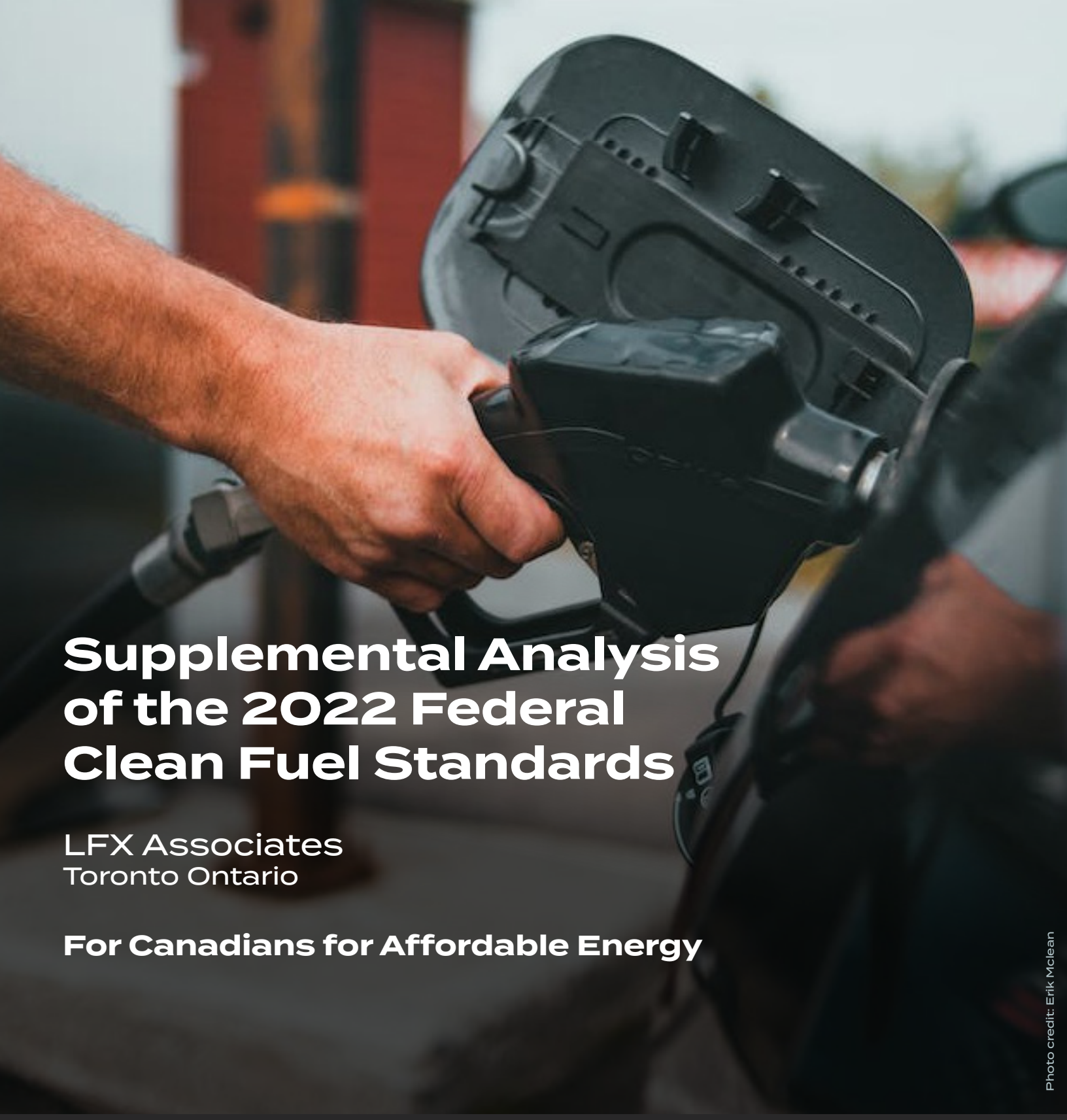

Supplemental Analysis of the 2022 Federal Clean Fuel Standards

LFX Associates
Toronto Ontario

For Canadians for Affordable Energy

Photo credit: Erik Mclean

LFX ASSOCIATES

Lead Author: **Ross McKitrick**
January 3, 2023

LFXassociates.ca

Executive Summary

This report provides an analysis of the economic consequences of the federal Clean Fuels Standard supplemental to that provided in McKitrick (2022a). The economic model used for that analysis was calibrated to Statistics Canada Input-Output tables that preceded the closure of the Come-By-Chance refinery in Newfoundland, so the present analysis takes into account that change in refining capacity. Additionally the model was revised to take account of new empirical information on the elasticity of substitution between conventional cars and electric vehicles. This note focuses on the "capped" scenario from McKitrick (2022a) in which sufficient alternative compliance options are available so that the costs of the policy remain below $275 per tonne of greenhouse gases reduced.

