Air Quality Health Co-benefits of CO_2 Reductions in Various Decarbonization Pathways

Marjan Soltanzadeh
Amir Hakami

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Synopsis

- We use reverse influence modelling tools within the U.S. EPA's Community Multiscale Air Quality (CMAQ) model to attribute national mortality counts associated with chronic exposure to particulate matter air pollution to various sources at different locations and of different types. By monetizing attributed source impacts, and combining them with sectoral criteria air contaminants and carbon dioxide emission profiles, we derive sectoral and location-specific co-benefits. Better regarded as combustion-based health co-benefits, these estimates are provincially aggregated and applied to scenario-based CO_2 emission projections under various decarbonization pathways until 2050.

Introduction - I

- Co-benefits due to reduced emissions of criteria pollutants (or their precursors): reduced health impacts due to improved air quality when combustion does not take place.
  - Air pollution impact on human health ($PM_{2.5}$); only chronic exposure mortality is considered (Crouse et al., 2012).
    - Mortality accounts for more than 95% of valuated air pollution health impacts in Canada (HC, 2019), with morbidity (i.e., non-fatal) outcomes making up the balance.
    - $PM_{2.5}$ accounts for more than 2/3 of air pollution health impacts (HC, 2019)
  - Only applicable to combustion-based CO_2 emissions, and not other greenhouse gases.
  - Impact estimated through pathways that result in reduced primary (e.g., elemental and organic carbon) and precursor (SO_2, NH_3, NO_X) emissions.

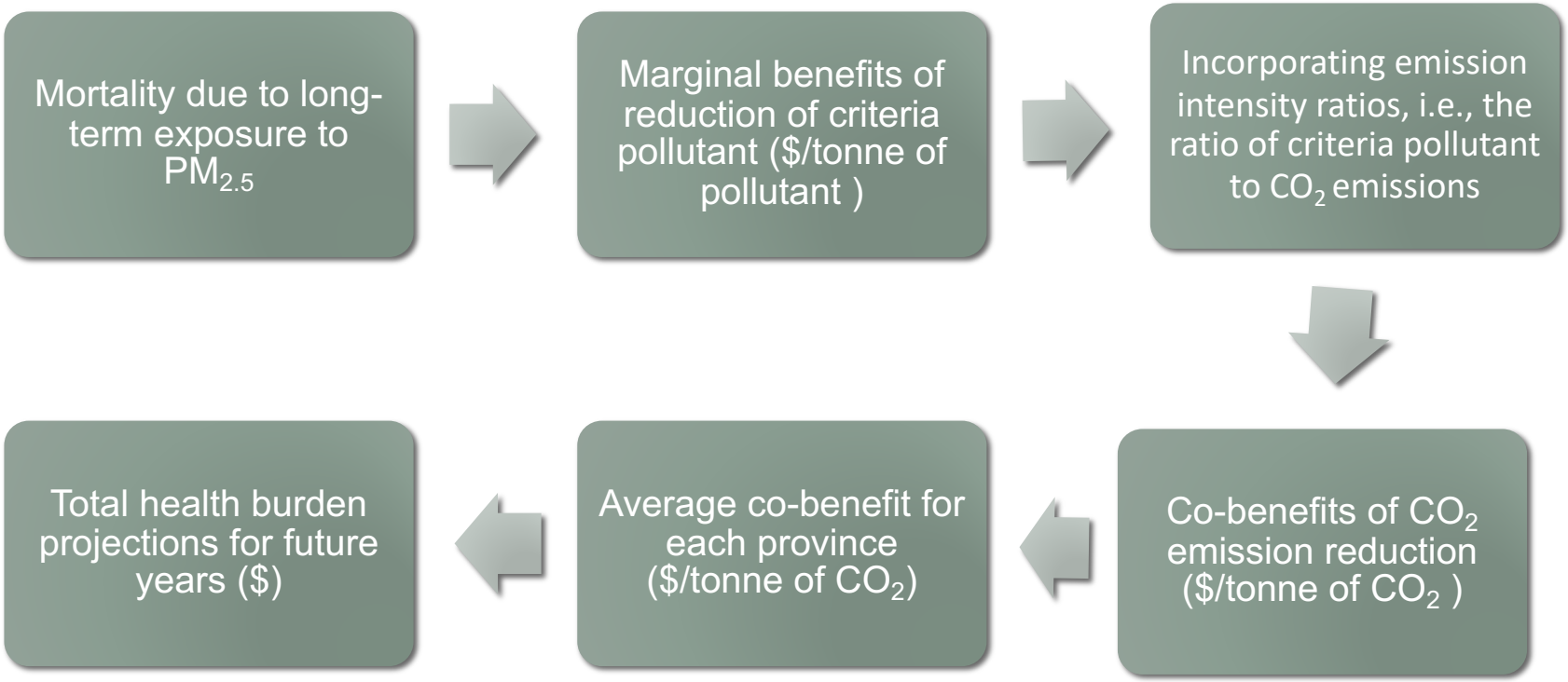
Introduction - II

- CO_2 reduction co-benefits through various decarbonization scenarios.
  - Sectoral and provincial projections of CO_2 emissions
  - Sectoral and provincial projections of air quality benefits of emission reductions.
    - When driven by combustion, Direct Air Capture (DAC) emissions have health impacts leading to negative co-benefits (i.e., increased health impact coinciding with reduced CO_2 emissions).
    - Absent conclusive literature, biofuel emissions are assumed have the same air pollution emissions as fossil fuels.

- Not considering interactions between climate and air quality
  - The impact of short-lived climate forcers (SLCFs) on climate not considered.
  - The impact of a changing climate (rising temperature, impact on energy, vegetation, etc) on air quality not considered.

Methodology

Reverse, adjoint, or backward influence modelling.



Methodology

$$\frac{\$}{E_{CO2}} = \frac{\$}{E_{CAC}} \times \frac{E_{CAC}}{E_{CO2}}$$

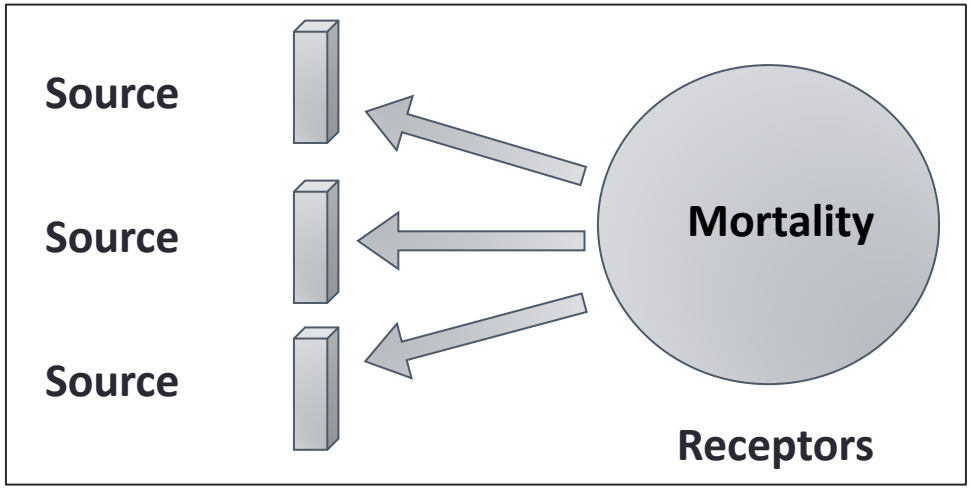
Co-benefit ($/tonne of CO_2)

Marginal benefit of criteria pollutant ($/tonne of pollutant)

Emission ratio of criteria pollutant to CO_2 at each location

*Zhao, Shunliu, et al. "A multiphase CMAQ version 5.0 adjoint." Geoscientific Model Development 13.7 (2020): 2925.

Marginal Benefit Estimation: Adjoint Model



- An adjoint model attributes valuated health outcomes to individual sources in Canada (Zhao et al., 2020).
  - Attributed impacts are marginal benefits (MBs) of each pollutant emission reduction ($/tonne-pollutant).
  - Resolution lost as MBs are aggregated to provincial averages.
    - CO2 projections only available at provincial level.

Marginal Benefit Estimation (cont'd)

- Influences on nationwide mortality are traced back to individual sources
- Adjoint version of the multiphase USEPA's Community Multiscale Air Quality (CMAQ) model.
- Continental domain with 36 km resolution with 34 vertical layers.
- The Concentration Response Function (CRF) for the adjoint cost function is based on $PM_{2.5}$ and chronic exposure mortality (Crouse et al., 2012).
- $PM_{2.5}$ marginal benefits based on adjoint simulations for 2016.
- The marginal benefits are calculated for NO_x, SO_2,$PM_{2.5}$ and NH_3.
- Intensity ratios for primary and precursor emissions (i.e., the ratio of criteria contaminant to CO2 emissions) are projected for various sectors based on historical trends.

*Crouse et al. (2012) examined the association between $PM_{2.5}$ derived from satellite observations and mortality during ten years of follow-up of a cohort of 2.1 million Canadians based on the 1991 long form census. Using a spatial random-effects Cox model including individual and ecological covariates and an urban/rural indicator, and accounting for spatial autocorrelation among cohort members, they reported a hazard ratio of 1.10 (95% CI 1.05- 1.15) per 10 $\mu g/m^3$ $PM_{2.5}$. This translates to a concentration response factor of 0.00953 with standard error 0.00232.

