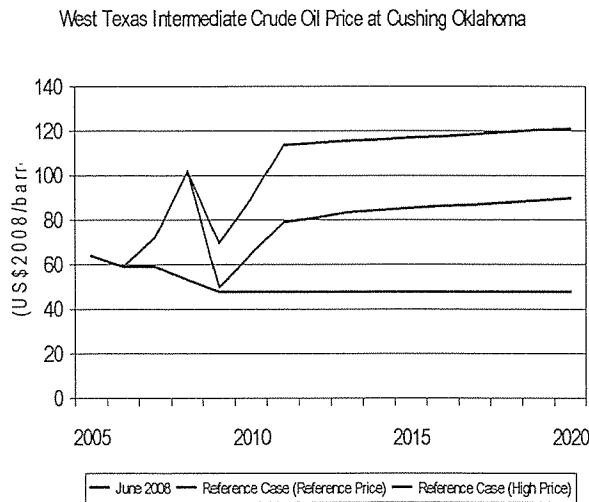
The current crisis is leading to significant change in short-term economic growth



- Near-term economic growth is significantly lower than our pre-recession forecast, with a decline in GDP of -1.9 percent in 2009.
- Our forecast predicts a strong recovery in GDP growth through 2010 to 2012, with medium and longer term growth settling back to converge with the 2% range of our earlier forecast.
- It should be further noted that this analysis reflects the March 2009 Macroeconomic Consensus forecast (somewhat more pessimistic than the last federal Budget for 2009, but more optimistic for 2010-2012). A case aligned to Budget 2009 near-term GDP growth rate is being prepared.

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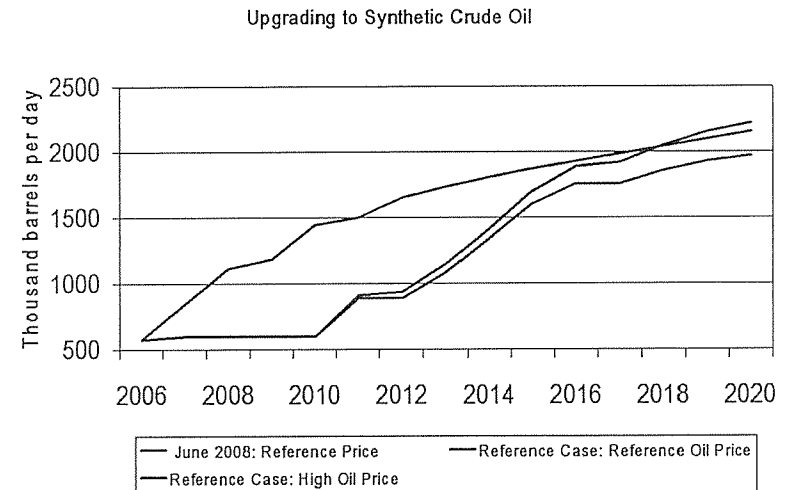
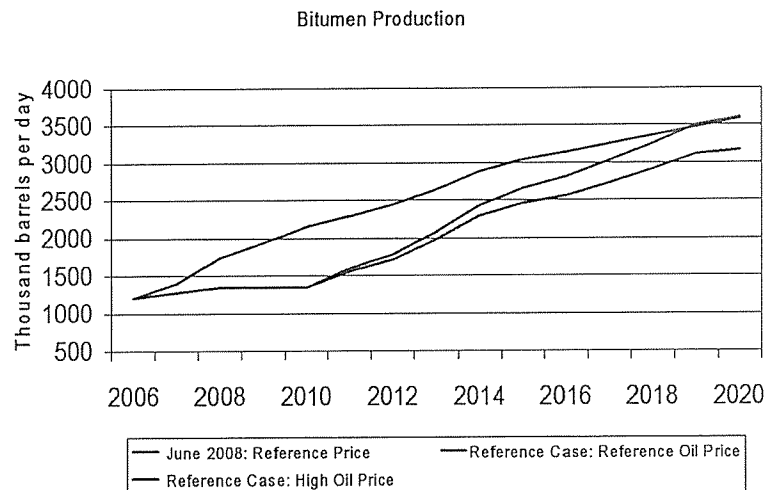
While the current economic crisis is driving short-term oil prices down, we expect a sustained departure from the moderate oil price assumptions in our previous forecast