In general the results are very similar to those reported in McKitrick (2022a), with slightly higher economic costs found for the province of Newfoundland.

1. Introduction

This note presents an economic assessment of the likely economic consequences of the Clean Fuels Standard (CFS) as announced in the Canada Gazette Volume 156 Number 14, Wednesday July 6, 2022.[1] The core of the regulation is a requirement to reduce the carbon intensity of liquid fuels used in transportation according to the following schedule:

Year	Gasoline	Diesel	Fuel Avg.	Average Ratio
2022	95.0	93.0	94.0	1.0000
2023	91.5	89.5	90.5	0.9628
2024	90.0	88.0	89.0	0.9468
2025	88.5	86.5	87.5	0.9309
2026	87.0	85.0	86.0	0.9149
2027	85.5	83.5	84.5	0.8989
2028	84.0	82.0	83.0	0.8830
2029	82.5	80.5	81.5	0.867
2030	81.0	79.0	80.0	0.8511

The columns labeled Gasoline and Diesel show the maximum allowed carbon intensity measured as grams of carbon dioxide equivalent (herein "CO2e") per megajoule of energy, herein denoted gCO2e / MJ. According to the regulation Section 5(5) the assumed baseline amounts are 95.0 and 93.0 gCO2e/MJ as shown in the entry for the year 2022. The prescribed caps begin in 2023 and decline through to 2030. The unweighted average of gasoline and diesel is shown in the "Fuel Avg" column. The final column, denoted "Average Ratio", shows the Fuel Average as a fraction of the baseline 2022 amount. As shown, the regulation requires carbon intensity in 2030 to be just over 85 percent of the level in 2022, thus yielding approximately a 15 percent reduction. According to the Government's Regulatory Impact Assessment (RIA), the regulation is expected to result in an overall greenhouse gas (GHG) emission reduction over the decade of between 151 and 267 megatonnes of CO2e with a central estimate of 205 Mt CO2e.

Previous criticisms of the CFS approach were presented in McKitrick (2022a).

[1]Available at https://www.canadagazette.gc.ca/rp-pr/p2/2022/2022-07-06/pdf/g2-15614.pdf.

2. The Modeling Framework

The analysis uses the LFX Canadian Model version 5.0, for which a detailed description is available in McKitrick (2022b).

The core of the model is an array of provincial input-output tables that resolve intermediate and final demand across 26 economic sectors, with special focus on energy sector detail that allows tracking of CO2 and methane emission sources. Input-output coefficients are determined each period based on current prices. Within each sector the model tracks tax and subsidy payments, labour and capital demands, returns to investors and final output. The model employs recursive dynamics in which investment (fixed capital formation) responds to the market returns to existing capital. Households earn income from supplying labour and capital and provide net savings to fund capital investment and government borrowing. Markets for all intermediate and final goods clear using the Leontief equation (a standard national accounting identity) while markets for labour and capital clear using a price search algorithm. A search algorithm also selects an interest rate to clear the market for savings and borrowing, and an exchange rate to balance the current and capital accounts.

Regulatory policies are represented in the model using efficiency loss parameters that measure the increase in marginal operating costs associated with regulations, that do not accrue elsewhere as additional revenue. These are called regulatory rents. Where the regulation yields an improvement in, for example, GHG emission intensity, this is reflected in the GHG accounts. The CFS standard increases the marginal cost of producing fuels in Canada, and reduces the GHG emissions per unit of fuel consumption. The projected change in the cost of fuel production is explained in Section 9 of McKitrick (2022b).

The revisions to the model compared to that used for McKitrick (2022a) are as follows.

- The Come-By-Chance (CBC) refinery in Newfoundland is assumed to be closed permanently. Previously the LFX model was calibrated to editions of the Statistics Canada Input-Output tables in which the CBC refinery was still operating. While there are plans to convert the refinery to a biofuels plant, this work is only in the planning stages. The LFX model automatically redirects some spending from refined fuels into biofuels production so no revision to the model was needed to take account of the fact that production at CBC may displace some elsewhere.
- The electric vehicle (EV) sales mandate is now handled somewhat differently in the model than before. The phase-in schedule remains the same. Previously it was assumed that the cost of buying vehicles would rise due to the mandate to purchase costlier EV's, and this would be costly to consumers but not beneficial to automakers because they are currently losing money on EV units. However, automakers will need to increase the selling price of conventional cars in order to induce substitution towards EVs, and this implies there will be windfall rents earned on conventional cars during the transition. These windfall earnings for automakers are now taken into account using cross-price elasticity estimates in Hosamaldin (2021). Specifically, the market share elasticity of EVs with respect to price was estimated to be 0.9, so the percent change in EV market share is equal to 0.9 times the percent change in the price of gasoline cars. This in turn implies that to achieve an x percent increase in the EV market share requires an increase in the price of gasoline cars equal to x/0.9.