Major Sectors (ECCC classification)

- **Transportation mobile on-road heavy duty**
  - Heavy-duty Gasoline Vehicles
  - Heavy-duty Diesel Vehicle
- **Transportation mobile on-road light duty**
  - Light-duty Diesel Trucks
  - Light-duty Diesel Vehicle
  - Light-duty Gasoline Trucks
  - Light-duty Gasoline Vehicles
  - Light-duty LPG/NG Trucks
  - Light-duty LPG/NG Vehicles
- **Fossil-fuel- burning Electrical Generation Units (EGUs)**
  - Coal
  - Diesel
  - Natural Gas
- **Oil & Gas**

Criteria Contaminant Emissions Data

- **Transportation**
  - Criteria Pollutant Emissions:
    Canada's Air Pollutant Emissions Inventory
  - CO_2 Emissions
    Canada's Official Greenhouse Gas Inventory

- **EGUs**
  - Criteria Pollutant Emissions:
    National Pollutant Release Inventory Data Search
  - CO_2 Emissions: Greenhouse Gas Reporting Program (GHGRP) - Facility Greenhouse Gas (GHG) Data

RESULTS

Notes/Discussion – I

- Results shown are based on 2016 marginal benefit estimates, applied to 5-year CO_2 projections.
  - Marginal benefit estimates are aggregated to provincial averages based on total (rather than sectoral) emissions.

- In calculation of marginal benefits, ECCC CAC and CO_2 emission data is used. However, in projections to future year, CO_2 emissions are based on Navius modelling and and subsequent projections by Welburn Consulting.

Notes/Discussion – II

- Relying on provincial average co-benefits and emissions does entail added errors, particularly for sectors that have higher emissions and burdens in populated areas, e.g, transportation.

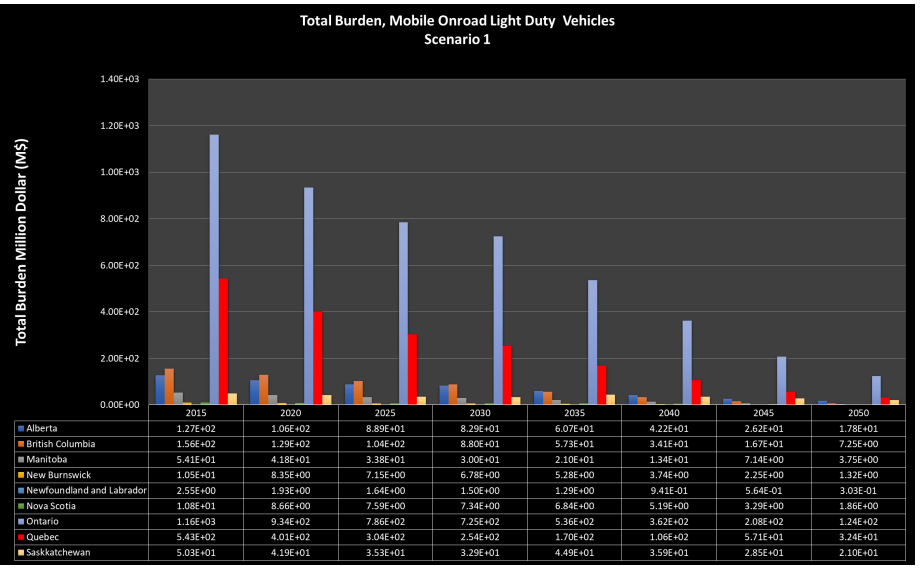
- The challenge in proper spatial representation in calculation of provincial average marginal benefits is that it requires spatially resolved sectoral information, which are not immediately available to us.

- It should be noted that provincial values are not health burden of air pollution in a province, but the national burden attributed to emissions from that province.

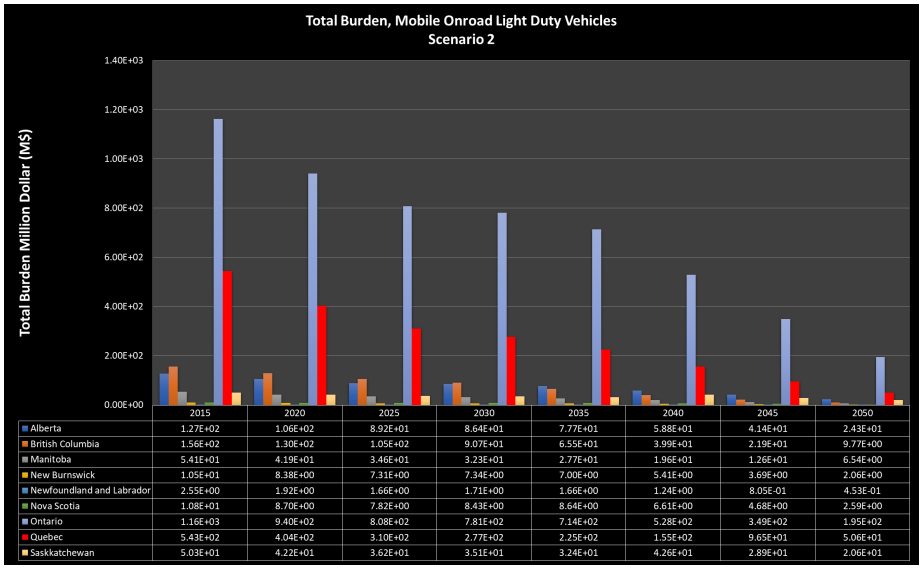
Transportation

Light Duty Vehicles (LDVs)

Total Burden ($M)



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+02	1.06E+02	8.89E+01	8.29E+01	6.07E+01	4.22E+01	2.62E+01	1.78E+01
British Columbia	1.56E+02	1.29E+02	1.04E+02	8.80E+01	5.73E+01	3.41E+01	1.67E+01	7.25E+00
Manitoba	5.41E+01	4.18E+01	3.38E+01	3.00E+01	2.10E+01	1.34E+01	7.14E+00	3.75E+00
New Burnswick	1.05E+01	8.35E+00	7.15E+00	6.78E+00	5.28E+00	3.74E+00	2.25E+00	1.32E+00
Newfoundland and Labrador	2.55E+00	1.93E+00	1.64E+00	1.50E+00	1.29E+00	9.41E-01	5.64E-01	3.03E-01
Nova Scotia	1.08E+01	8.66E+00	7.59E+00	7.34E+00	6.84E+00	5.19E+00	3.29E+00	1.86E+00
Ontario	1.16E+03	9.34E+02	7.86E+02	7.25E+02	5.36E+02	3.62E+02	2.08E+02	1.24E+02
Quebec	5.43E+02	4.01E+02	3.04E+02	2.54E+02	1.70E+02	1.06E+02	5.71E+01	3.24E+01
Saskkatchewan	5.03E+01	4.19E+01	3.53E+01	3.29E+01	4.49E+01	3.59E+01	2.85E+01	2.10E+01



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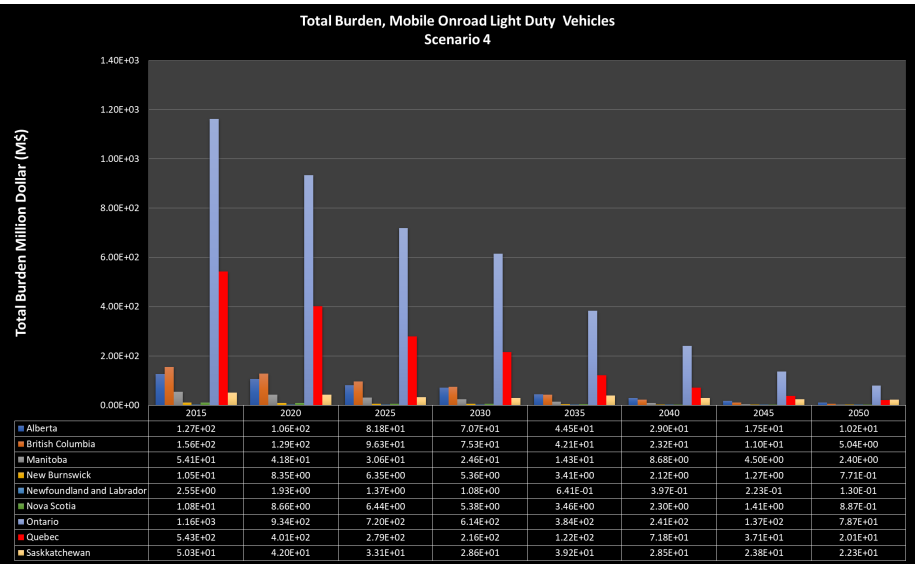
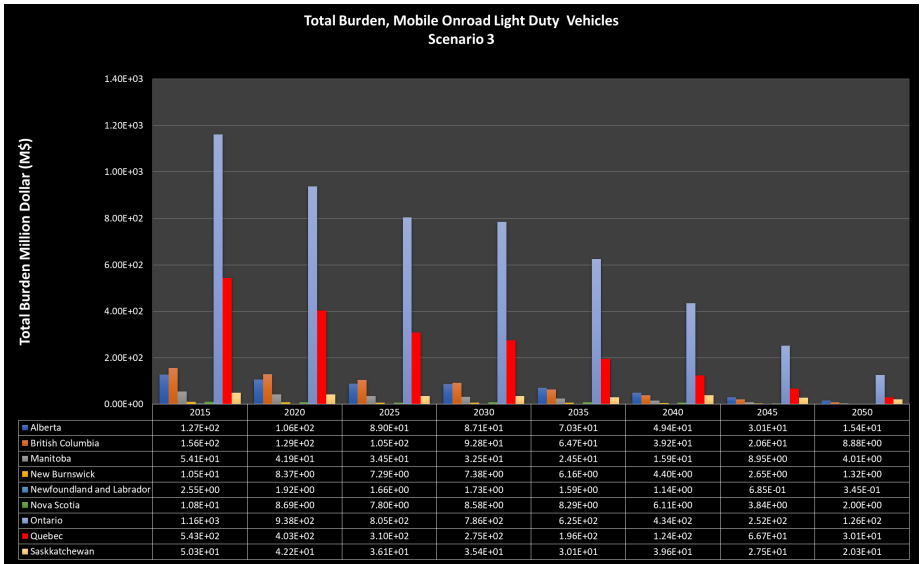
British Columbia	1.56E+02	1.30E+02	1.05E+02	9.07E+01	6.55E+01	3.99E+01	2.19E+01	9.77E+00
Manitoba	5.41E+01	4.19E+01	3.46E+01	3.23E+01	2.77E+01	1.96E+01	1.26E+01	6.54E+00
New Burnswick	1.05E+01	8.38E+00	7.31E+00	7.34E+00	7.00E+00	5.41E+00	3.69E+00	2.06E+00
Newfoundland and Labrador	2.55E+00	1.92E+00	1.66E+00	1.71E+00	1.66E+00	1.24E+00	8.05E-01	4.53E-01
Nova Scotia	1.08E+01	8.70E+00	7.82E+00	8.43E+00	8.64E+00	6.61E+00	4.68E+00	2.59E+00
Ontario	1.16E+03	9.40E+02	8.08E+02	7.81E+02	7.14E+02	5.28E+02	3.49E+02	1.95E+02
Quebec	5.43E+02	4.04E+02	3.10E+02	2.77E+02	2.25E+02	1.55E+02	9.65E+01	5.06E+01
Saskkatchewan	5.03E+01	4.22E+01	3.62E+01	3.51E+01	3.24E+01	4.26E+01	2.89E+01	2.06E+01