- Oil prices represent a critical element of economic growth and energy-related GHG emissions, particularly for Canada given its position as both an oil producer and a relatively heavy oil consumer.
- The NEB view, shared by most other major energy forecasters, is that despite the recent sharp declines in oil price, economic recovery will see a structural shift in global supply and demand for this commodity, with prices well above the long-term average of \$50 per barrel previously assumed.
- Forecasts continue to vary significantly, however. The above chart depicts the NEB's view of the most likely (averaging ~\$80 per barrel) and high price (~\$120 per barrel) scenarios out to 2020.
- Regional Natural gas are assumed to follow the world oil price trend. Natural gas prices decline in 2009 to about \$US 5 per mmbtu, but begin to recover to reach \$US 8.5 per mmbtu by 2020.

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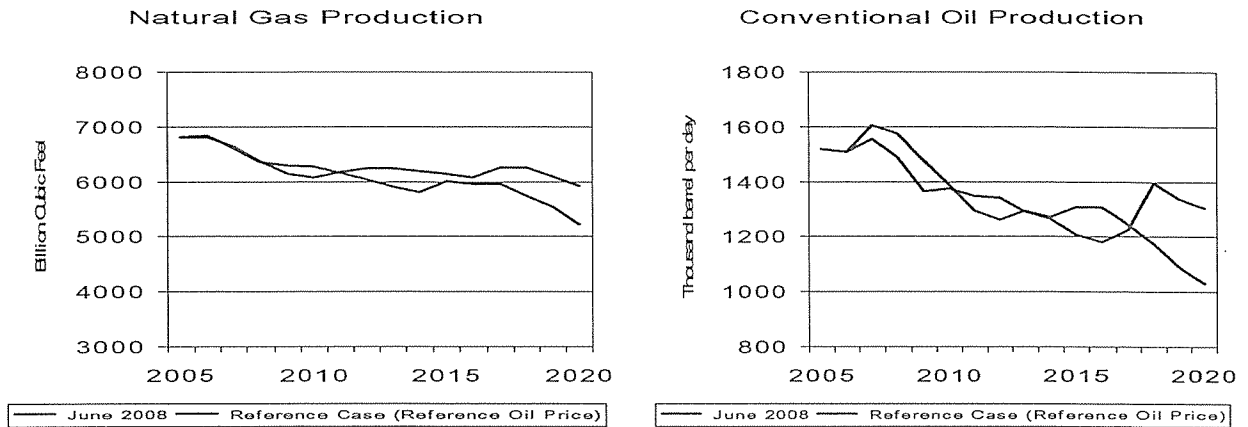
Deferral of near- and medium-term investments leads to a reduction in the pace of raw bitumen production and its upgrading to synthetic crude oil



- Deferral of near- and medium-term investments in the face of falling world oil prices, coupled with the NEB's assumption of higher production levels in competing conventional sources in Canada, leads to a reduction in the pace of raw bitumen production in the oil sands.
- Likewise, the pace of bitumen and heavy oil upgrading is forecast to be significantly reduced in the early and mid-term years of the updated reference case, and returns to the previous 2020 forecast only under the high oil price scenario

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Natural Gas Production and Conventional Oil Production is generally higher than previously assumed in the updated NEB outlook, particularly in the later years of the forecast



- The NEB is projected a significant increase in unconventional natural gas productions (e.g., coal-bed methane, shale gas, etc), much of which has yet to be discovered
- Even with the exploitation of these new sources, natural gas production is projected to continue its decline, with production stabilizing at around 6 Trillion cubic feet per year
- Conventional oil production is also projected to be higher than the June 2008 outlook. This reflects new discovers in the off-shore and in Saskatchewan. Conventional production is expected to fall from about 1.5 million barrels per day to about 1.2 million barrels per day by 2016, then peaking at 1.4 million barrels per day by 2018