The model otherwise remains the same. Note that since the EV policy is the same in both the base case and the policy experiment runs the new EV mandate representation is not expected to have a large effect.

3. Costs of Compliance with Credit Prices Capped at $275 per tonne

The macroeconomic impacts of the CFS are summarized in the following nine charts. Each one compares the outcome under the CFS as described relative to the base case (which includes the carbon tax).

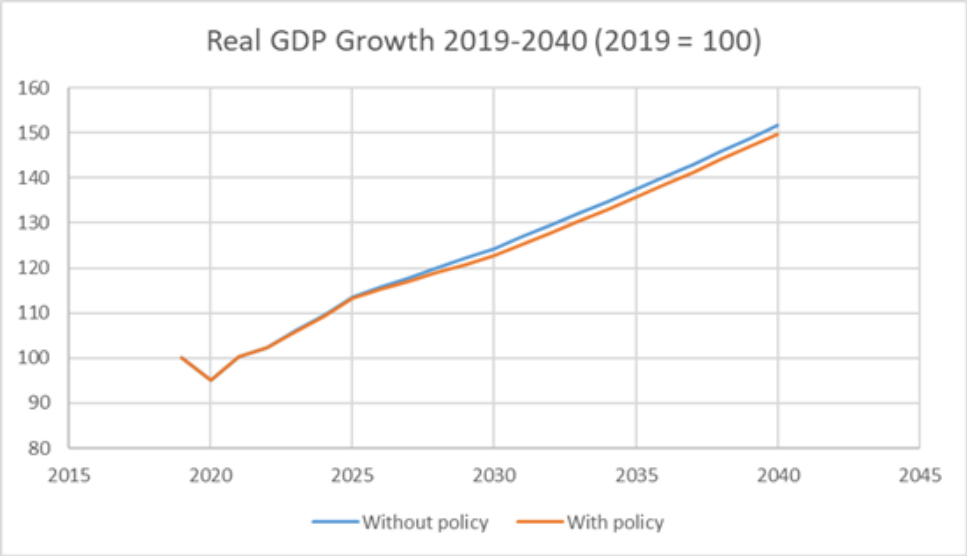

Figure 2: GDP growth 2019 to 2040 under the CFS, capped credit cost option.

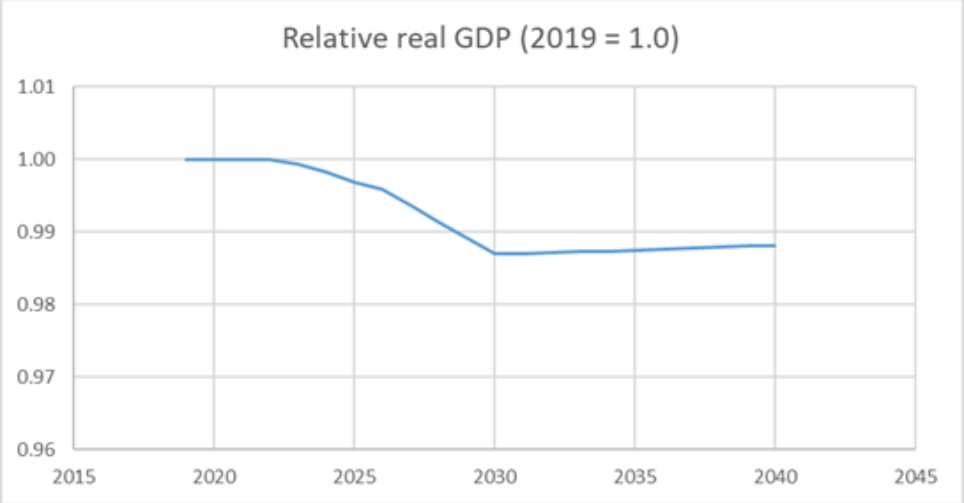

Figure 3: Real Gross Domestic Product as a fraction of the base case.