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+02	1.06E+02	8.18E+01	7.07E+01	4.45E+01	2.90E+01	1.75E+01	1.02E+01
British Columbia	1.56E+02	1.29E+02	9.63E+01	7.53E+01	4.21E+01	2.32E+01	1.10E+01	5.04E+00
Manitoba	5.41E+01	4.18E+01	3.06E+01	2.46E+01	1.43E+01	8.68E+00	4.50E+00	2.40E+00
New Burnswick	1.05E+01	8.35E+00	6.35E+00	5.36E+00	3.41E+00	2.12E+00	1.27E+00	7.71E-01
Newfoundland and Labrador	2.55E+00	1.93E+00	1.37E+00	1.08E+00	6.41E-01	3.97E-01	2.23E-01	1.30E-01
Nova Scotia	1.08E+01	8.66E+00	6.44E+00	5.38E+00	3.46E+00	2.30E+00	1.41E+00	8.87E-01
Ontario	1.16E+03	9.34E+02	7.20E+02	6.14E+02	3.84E+02	2.41E+02	1.37E+02	7.87E+01
Quebec	5.43E+02	4.01E+02	2.79E+02	2.16E+02	1.22E+02	7.18E+01	3.71E+01	2.01E+01
Saskkatchewan	5.03E+01	4.20E+01	3.31E+01	2.86E+01	3.92E+01	2.85E+01	2.38E+01	2.23E+01



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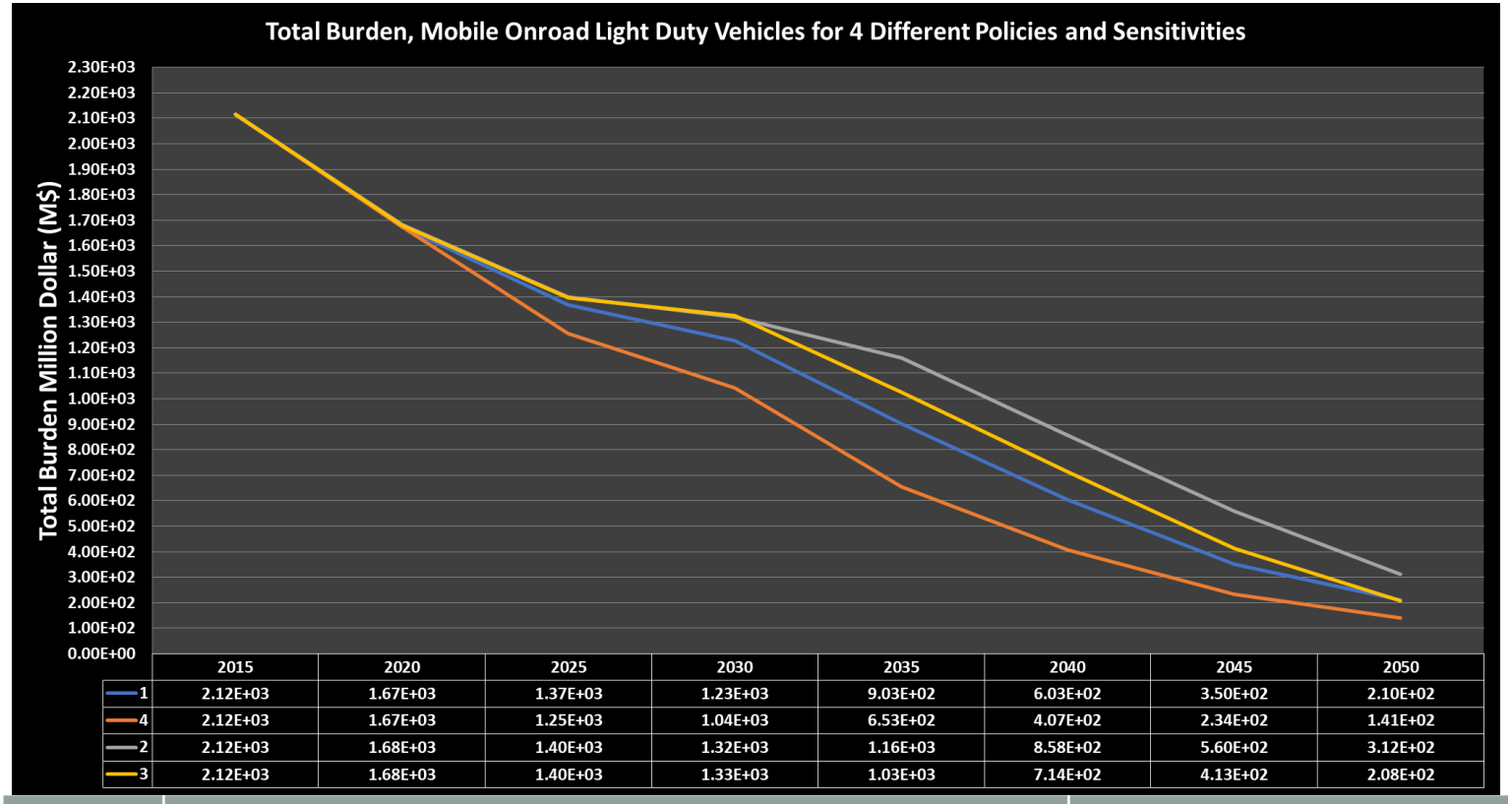
British Columbia	1.56E+02	1.29E+02	1.05E+02	9.28E+01	6.47E+01	3.92E+01	2.06E+01	8.88E+00
Manitoba	5.41E+01	4.19E+01	3.45E+01	3.25E+01	2.45E+01	1.59E+01	8.95E+00	4.01E+00
New Burnswick	1.05E+01	8.37E+00	7.29E+00	7.38E+00	6.16E+00	4.40E+00	2.65E+00	1.32E+00
Newfoundland and Labrador	2.55E+00	1.92E+00	1.66E+00	1.73E+00	1.59E+00	1.14E+00	6.85E-01	3.45E-01
Nova Scotia	1.08E+01	8.69E+00	7.80E+00	8.58E+00	8.29E+00	6.11E+00	3.84E+00	2.00E+00
Ontario	1.16E+03	9.38E+02	8.05E+02	7.86E+02	6.25E+02	4.34E+02	2.52E+02	1.26E+02
Quebec	5.43E+02	4.03E+02	3.10E+02	2.75E+02	1.96E+02	1.24E+02	6.67E+01	3.01E+01
Saskkatchewan	5.03E+01	4.22E+01	3.61E+01	3.54E+01	3.01E+01	3.96E+01	2.75E+01	2.03E+01