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The NEB assumes a significant greening of the electricity generation sectors

- British Columbia & Territories
 - 920 MW of installed wind
- Prairies
 - 776 MW of installed wind
 - Saskatchewan CCS pilot project
- Ontario
 - 810 MW of installed wind
 - Coal fire capacity is retired by 2015
 - Nuclear plants are refurbished or replaced
- Quebec
 - 6205 MW of installed wind
 - 2270 MW of new hydro capacity
- Atlantic
 - 1117 MW of installed wind
 - New Brunswick installs two 1000 MW nuclear plants in 2017 and 2019
 - Lower Churchill 2260 MW hydro in 2015
- The NEB's proposed energy supply forecast includes a number of projects affecting the electricity generation sector. We have incorporated certain of these assumptions in our working reference case
 - Ontario coal-fired phase-out and supply replacement programs
 - Large hydro projects such as Conawapa, Lower Church and Peace River Site C
 - A modest expansion of wind power
- However, we have left out federal government initiatives since January 1, 2006, assumed nuclear facilities in Alberta, and some of the assumed growth in wind power

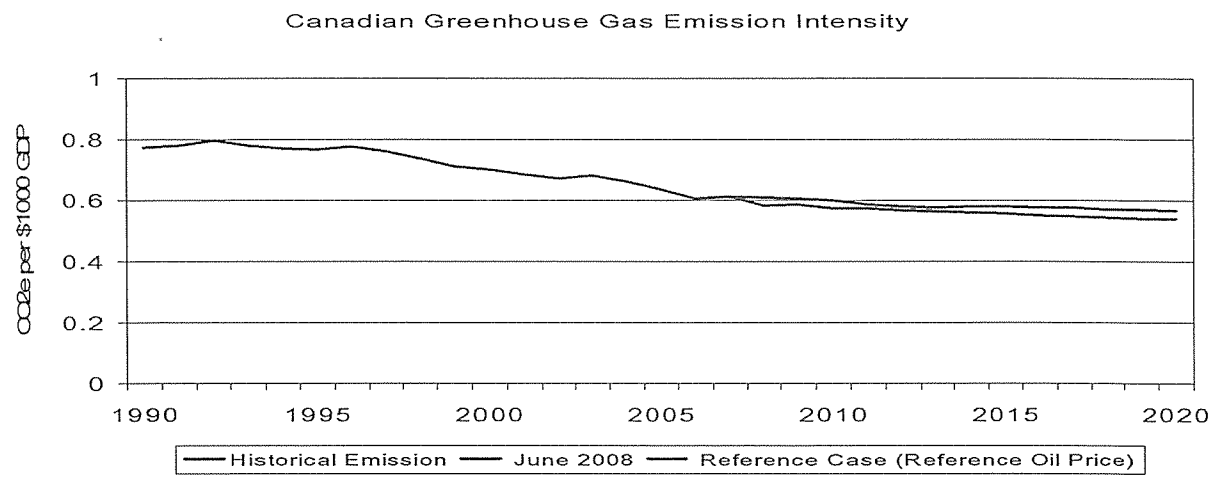
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The energy supply and demand trends under the April 2009 case also include some methodological changes adopted by the NEB

- The most important change is with respect to the energy and emissions drivers for the residential and commercial sectors
 - For residential demand, there has been a switch to using changes in residential housing stock instead of personal disposal income to estimate demand growth
 - This makes energy demand less sensitive to income growth
 - For commercial demand, the NEB has adopted commercial floor space instead of commercial gross output as the driver of demand growth
 - This makes energy demand less sensitive to changes in production levels for any given commercial activity