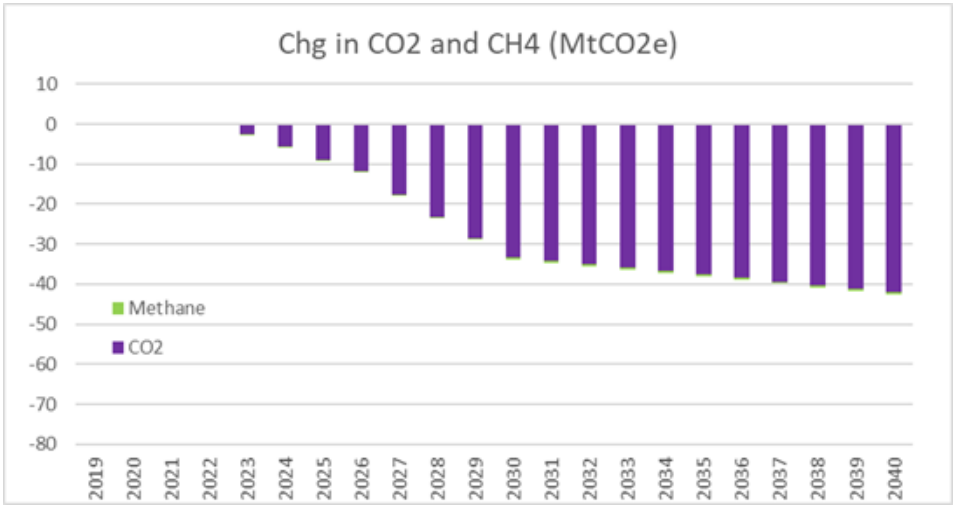

Figure 4: Change in GHG emissions compared to the base case.

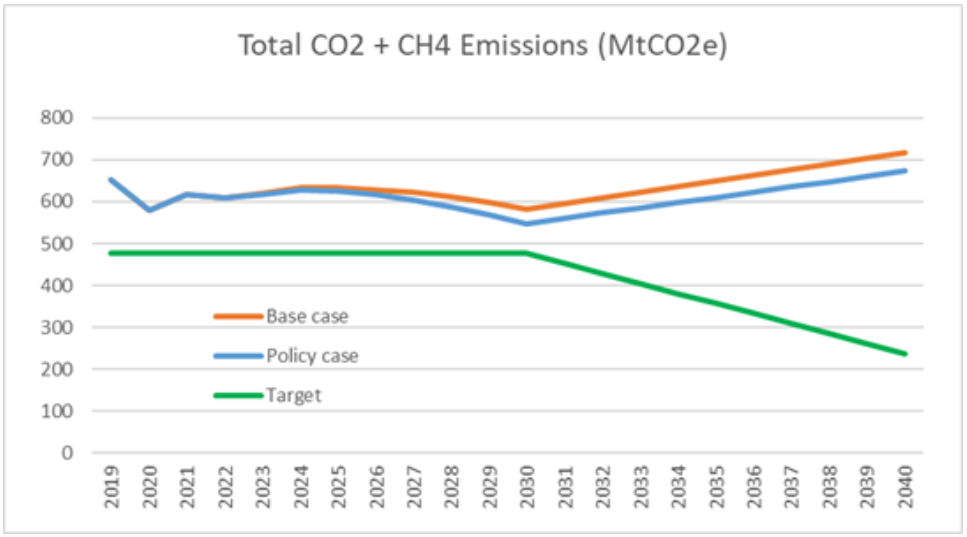

Figure 5: GHG Emissions under base case and policy case (with CFS) compared to Paris/Net Zero target.

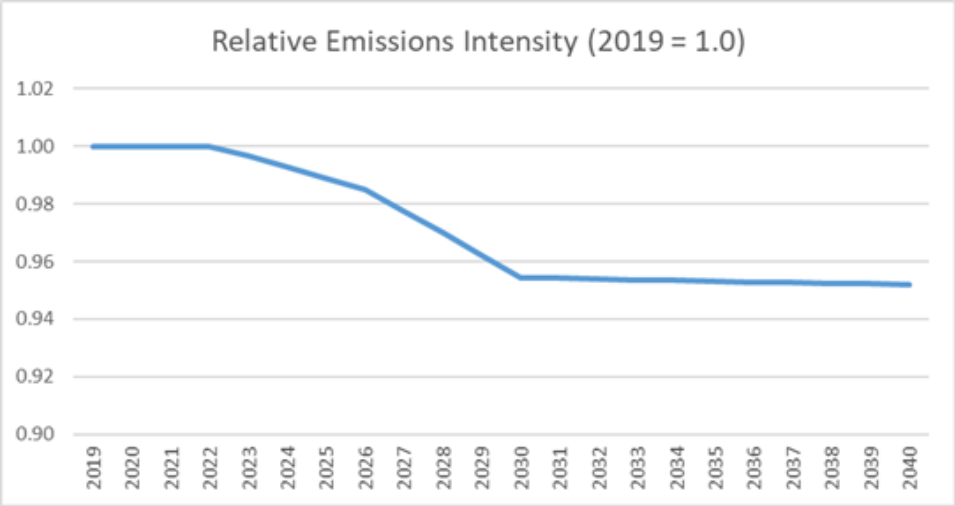

Figure 6: Emissions intensity (GHG/GDP) under the CFS as a fraction of the base case.