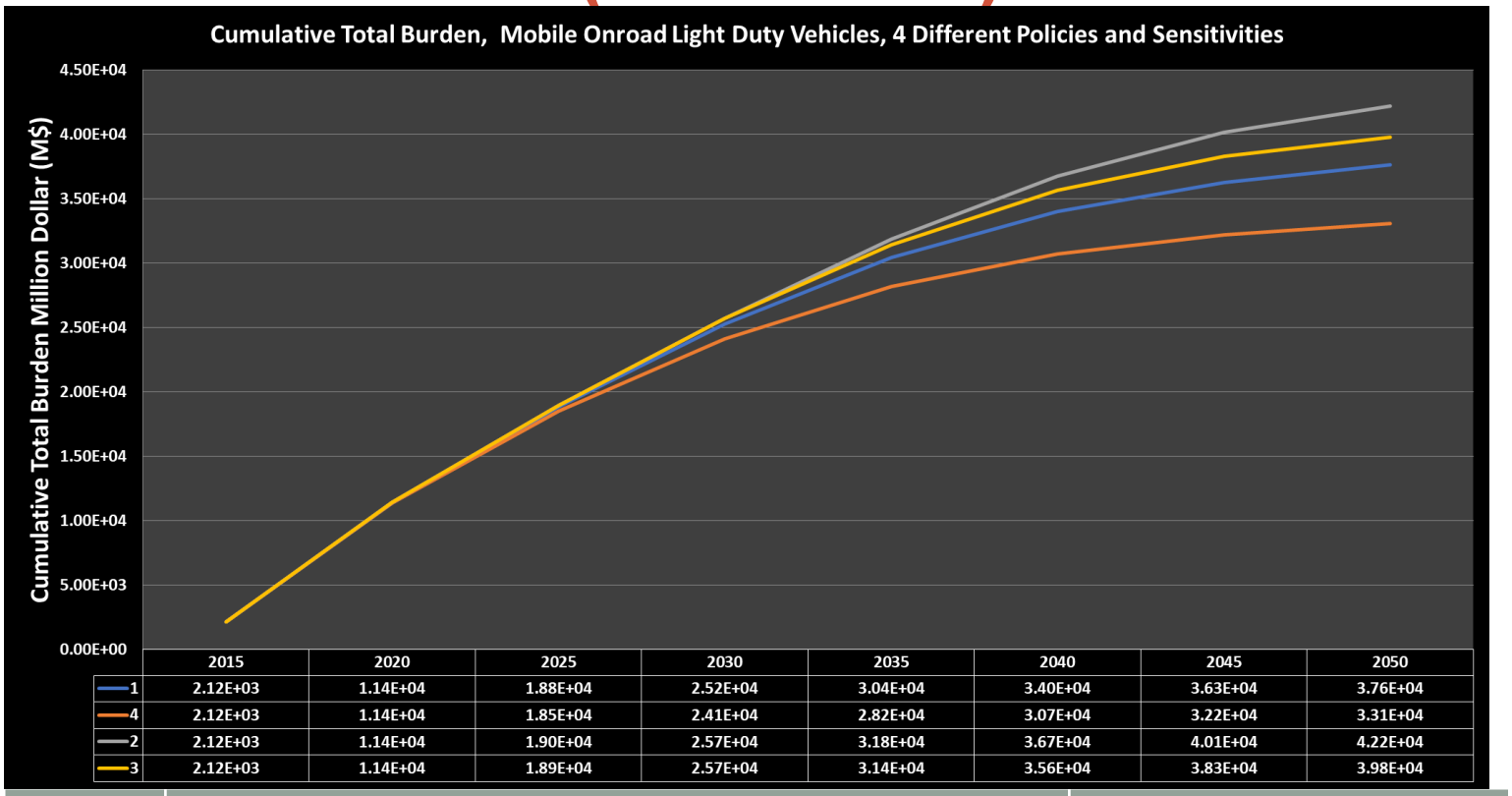
National Total Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	2.12E+03	1.67E+03	1.37E+03	1.23E+03	9.03E+02	6.03E+02	3.50E+02	2.10E+02
4	2.12E+03	1.67E+03	1.25E+03	1.04E+03	6.53E+02	4.07E+02	2.34E+02	1.41E+02
2	2.12E+03	1.68E+03	1.40E+03	1.32E+03	1.16E+03	8.58E+02	5.60E+02	3.12E+02
3	2.12E+03	1.68E+03	1.40E+03	1.33E+03	1.03E+03	7.14E+02	4.13E+02	2.08E+02

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

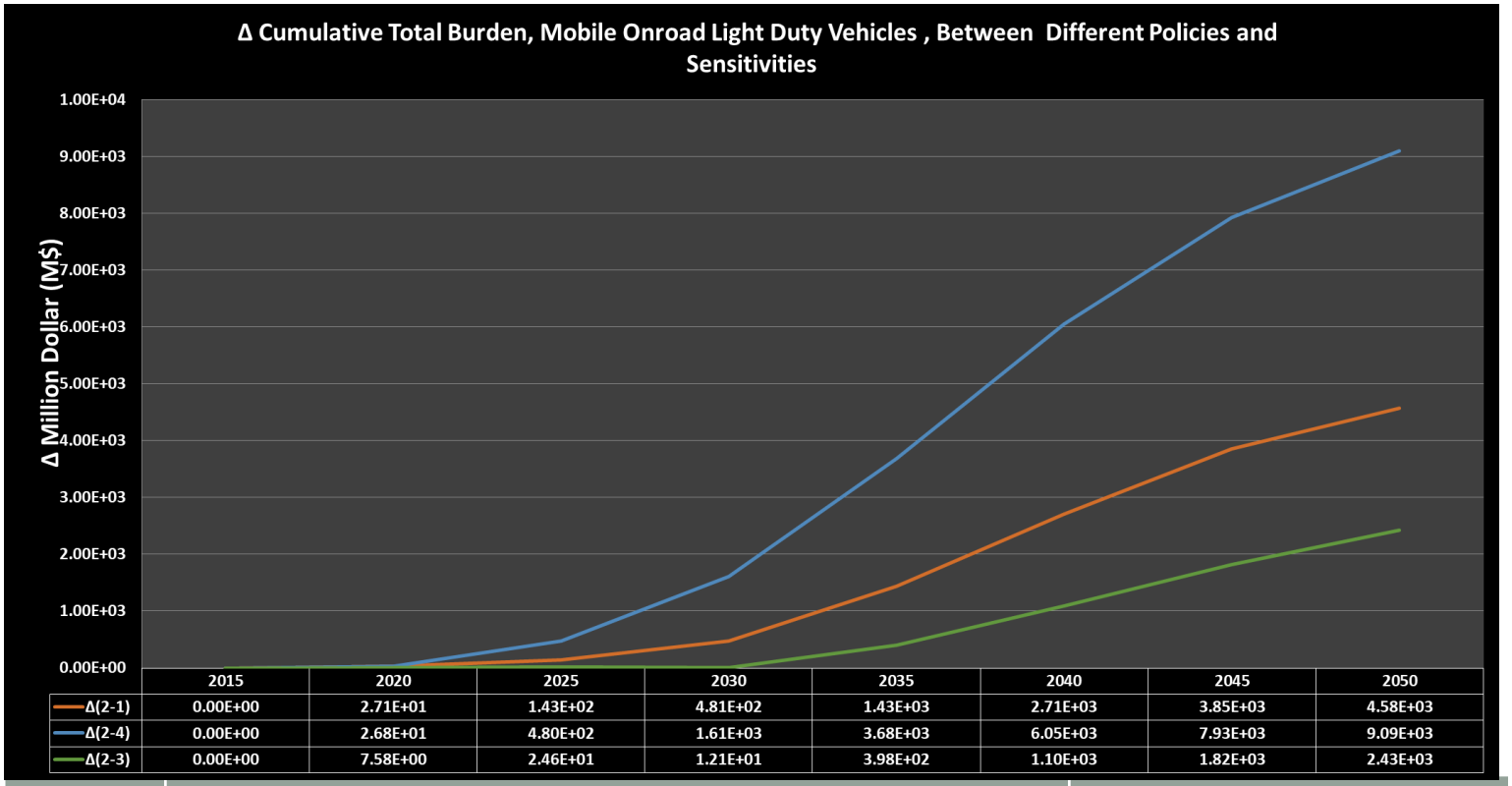
Cumulative National Total Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	2.12E+03	1.14E+04	1.88E+04	2.52E+04	3.04E+04	3.40E+04	3.63E+04	3.76E+04
4	2.12E+03	1.14E+04	1.85E+04	2.41E+04	2.82E+04	3.07E+04	3.22E+04	3.31E+04
2	2.12E+03	1.14E+04	1.90E+04	2.57E+04	3.18E+04	3.67E+04	4.01E+04	4.22E+04
3	2.12E+03	1.14E+04	1.89E+04	2.57E+04	3.14E+04	3.56E+04	3.83E+04	3.98E+04

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Cumulative National Total Burden ($M) Difference Between Policies (2015-2050)

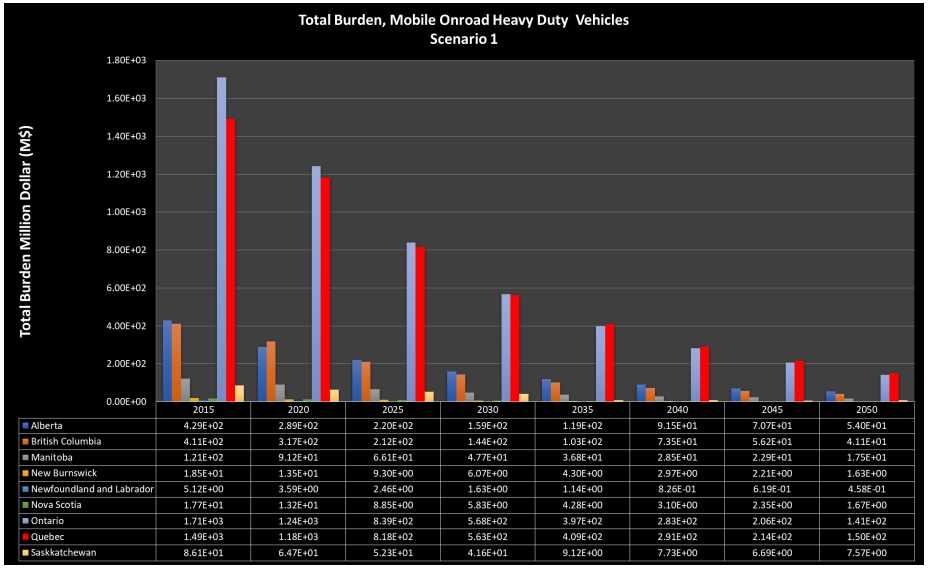


	2015	2020	2025	2030	2035	2040	2045	2050
Δ(2-1)	0.00E+00	2.71E+01	1.43E+02	4.81E+02	1.43E+03	2.71E+03	3.85E+03	4.58E+03
Δ(2-4)	0.00E+00	2.68E+01	4.80E+02	1.61E+03	3.68E+03	6.05E+03	7.93E+03	9.09E+03
Δ(2-3)	0.00E+00	7.58E+00	2.46E+01	1.21E+01	3.98E+02	1.10E+03	1.82E+03	2.43E+03