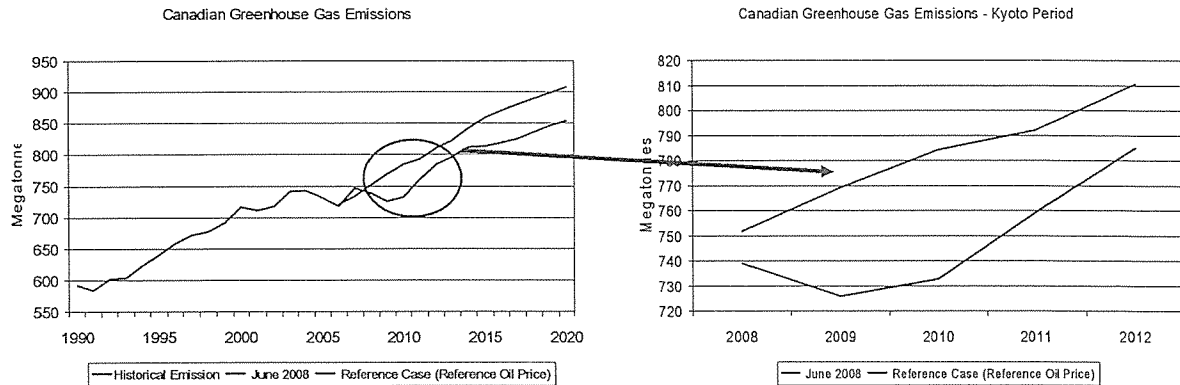
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Higher energy prices, coupled with a “greening” of electricity generation reduces the greenhouse gas emission intensity of the Canadian economy



- Overall Greenhouse Gas Emission intensity under the Reference case is projected to be some 5% lower than pre-recession estimates by 2020, reflecting the changes to key parameters and assumptions.
 - Higher energy prices promote improve the relative economics of more energy efficient buildings, equipment, appliances, and industrial process thereby lowering emission intensity
 - More greener electricity generation also lowers emission intensity

National Greenhouse Gas Emissions under the Reference case are projected to be lower than pre-recession estimates



- National Greenhouse Gas Emissions under the Reference case are projected to be about 6% lower than pre-recession estimates for 2009-2010, reflecting the more pessimistic short-term economic growth scenario
- Emissions to 2020 are also lower, about 3% lower than the pre-recession forecast.
 - Reflects higher world oil prices than previously assumed, and updated NEB assumptions about major “clean” energy projects
- Looking at the near-term situation, greenhouse gas emissions under the new reference case will fall by over 3% from 2007 to 2009, and return to 2007 levels by 2011.
- Cumulatively, emissions will be some 4% lower than the pre-recession forecast over the 2008-2012 Kyoto period, moving Canada’s average annual Kyoto period emissions from 41% down to 35% above the Kyoto target.

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Greenhouse gas emissions in the update are some 50 Mt below the pre-recession reference case

	2010			2015			2020			% Growth 2010 to 2020	
	June 2008 Mt	Reference Case Mt	% Chg	June 2008 Mt	Reference Case Mt	% Chg	June 2008 Mt	Reference Case Mt	% Chg	June 2008 Mt	Reference Case Mt
Residential	43.9	44.9	2.3%	48.3	46.7	-3.3%	51.9	48.2	-7.1%	18.2%	7.3%
Commercial	43.1	39.9	-7.4%	51.1	46.9	-8.2%	58.4	55.0	-5.8%	35.5%	37.8%
Transportation	170.8	171.4	0.4%	197.7	182.6	-7.6%	217.3	188.8	-13.1%	27.2%	10.2%
Industrial: Non-Regulated	42.8	40.1	-6.3%	47.9	46.7	-2.5%	52.4	50.9	-2.9%	22.4%	26.9%
Industrial: Regulated	374.1	340.5	-9.0%	394.3	380.2	-3.6%	403.3	387.8	-3.8%	7.8%	13.9%
Agriculture, Wastes & Others	100.9	96.2	-4.7%	112.1	110.9	-1.1%	123.1	123.2	0.1%	22.0%	28.1%
Total	775.6	732.9	-5.5%	851.3	814.0	-4.4%	906.4	853.9	-5.8%	16.9%	16.5%