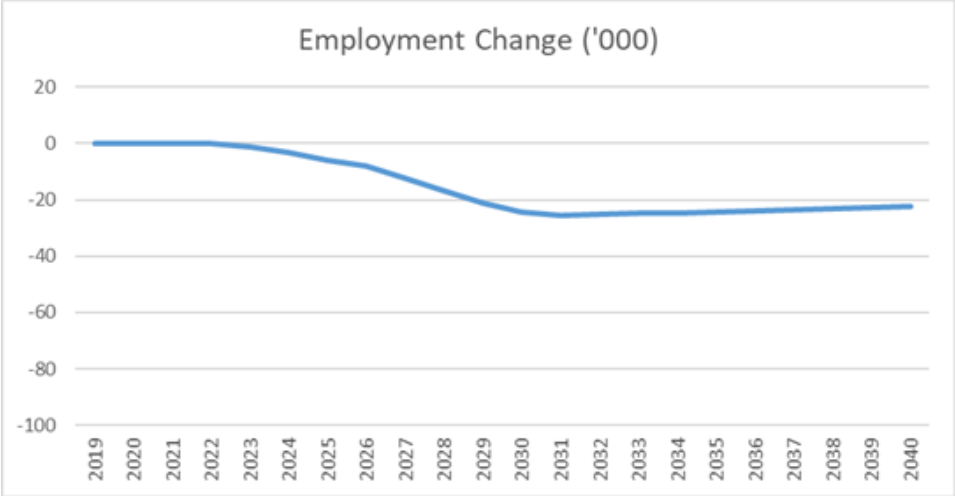

Figure 7: Change in equilibrium employment (thousand jobs) compared to base case.

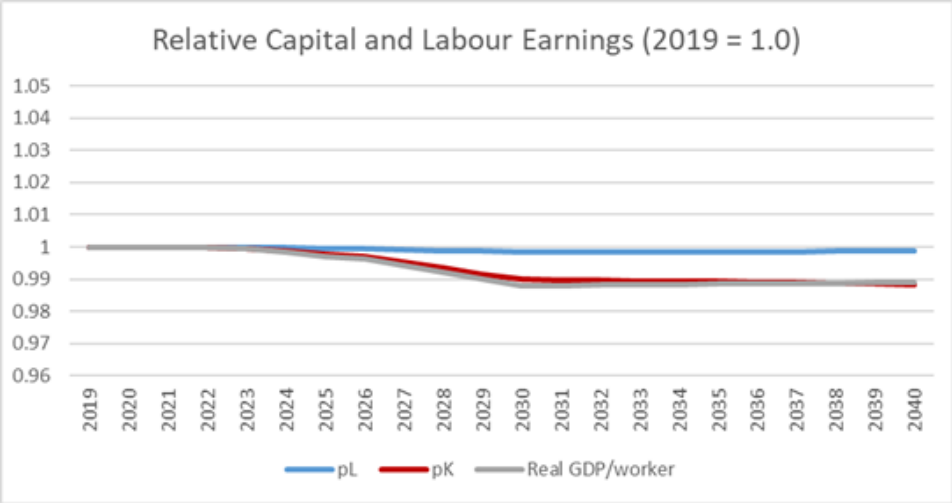

Figure 8: Prices of labour and capital (pL, pK respectively) and Real GDP/ worker as a fraction of the base case.

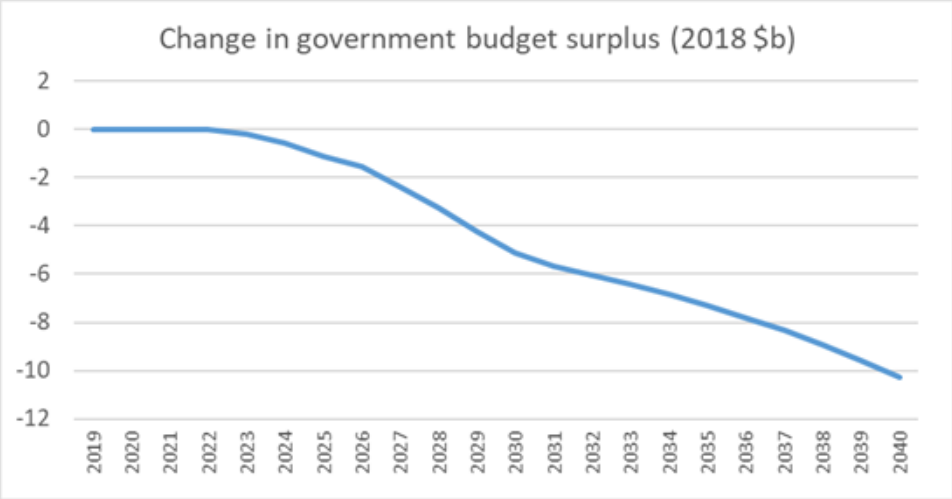

Figure 9: Effect on Consolidated Government Budget Surplus under policy case.