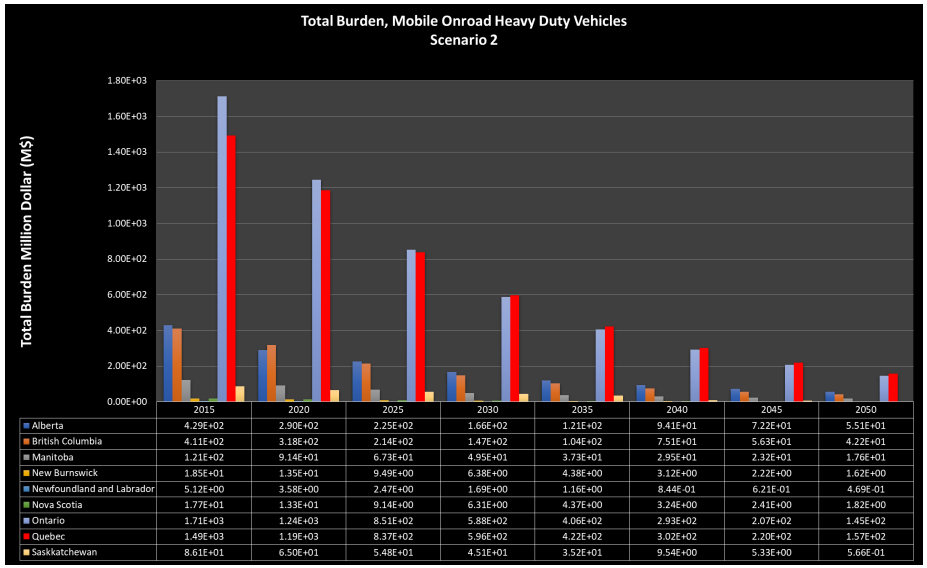
ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Heavy Duty Vehicles (HDVs)

Total Burden ($M)



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.29E+02	2.89E+02	2.20E+02	1.59E+02	1.19E+02	9.15E+01	7.07E+01	5.40E+01
British Columbia	4.11E+02	3.17E+02	2.12E+02	1.44E+02	1.03E+02	7.35E+01	5.62E+01	4.11E+01
Manitoba	1.21E+02	9.12E+01	6.61E+01	4.77E+01	3.68E+01	2.85E+01	2.29E+01	1.75E+01
New Burnswick	1.85E+01	1.35E+01	9.30E+00	6.07E+00	4.30E+00	2.97E+00	2.21E+00	1.63E+00
Newfoundland and Labrador	5.12E+00	3.59E+00	2.46E+00	1.63E+00	1.14E+00	8.26E-01	6.19E-01	4.58E-01
Nova Scotia	1.77E+01	1.32E+01	8.85E+00	5.83E+00	4.28E+00	3.10E+00	2.35E+00	1.67E+00
Ontario	1.71E+03	1.24E+03	8.39E+02	5.68E+02	3.97E+02	2.83E+02	2.06E+02	1.41E+02
Quebec	1.49E+03	1.18E+03	8.18E+02	5.63E+02	4.09E+02	2.91E+02	2.14E+02	1.50E+02
Saskkatchewan	8.61E+01	6.47E+01	5.23E+01	4.16E+01	9.12E+00	7.73E+00	6.69E+00	7.57E+00



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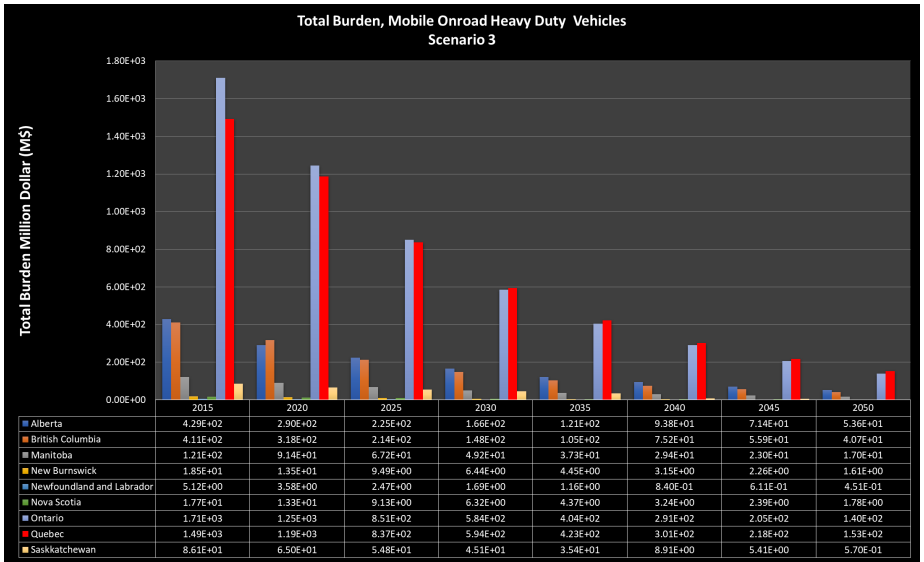
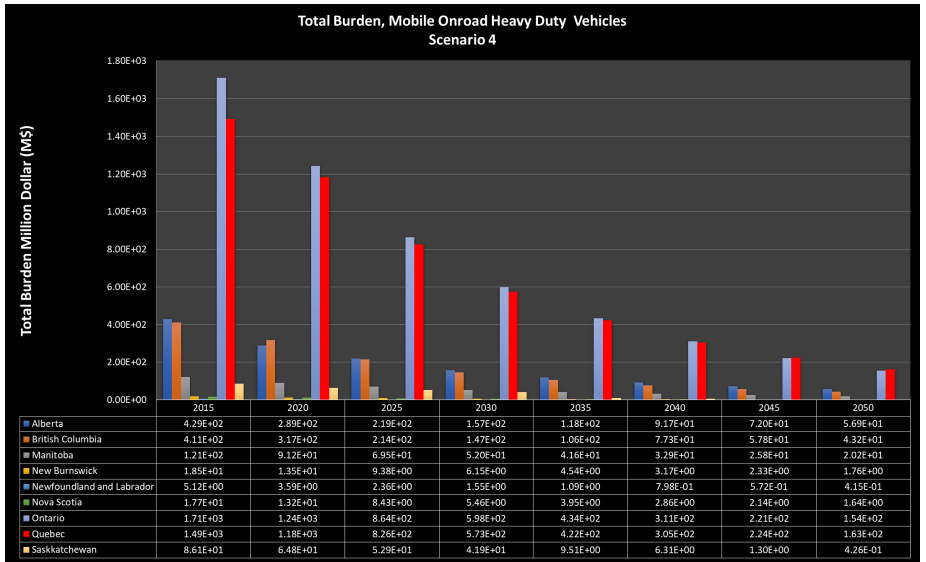
British Columbia	4.11E+02	3.18E+02	2.14E+02	1.47E+02	1.04E+02	7.51E+01	5.63E+01	4.22E+01
Manitoba	1.21E+02	9.14E+01	6.73E+01	4.95E+01	3.73E+01	2.95E+01	2.32E+01	1.76E+01
New Burnswick	1.85E+01	1.35E+01	9.49E+00	6.38E+00	4.38E+00	3.12E+00	2.22E+00	1.62E+00
Newfoundland and Labrador	5.12E+00	3.58E+00	2.47E+00	1.69E+00	1.16E+00	8.44E-01	6.21E-01	4.69E-01
Nova Scotia	1.77E+01	1.33E+01	9.14E+00	6.31E+00	4.37E+00	3.24E+00	2.41E+00	1.82E+00
Ontario	1.71E+03	1.24E+03	8.51E+02	5.88E+02	4.06E+02	2.93E+02	2.07E+02	1.45E+02
Quebec	1.49E+03	1.19E+03	8.37E+02	5.96E+02	4.22E+02	3.02E+02	2.20E+02	1.57E+02
Saskkatchewan	8.61E+01	6.50E+01	5.48E+01	4.51E+01	3.52E+01	9.54E+00	5.33E+00	5.66E-01