- Transportation is the largest single source of a decline in total emissions by 2020, due primarily to the significantly higher oil prices assumed in the updated forecast.
- Emissions in the regulated industries are the second largest source of the decline, driven by the lower oil sands production and upgrading, lower and greener electricity, and lower overall production
- Emissions in other sectors of the economy remain relatively stable

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Overall greenhouse gas emissions for the regulated sectors are some 15 Mt lower in Reference Case compared to the pre-recession case

	2010			2015			2020			% Growth 2010 to 2020	
	June 2008 Mt	Reference Case Mt	% Chg	June 2008 Mt	Reference Case Mt	% Chg	June 2008 Mt	Reference Case Mt	% Chg	June 2008	Reference Case
Pipelines	14.6	14.6	0.0%	15.6	14.6	-6.4%	15.1	14.0	-7.3%	3.4%	-3.3%
Pulp and Paper	5.7	5.0	-12.3%	4.8	4.5	-6.3%	4.0	3.8	-5.0%	29.8%	-23.0%
Chemical	8.9	9.7	9.0%	11.2	14.6	30.4%	12.1	16.9	39.7%	36.0%	73.8%
Petroleum Refining	20.6	26.9	30.6%	26.7	33.5	25.5%	26.5	32.1	21.1%	28.6%	19.4%
Cement, Lime & Gypsum	15.5	13.6	-12.3%	16.2	14.7	-9.3%	16.9	15.7	-7.1%	9.0%	15.3%
Iron and Steel	15.3	12.4	-19.0%	16	14.7	-8.1%	16.6	15.3	-7.8%	8.5%	23.5%
Aluminum and Smelting	17.7	12.2	-31.1%	18.3	16.3	-10.9%	19.0	17.3	-8.9%	7.5%	41.4%
Iron Ore, Polash, Mining	3.8	4.4	15.8%	3.9	4.3	10.3%	4.0	4.2	5.0%	5.3%	-4.6%
Conventional Oil and Gas	87.5	78.5	-10.3%	80.6	77.0	-4.5%	68.7	73.4	6.8%	-21.5%	-6.4%
Electricity Generation	115.6	110.8	-4.2%	108.5	114.5	5.5%	115.5	113.7	-1.6%	-0.1%	2.6%
Oil Sands	68.9	52.3	-24.1%	92.4	71.3	-22.8%	105	81.4	-22.5%	52.4%	55.6%
Total: Regulated Industries	374.1	340.5	-9.0%	394.3	380.2	-3.6%	403.3	387.8	-3.8%	7.8%	13.9%

- Emissions for the regulated sectors are lower than the pre-recession scenario, but the growth between 2010 and 2020 is higher
 - Oil sands emissions are significant lower relative to pre-recession estimates
 - Chemical and petroleum refining are somewhat higher
- The overall industrial sector growth rate to 2020 is higher, although off of a much reduced 2010 base.

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Annex 1 – Sensitivity Cases

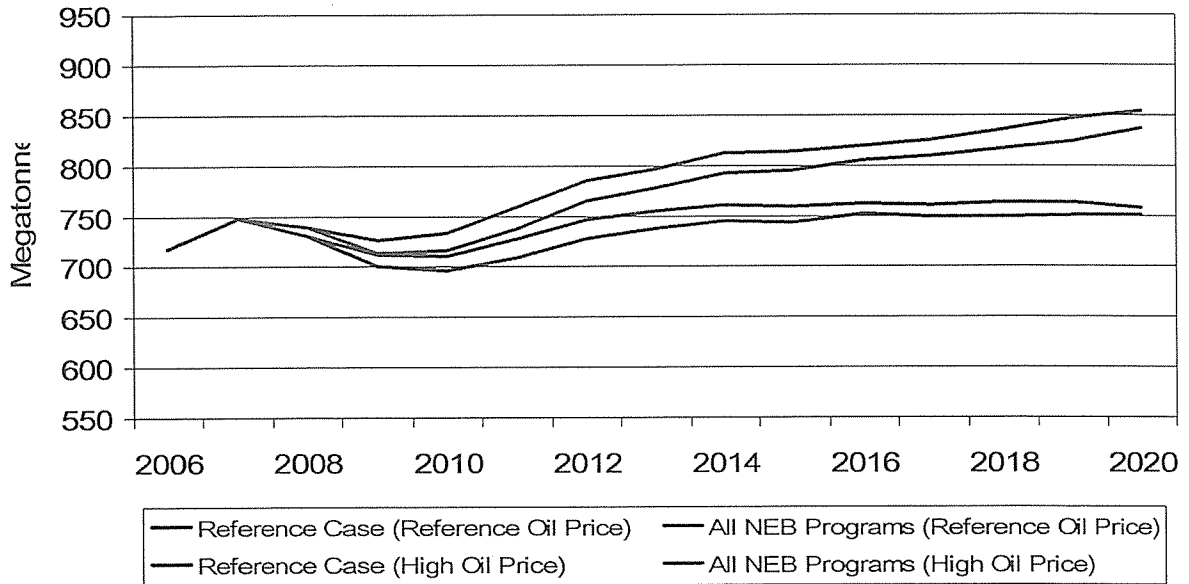
We have examined the impact of variations on the NEB's assumptions on our emissions forecast