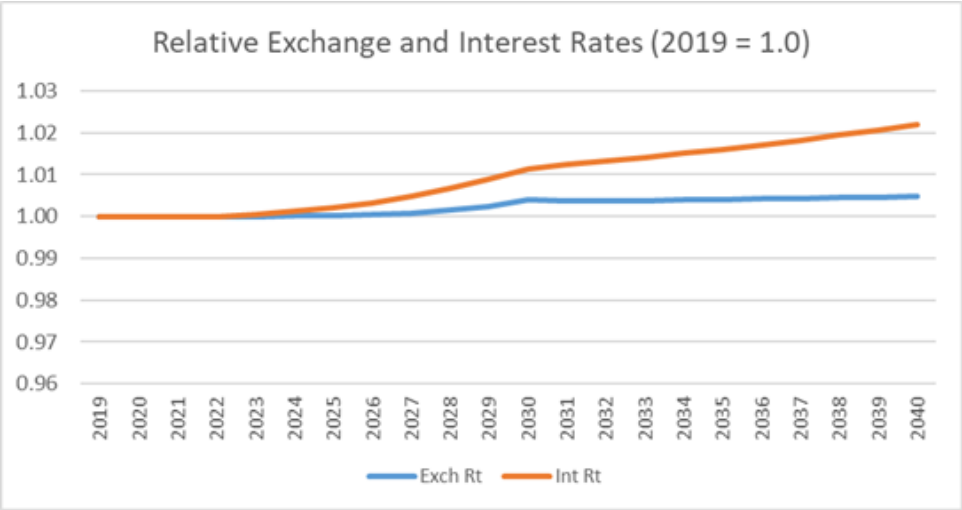

Figure 10: Exchange rate and interest rate as fractions of base case.

As shown in Figures 2 and 3, real GDP grows but more slowly than under the base case, opening up a gap of 1.3 percent as of 2030. In absolute terms, instead of the economy growing by 23.9 percent between 2019 and 2030 it only grows by 22.3 percent. GHG emissions fall by 34 Mt CO2e (Figure 4). As shown in Figure 5 this, combined with the carbon pricing system, brings the economy within about 71 Mte of the Paris target as of 2030, but with continued growth of the population and economy in the 2030s the emissions path diverges from the Net Zero target and later in the decade returns to current levels. Emissions intensity of GDP declines by 4.6 percent by 2030 and the gap stays approximately constant thereafter (Figure 6).

Figure 7 shows that total employment in the Canadian economy declines by about 24,000 jobs against the base case as of 2030, which is 0.1 percent of the projected work force. Note that this is an equilibrium estimate, meaning it represents the change after unemployment has cleared from the job market. Also note that this assumes the Government expands employment by nearly 11,000 workers as of 2030 in response to changing labour market conditions due to the policy. Over the 2020s the employment loss (even after expanding government employment) totals almost 93,000 person-years. Employment begins to recover very slowly in the 2030s and by 2040 is still about 22,000 below the base case. Figure 8 shows that factor markets clear primarily through a drop in the price of capital rather than labour. Coupled with this, real fixed capital investment falls by 1.0 percent, a much larger adjustment than the reduction in employment. Returns to capital also fall resulting in a drop in GDP per worker of 1.2 percent as of 2030, with no recovery thereafter.

Figure 9 shows that the policy causes the consolidated (provincial plus federal) government budget deficit to increase by about $5 billion as of 2030 and by about $10 billion as of 2040 with a total accumulated debt increment of $95.6 billion by 2040. The modeled scenario does not impose the requirement of a balanced budget or a constant surplus (or deficit). Consequently the macroeconomic effects include an expansionary fiscal position of the government sector. One consequence is that interest rates rise slightly. Figure 10 shows that the real interest rate rises by a factor of about 1.01 as of the early 2030s compared to the base case. This does not mean that rates go up by 101 basis points, instead it means that the interest rate in 2030 would be 1.01× the rate that otherwise would have been

observed. The exchange rate goes up very sightly, less than one percent. Since this is the price of purchasing foreign exchange it represents a depreciation of the currency, not an appreciation.

Tables 2 to 5 provide further detail on the economic effects. Table 2 presents percent changes in 2030 compared to the base case by province in GDP, Employment, GDP per worker and GHG Emissions, as well as compliance costs in $b nationally and by province. GDP losses vary widely by province, peaking at 2.9 percent in Newfoundland followed by 2.1 percent in New Brunswick, and 1.5 percent in Alberta and Saskatchewan.