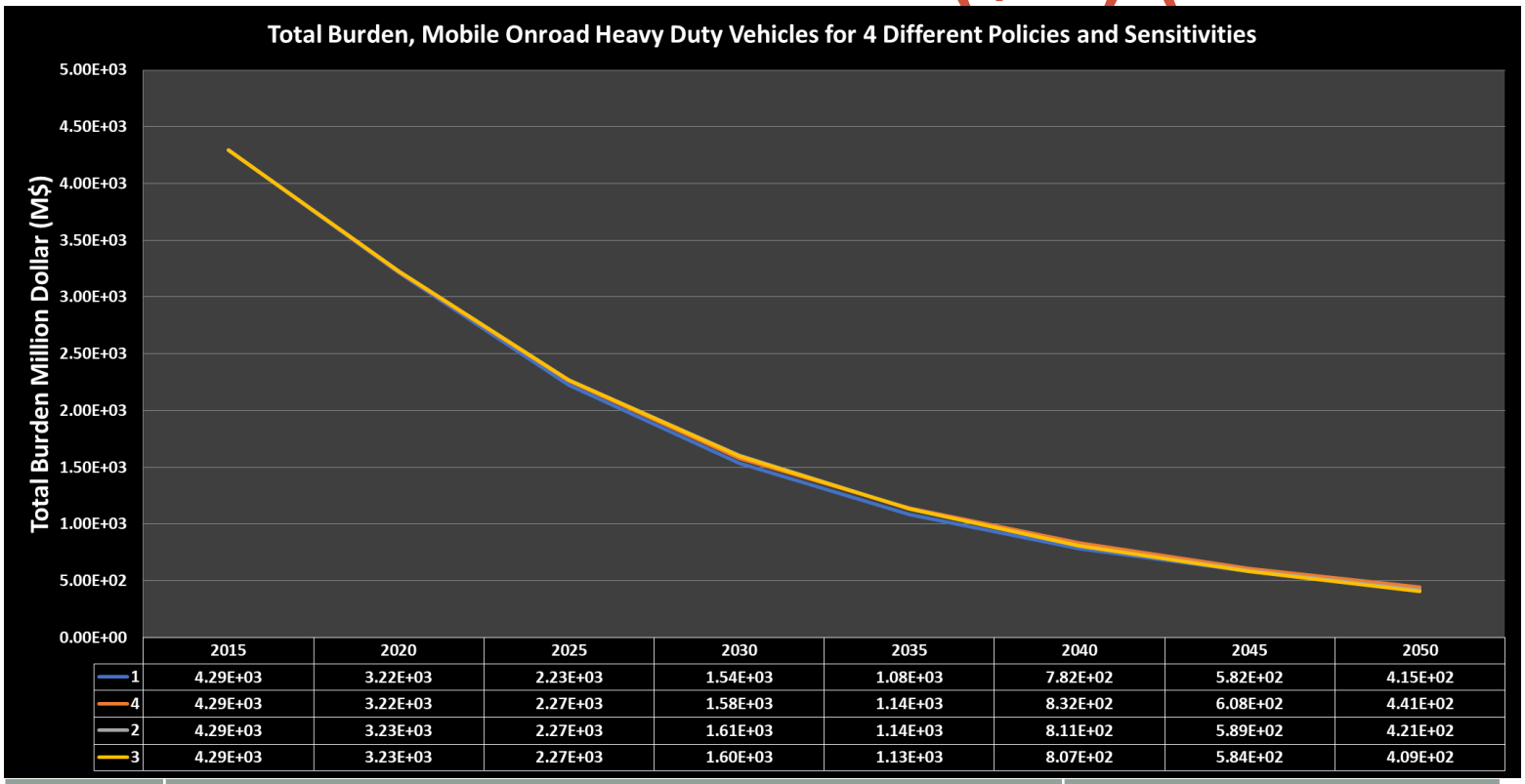


	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.29E+02	2.90E+02	2.25E+02	1.66E+02	1.21E+02	9.38E+01	7.14E+01	5.36E+01
British Columbia	4.11E+02	3.18E+02	2.14E+02	1.48E+02	1.05E+02	7.52E+01	5.59E+01	4.07E+01
Manitoba	1.21E+02	9.14E+01	6.72E+01	4.92E+01	3.73E+01	2.94E+01	2.30E+01	1.70E+01
New Burnswick	1.85E+01	1.35E+01	9.49E+00	6.44E+00	4.45E+00	3.15E+00	2.26E+00	1.61E+00
Newfoundland and Labrador	5.12E+00	3.58E+00	2.47E+00	1.69E+00	1.16E+00	8.40E-01	6.11E-01	4.51E-01
Nova Scotia	1.77E+01	1.33E+01	9.13E+00	6.32E+00	4.37E+00	3.24E+00	2.39E+00	1.78E+00
Ontario	1.71E+03	1.25E+03	8.51E+02	5.84E+02	4.04E+02	2.91E+02	2.05E+02	1.40E+02
Quebec	1.49E+03	1.19E+03	8.37E+02	5.94E+02	4.23E+02	3.01E+02	2.18E+02	1.53E+02
Saskkatchewan	8.61E+01	6.50E+01	5.48E+01	4.51E+01	3.54E+01	8.91E+00	5.41E+00	5.70E-01



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.29E+02	2.89E+02	2.19E+02	1.57E+02	1.18E+02	9.17E+01	7.20E+01	5.69E+01
British Columbia	4.11E+02	3.17E+02	2.14E+02	1.47E+02	1.06E+02	7.73E+01	5.78E+01	4.32E+01
Manitoba	1.21E+02	9.12E+01	6.95E+01	5.20E+01	4.16E+01	3.29E+01	2.58E+01	2.02E+01
New Burnswick	1.85E+01	1.35E+01	9.38E+00	6.15E+00	4.54E+00	3.17E+00	2.33E+00	1.76E+00
Newfoundland and Labrador	5.12E+00	3.59E+00	2.36E+00	1.55E+00	1.09E+00	7.98E-01	5.72E-01	4.15E-01
Nova Scotia	1.77E+01	1.32E+01	8.43E+00	5.46E+00	3.95E+00	2.86E+00	2.14E+00	1.64E+00
Ontario	1.71E+03	1.24E+03	8.64E+02	5.98E+02	4.34E+02	3.11E+02	2.21E+02	1.54E+02
Quebec	1.49E+03	1.18E+03	8.26E+02	5.73E+02	4.22E+02	3.05E+02	2.24E+02	1.63E+02
Saskkatchewan	8.61E+01	6.48E+01	5.29E+01	4.19E+01	9.51E+00	6.31E+00	1.30E+00	4.26E-01

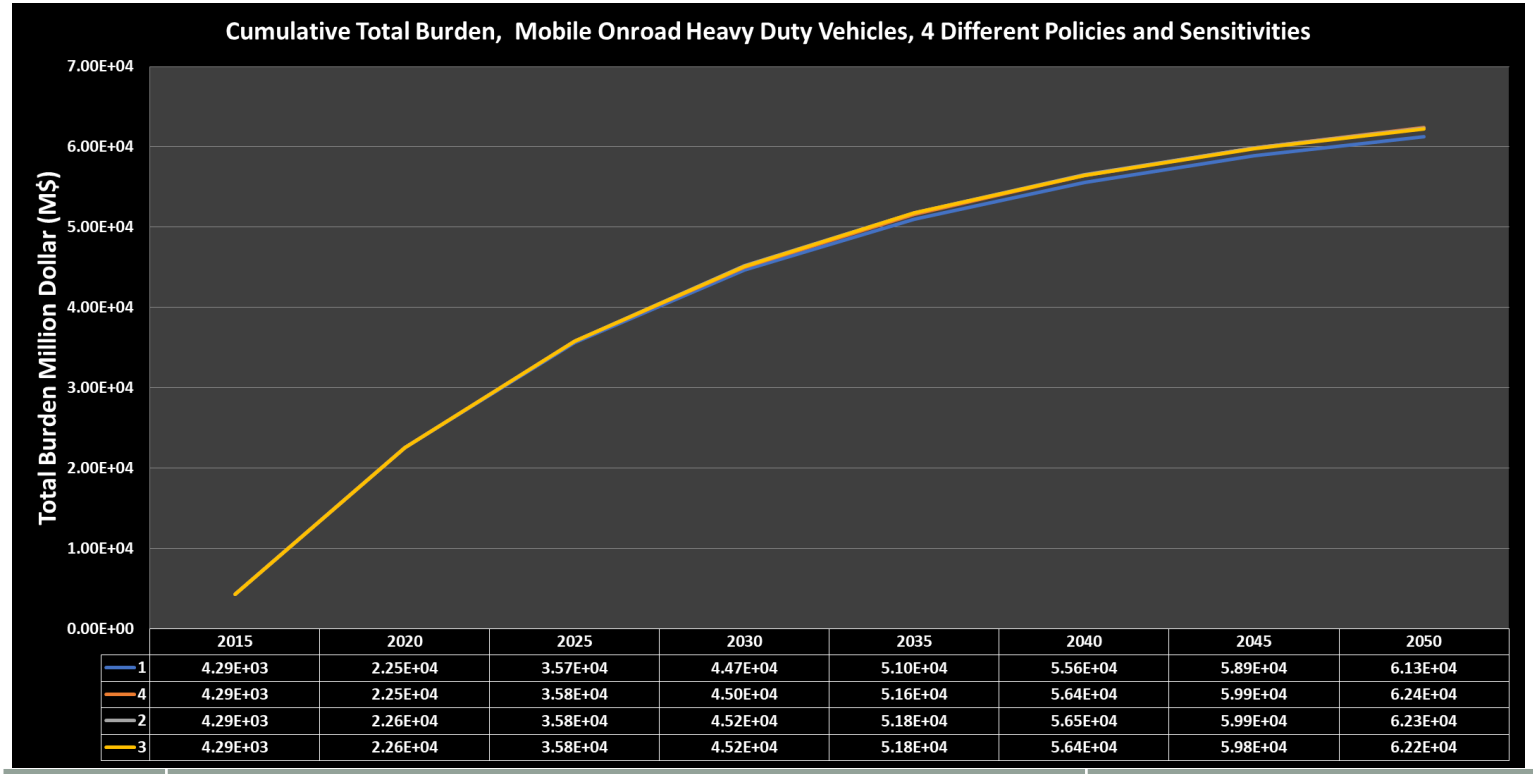
National Total Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	4.29E+03	3.22E+03	2.23E+03	1.54E+03	1.08E+03	7.82E+02	5.82E+02	4.15E+02
4	4.29E+03	3.22E+03	2.27E+03	1.58E+03	1.14E+03	8.32E+02	6.08E+02	4.41E+02
2	4.29E+03	3.23E+03	2.27E+03	1.61E+03	1.14E+03	8.11E+02	5.89E+02	4.21E+02
3	4.29E+03	3.23E+03	2.27E+03	1.60E+03	1.13E+03	8.07E+02	5.84E+02	4.09E+02