- The following slides elaborate on the impact of key NEB assumptions contained in their consultation reference case
- In these slides:
 - The “Reference” case refers to the forecast presented above, which includes only some of the major NEB assumptions with respect to electricity projects and provincial renewables investments, and does not include federal and other programs after January 1, 2006 (e.g. building retrofit programs, incandescent light phase-out, fuel efficiency regulations)
 - The “All NEB programs” case includes the full range of NEB assumptions, and incorporates all federal and provincial government programs as of February, 2009 (but not federal and provincial industrial regulations, with the exception of Alberta's) as well as additional major electricity and renewables assumptions to those noted above:
 - 1,000 Mw nuclear facility in Alberta
 - Biomass expansion in Ontario
 - 1,800 Mw of additional wind

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Under the updated baselines, and under the reference and high oil prices, total greenhouse gas emissions range from a low of 750 Mt to a high of 855 Mt in 2020

Canadian Greenhouse Gas Emissions



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2020 reductions required to meet the 20% target below 2006 (i.e. 575 Mt) range from a low of 177 Mt to a high of 279 Mt, depending on which updated baseline is chosen

Scenarios	Forecast Emissions in 2020 Mt	Reductions Required in 2020 to meet the 20% Target Mt
June 2008	910	331
Reference Case (with Reference Oil Price)	854	279
All NEB Programs (Reference Oil Price)	759	184
Reference Case (with High Oil Price)	837	262
All NEB Programs (High Oil Price)	751	177

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Electricity generation is greener under the “All NEB Programs Cases”

	Reference Case (Reference Oil Price)			All NEB Programs (Reference Oil Price)		% Share of Total Generation	
	2007 GWh	2010 GWh	2020 GWh	2010 GWh	2020 GWh	Reference Case	All NEB Programs
Hydro	360047	364905	394451	359687	378920	51.7%	55.5%
Uranium	92924	97745	108683	97590	107357	14.2%	15.7%
Renewables (Biomass, Wind, etc)	20279	26594	58679	26946	66080	7.7%	9.7%
Natural Gas	42466	49773	130471	48530	79035	17.1%	11.6%
Refined Petroleum Products	16065	14494	16522	11209	11141	2.2%	1.6%
Coal	97319	80383	54140	72287	39965	7.1%	5.9%
Total	629100	633893	762946	616249	682499	100.0%	100.0%

- Under the “All NEB Programs Cases” some 81% of electricity generation in 2020 is from non-emitting sources. Under the Reference case, it is some 73%.
- In both cases, there is a very significant growth in renewables and natural gas generation, while the “All NEB Programs” case has much less reliance on oil and coal, and about 11% lower overall electricity generation by 2020.