Region	GDP	Employment	GDP/worker	GHG Emissions	Direct Compliance Costs ($b)
Canada	-1.3	-0.1	-1.2	-5.8	9.2
British Columbia	-0.9	0.0	-0.9	-5.2	0.2
Alberta	-1.5	-0.3	-1.2	-4.2	2.5
Saskatchewan	-1.5	-0.4	-1.1	-4.7	0.7
Manitoba	-0.7	-0.1	-0.7	-5.9	0.0
Ontario	-1.1	0.0	-1.1	-6.2	2.1
Quebec	-1.2	-0.1	-1.1	-5.7	1.9
New Brunswick	-2.1	-0.7	-1.5	-11.8	1.2
Nova Scotia	-1.1	-0.1	-0.9	-7.6	0.0
PEI	-1.3	2.3	-3.5	-9.8	0.0
Newfoundland	-2.9	-0.8	-2.2	-6.8	0.5

Table 2. Cols 1—4: Percentage changes by province in major macroeconomic indicators at 2030. Col 5: Direct cost of complying with regulation ($b). Total may not add due to rounding.

Employment losses also vary by province and indeed some provinces experience no net change or, in the case of PEI, a gain, due to reductions in the costs of hiring workers necessary to clear the labour market elsewhere. (Although note that PEI moves to a net employment loss the following year.) The drop in real income per worker is highest in PEI at 3.5 percent. This measure takes into account losses in both labour and capital earnings. Newfoundland also experiences a large drop (2.2 percent) followed by New Brunswick (1.4 percent) and Ontario and Alberta (1.2 percent). Total compliance costs nationally (in the form of regulatory rents which do not accrue anywhere else as income) are $9.2 billion.

Region	Consumption	Imports	Exports
Canada	-0.7	0.2	0.7
British Columbia	-0.4	0.2	0.7
Alberta	-1.1	0.0	1.2
Saskatchewan	-1.2	0.1	1.6
Manitoba	-0.6	0.2	0.0
Ontario	-0.5	0.3	0.5
Quebec	-0.7	0.3	0.8
New Brunswick	-1.2	0.1	2.8
Nova Scotia	-0.8	0.2	0.2
PEI	-1.0	0.5	0.1
Newfoundland	-2.6	0.0	2.4

Table 3: Percentage changes against base case (2030) by province in real household consumption, nominal imports and nominal exports.

Table 3 provides further detail on the economic costs. Real consumption per household drops by 0.7 percent nationally with the largest drop in Newfoundland, followed by Saskatchewan and New Brunswick then Alberta and PEI. Both imports and exports rise in most provinces. Increases in imports are relatively largest in provinces that need to import substitutes for petroleum, chiefly in the form of ethanol.

Table 4 provides sectoral detail on output, labour demand and capital demand at the national level. Output in the Refined Fuels sector drops by 5.6 percent. Other sectors experiencing large output reductions are Air, Rail and Bus Transportation and Trucking, Courier and Storage, both of which are major users of transport fuels. Labour and capital demands do not merely follow output changes. Some sectors respond by making changes in employment that are relatively large compared to changes in output, such as Construction and Wholesale and Retail Sales and Entertainment. These results arise in the model based on the historic patterns of adjusting labour demand and returns to capital in response to market conditions.

Sector (Canada-wide)	Output (%)	Labour Demand ('000)	Capital Demand (%)
Agriculture, Fishing and Trapping	-0.7	0.1	0.3
Forestry and Logging	-0.5	0.7	1.6
Oil Sands	0.0	0.1	0.4
Conventional Crude Oil	-0.2	-0.3	0.2
Natural Gas	-1.3	-0.6	-0.4
Oil and Gas Support Activities	-0.7	-0.2	0.0
Coal	-0.2	0.0	0.7
Other Mining	-0.4	0.7	0.4
Electricity	-1.1	-1.5	-0.8
Other Utilities incl. Gas Distribution	-1.4	-0.6	-0.9
Construction	-1.0	-5.5	-0.5
Food Production	-0.5	-0.9	0.0
Semi-durables	-0.4	-0.4	0.1
Refined Fuels	-5.6	-0.9	-4.6
Other Petrochemicals	-0.1	-0.1	0.2
Cement and Concrete	-0.9	-0.1	-0.3
Automotive Parts and Assembly	-0.4	-1.0	-0.1
Other Manufacturing	-0.5	-3.8	0.0
Wholesale and Retail Sales	-0.6	-7.6	-0.1
Air, Rail & Bus Transportation	-2.4	-1.8	-0.1
Gas Pipelines	-0.2	0.0	0.1
Crude Pipelines	-0.7	0.0	-0.3
Trucking, Courier and Storage	-1.8	-1.4	-0.2
Media, Banking, Finance, IT, Other Prof Svc	-0.4	-5.5	0.0
Education & Health	-0.2	1.6	0.3
Entertainment & Misc	-0.7	-6.0	-0.1
Government		10.6	

Table 4: Changes in key economic indicators by sector as of 2030. Output and Capital demand: Changes are in % terms. Labour demand: thousand workers.