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

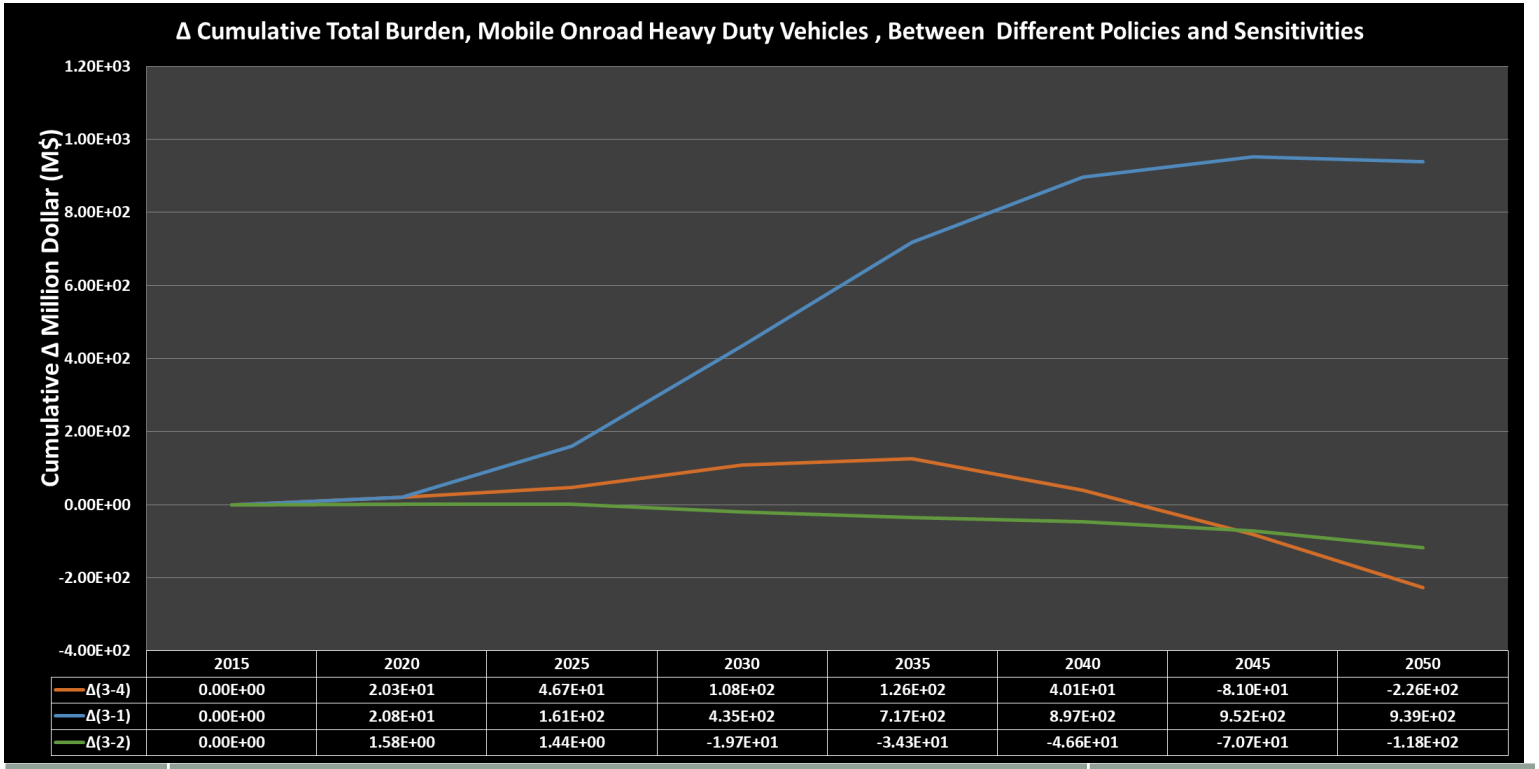
Cumulative National Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	4.29E+03	2.25E+04	3.57E+04	4.47E+04	5.10E+04	5.56E+04	5.89E+04	6.13E+04
4	4.29E+03	2.25E+04	3.58E+04	4.50E+04	5.16E+04	5.64E+04	5.99E+04	6.24E+04
2	4.29E+03	2.26E+04	3.58E+04	4.52E+04	5.18E+04	5.65E+04	5.99E+04	6.23E+04
3	4.29E+03	2.26E+04	3.58E+04	4.52E+04	5.18E+04	5.64E+04	5.98E+04	6.22E+04

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Cumulative National Burden ($M) - Difference Between Policies (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
Δ(3-4)	0.00E+00	2.03E+01	4.67E+01	1.08E+02	1.26E+02	4.01E+01	-8.10E+01	-2.26E+02
Δ(3-1)	0.00E+00	2.08E+01	1.61E+02	4.35E+02	7.17E+02	8.97E+02	9.52E+02	9.39E+02
Δ(3-2)	0.00E+00	1.58E+00	1.44E+00	-1.97E+01	-3.43E+01	-4.66E+01	-7.07E+01	-1.18E+02

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Notes on Transportation Health Burdens

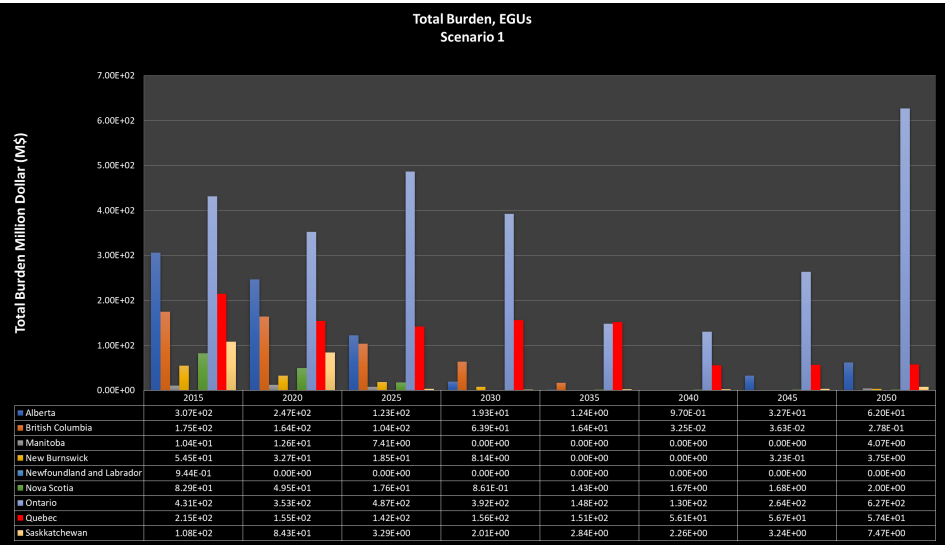
- Overall, results from provincially averaged co-benefits and emission projections tend to underestimate air pollution health burdens compared to better resolved estimates.
  - At finer spatial resolution, higher emissions and larger co-benefits coincide at population centres. Averaging these values at provincial levels would result in smaller product of the two values (emissions and co-benefits) that make up the national health burden estimates.

- Transportation health burdens are calculated for $PM_{2.5}$ contributions from tailpipe emissions only; fugitive and tire and brake wear emissions are not included.

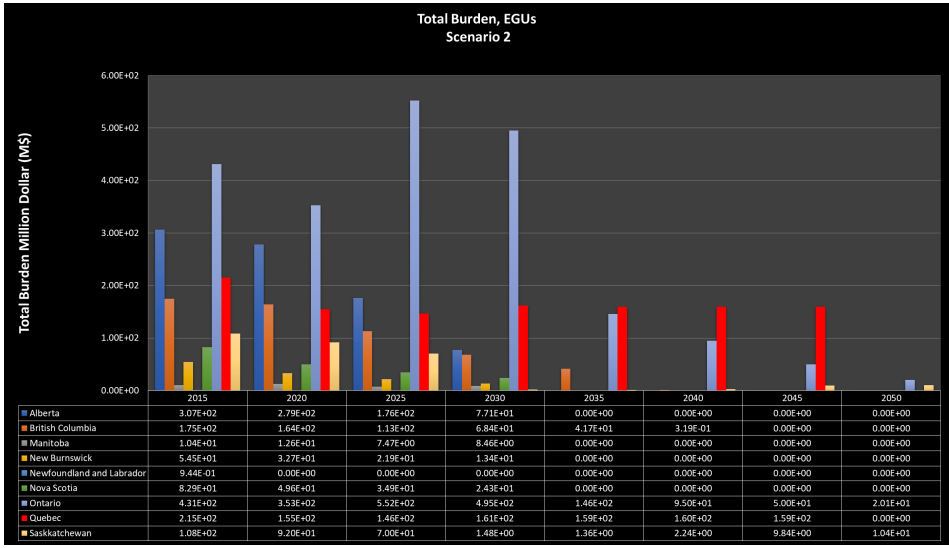
- Fuel switch to biofuels does not entail health benefits under the assumptions used in these calculations, as the combustion of biofuels is assumed to produce the same level of criteria pollutant emissions as that of fossil fuels.