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Under the “All NEB Programs Case”, the assumed implementation of additional federal and provincial programs is projected to significantly reduce emissions in all sectors relative to the Reference Case

	2010		2015		2020		% Change 2010 to 2020	
	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt
Residential	44.9	43.3	46.7	42.6	48.2	40.7	7.3%	-6.0%
Commercial	39.9	36.8	46.9	37.9	55.0	39.1	37.8%	6.0%
Transportation	171.4	162.8	182.6	164.8	188.8	164.0	10.2%	0.7%
Industrial: Non-Regulated	40.1	43.1	46.7	52.3	50.9	56.7	26.9%	31.6%
Industrial: Regulated	340.5	329.0	380.2	351.1	387.8	336.6	13.9%	2.3%
Agriculture, Wastes & Others	96.2	96.0	110.9	110.1	123.2	121.5	28.1%	26.7%
Total	732.9	710.9	814.0	758.8	853.9	758.5	16.5%	6.7%

- Under the “All NEB Programs Case, the implementation of stringent energy efficiency programs and standards has a dramatic impact on emissions in end-use sectors such as residential, commercial and transportation.
 - Lower demand from these policies have an indirect impact on emissions from electricity generation sector.
 - The aggressive policy also impact the electricity mix
- Emissions from the non-regulated sector grows more rapidly in the “All NEB Programs Case” as industries which provide “greener” products are more positively impacted
- The NEB is currently review their assumptions and have indicated that they will be made less stringent

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Greenhouse gas emissions for the regulated sectors under the “All NEB Programs Case” are some 13% lower than those under the Reference Case

	2010		2015		2020		% Change 2010 to 2020	
	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt	Reference Case Mt	All NEB Programs Mt
Pipelines	14.6	14.5	14.6	14.4	14.0	13.6	-3.9%	-6.3%
Pulp and Paper	5.0	5.0	4.5	4.5	3.8	3.7	-23.0%	-26.3%
Chemical	9.7	9.7	14.6	14.1	16.9	15.8	73.8%	63.2%
Petroleum Refining	26.9	26.7	33.5	32.2	32.1	30.2	19.4%	12.9%
Cement, Lime & Gypsum	13.6	13.8	14.7	15.2	15.7	16.2	15.3%	17.0%
Iron and Steel	12.4	12.4	14.7	14.7	15.3	15.0	23.5%	21.0%
Aluminum and Smelting	12.2	12.2	16.3	16.1	17.3	16.6	41.4%	36.5%
Iron Ore, Potash and Other Mining	4.4	4.8	4.3	5.1	4.2	5.0	-4.6%	3.9%
Conventional Oil and Gas	78.5	78.3	77.0	75.8	73.4	71.0	-6.4%	-9.3%
Electricity Generation	110.8	99.9	114.5	90.9	113.7	74.8	2.6%	-25.1%
Oil Sands	52.3	51.7	71.3	68.2	81.4	74.8	55.6%	44.7%
Total: Regulated Industries	340.5	329.0	380.2	351.1	387.8	336.6	13.9%	2.3%

- Under the “All NEB Programs Case”, the biggest change by 2020 is in the electricity generation sector, driven by a higher share of non-emitting generation combined with some 14% lower overall electricity demand under the “All NEB Programs” case

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Sensitivity Analysis – Rules of Thumb

Change in emissions from Selected Actions	
Action	Change in Emissions
One percentage point change in GDP	0.5 percentage point (or 4 Mt) change in aggregate emissions ¹
20 dollar change in price of oil	1.7 (or 14 Mt) change in emissions ¹
Addition of 700 MW nuclear power plant	1.4 Mt (if displaces natural gas-fired) to 4.4 Mt (if displaces coal-fired generation)
Addition of 100 MW wind farm	0.6 Mt (if displaces natural gas-fired) to 1.4 Mt (if displaces coal-fired generation)
Carbon capture and storage on a 450 MW coal-fired unit	2.4 Mt if assume 85% capture
Improving fuel economy of a passenger vehicle by 25%	1 tonne
Improving the energy intensity of an average house by 25%	1.5 tonnes if natural gas is the main fuel source

¹ These indicators are sensitive to a variety of assumptions, and will vary depending on the particular drivers of economic change and the set of assumed government policy decisions affecting energy supply and demand