Finally Table 5 presents some key national summary indicators of the consequences of the CFS policy. Direct regulatory compliance costs nationally are $9.2 billion or $412 per employed person. Total policy costs, taking into account regulatory rents and income declines, are $1,287 per employed person in 2030. Regulatory costs per tonne of emission reduction are $272, well above the federal RIA estimate of $151 per tonne (RIA p. 25). Since this is much larger than even the largest Social Cost of Carbon estimates in the mainstream literature (including the outliers relied upon by the RIA for its strained justification of the policy) the CFS fails a cost-benefit test. The final entry in Table 4 shows that, on average, by 2030, Canadian private sector firms will be earning 1.8 percent less on invested capital compared to sector-specific historical average returns. This indicates that the CFS policy will drive capital investment out of the country.

National Indicator	
Total Regulatory Compliance Costs	$9.2b
Direct regulatory costs per employed person (2018$)	$412
Total costs per employed person incl. income losses	$1,287
Regulatory Costs per tonne GHG reduced	$274
Capital returns relative to average	-1.8%

Table 5: National compliance cost indicators (2030).

4. Conclusion

The CFS as announced by the federal government will have long-lasting negative economic consequences. While it will reduce GHG emissions, likely by more than the federal government estimates, even on the assumption that generous credit creation will be permitted at a capped value of $275 per tonne, the policy will impose total economic costs of $1,287 per employed person in combined direct compliance costs and indirect income losses, and by 2030 the Canadian economy will be about 1.3 percent smaller than it otherwise would have been. The Government's Regulatory Impact Analysis ignores many important categories of cost, overstates the value of emission reductions and is wrong to assert that the policy passes a cost-benefit test. In reality it will reduce incomes, drive down the rate of return to investment in Canada and further dampen growth prospects. Since most of the ethanol used for compliance will be imported from the United States where its carbon intensity exceeds that of gasoline, the net international effect is likely to be an increase in GHG emissions. While the ethanol sector (and alternative fuels generally) will benefit from the rule, the economy overall will experience notable losses. Provinces that depend heavily on the oil and gas refining sector, such as New Brunswick and Newfoundland, are particularly at risk.

5. About the Author

Ross McKitrick holds a Ph.D. in economics from the University of British Columbia (1996) and is Professor of Economics at the University of Guelph in Guelph, Ontario. He is the author of Economic Analysis of Environmental Policy published by the University of Toronto Press in 2010. He has been actively studying climate change, climate policy and environmental economics since the mid-1990s. He built and published one of the first national-scale Computable General Equilibrium models for analysing the effect of carbon taxes on the Canadian economy in the 1990s. His academic research publications have appeared the Journal of Environmental Economics and Management, The Canadian Journal of Economics, Canadian Public Policy, Journal of the Royal Statistical Society, Energy Economics, Journal of Forecasting, Climatic Change, Climate Change Economics, Proceedings of the National Academy of Science, Journal of Geophysical Research, Climate Dynamics, Environmental Economics and Policy Studies, and many other highly-ranked outlets. Professor McKitrick has served as an expert reviewer for both Working Groups I and II of the Intergovernmental Panel on Climate Change for the past three Assessment Reports. He has also written policy analyses for the Fraser Institute (where he is a Senior Fellow), the CD Howe Institute, the University of Calgary School of Public Policy and other Canadian and international think tanks. Professor McKitrick appears frequently in Canadian and international media and is a regular contributor to the Financial Post comment page. His writings and other outputs are available at rossmckitrick.com.

LFX Associates (lfxassociates.ca) provides economic and policy analysis for Canadian clients with a focus on energy and industrial sectors.

6. References

Government of Canada (2022) Regulatory Impact Analysis, Clean Fuel Regulations. (Unofficial Version). Online at https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/clean-fuel/regulations/CFR_CG_II_RIAS_Unofficial_Version_EN_2022-06.pdf Accessed: July 13, 2022.

Hosamaldin, Aya and Simon Olofsson (2021) "Cross-price elasticities of demand on electric vehicles, by prices and taxes of gasoline vehicles." University of Gothenberg Bachelors Thesis, Department of Economics.

McKitrick, Ross (2022a) Economic Analysis of the 2022 Federal Clean Fuels Standard. August 2022, LFX Associates, Toronto. Available online at https://www.lfxassociates.ca/publications.html

McKitrick, Ross (2022b) "Detailed Description of the LFX-CM5 Model" July 2022, LFX Associates. Available online at https://www.lfxassociates.ca/publications.html