Electricity Generating Units (EGUs)

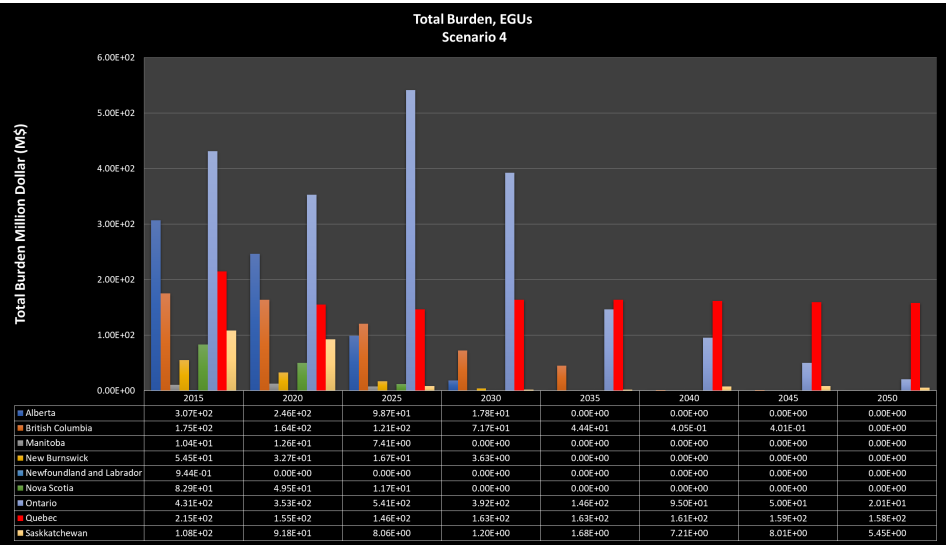
Total Burden ($M)



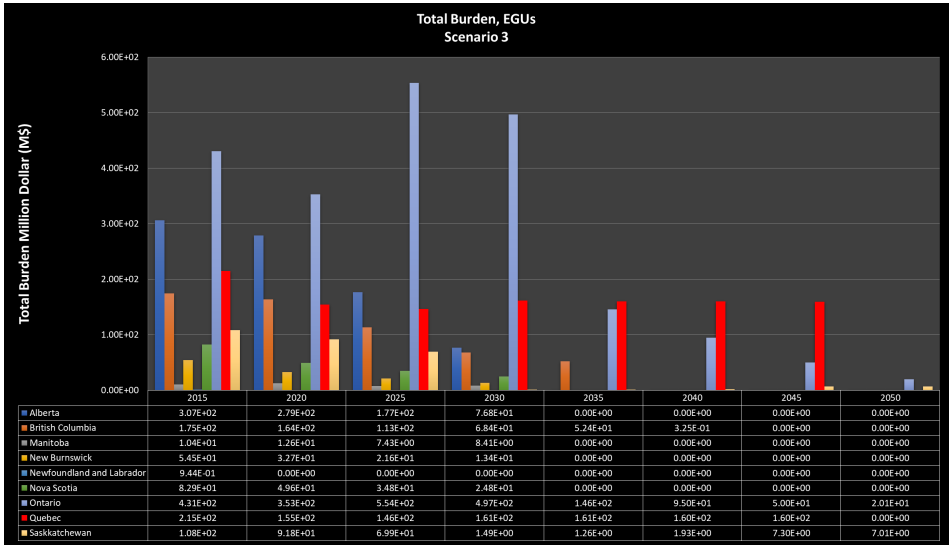
	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	3.07E+02	2.47E+02	1.23E+02	1.93E+01	1.24E+00	9.70E-01	3.27E+01	6.20E+01
British Columbia	1.75E+02	1.64E+02	1.04E+02	6.39E+01	1.64E+01	3.25E-02	3.63E-02	2.78E-01
Manitoba	1.04E+01	1.26E+01	7.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.07E+00
New Burnswick	5.45E+01	3.27E+01	1.85E+01	8.14E+00	0.00E+00	0.00E+00	3.23E-01	3.75E+00
Newfoundland and Labrador	9.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.29E+01	4.95E+01	1.76E+01	8.61E-01	1.43E+00	1.67E+00	1.68E+00	2.00E+00
Ontario	4.31E+02	3.53E+02	4.87E+02	3.92E+02	1.48E+02	1.30E+02	2.64E+02	6.27E+02
Quebec	2.15E+02	1.55E+02	1.42E+02	1.56E+02	1.51E+02	5.61E+01	5.67E+01	5.74E+01
Saskkatchewan	1.08E+02	8.43E+01	3.29E+00	2.01E+00	2.84E+00	2.26E+00	3.24E+00	7.47E+00



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	3.07E+02	2.79E+02	1.76E+02	7.71E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	1.75E+02	1.64E+02	1.13E+02	6.84E+01	4.17E+01	3.19E-01	0.00E+00	0.00E+00
Manitoba	1.04E+01	1.26E+01	7.47E+00	8.46E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	5.45E+01	3.27E+01	2.19E+01	1.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	9.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.29E+01	4.96E+01	3.49E+01	2.43E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	4.31E+02	3.53E+02	5.52E+02	4.95E+02	1.46E+02	9.50E+01	5.00E+01	2.01E+01
Quebec	2.15E+02	1.55E+02	1.46E+02	1.61E+02	1.59E+02	1.60E+02	1.59E+02	0.00E+00
Saskkatchewan	1.08E+02	9.20E+01	7.00E+01	1.48E+00	1.36E+00	2.24E+00	9.84E+00	1.04E+01

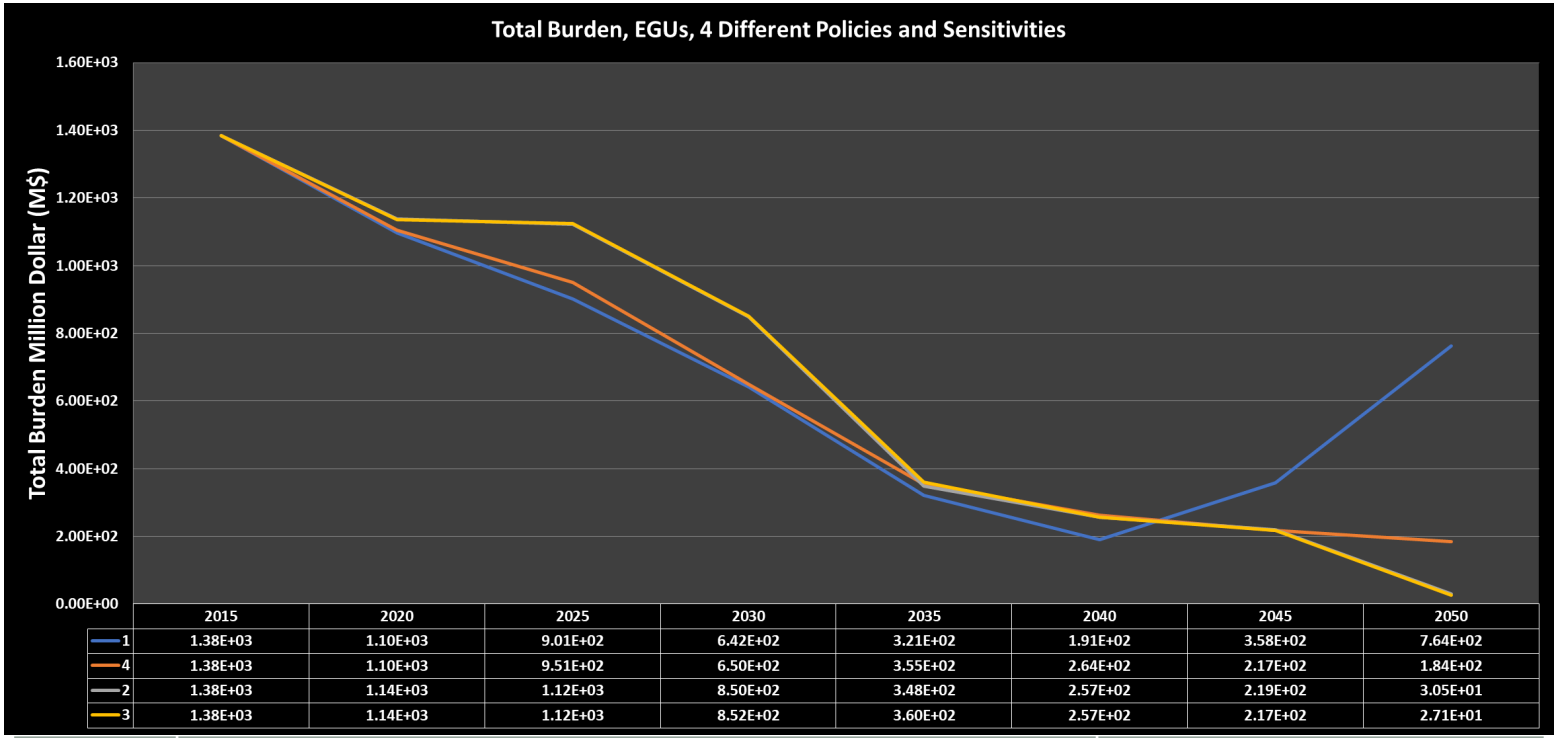


	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	3.07E+02	2.46E+02	9.87E+01	1.78E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	1.75E+02	1.64E+02	1.21E+02	7.17E+01	4.44E+01	4.05E-01	4.01E-01	0.00E+00
Manitoba	1.04E+01	1.26E+01	7.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	5.45E+01	3.27E+01	1.67E+01	3.63E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	9.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.29E+01	4.95E+01	1.17E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	4.31E+02	3.53E+02	5.41E+02	3.92E+02	1.46E+02	9.50E+01	5.00E+01	2.01E+01
Quebec	2.15E+02	1.55E+02	1.46E+02	1.63E+02	1.63E+02	1.61E+02	1.59E+02	1.58E+02
Saskkatchewan	1.08E+02	9.18E+01	8.06E+00	1.20E+00	1.68E+00	7.21E+00	8.01E+00	5.45E+00



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	3.07E+02	2.79E+02	1.77E+02	7.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	1.75E+02	1.64E+02	1.13E+02	6.84E+01	5.24E+01	3.25E-01	0.00E+00	0.00E+00
Manitoba	1.04E+01	1.26E+01	7.43E+00	8.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	5.45E+01	3.27E+01	2.16E+01	1.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	9.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.29E+01	4.96E+01	3.48E+01	2.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	4.31E+02	3.53E+02	5.54E+02	4.97E+02	1.46E+02	9.50E+01	5.00E+01	2.01E+01
Quebec	2.15E+02	1.55E+02	1.46E+02	1.61E+02	1.61E+02	1.60E+02	1.60E+02	0.00E+00
Saskkatchewan	1.08E+02	9.18E+01	6.99E+01	1.49E+00	1.26E+00	1.93E+00	7.30E+00	7.01E+00

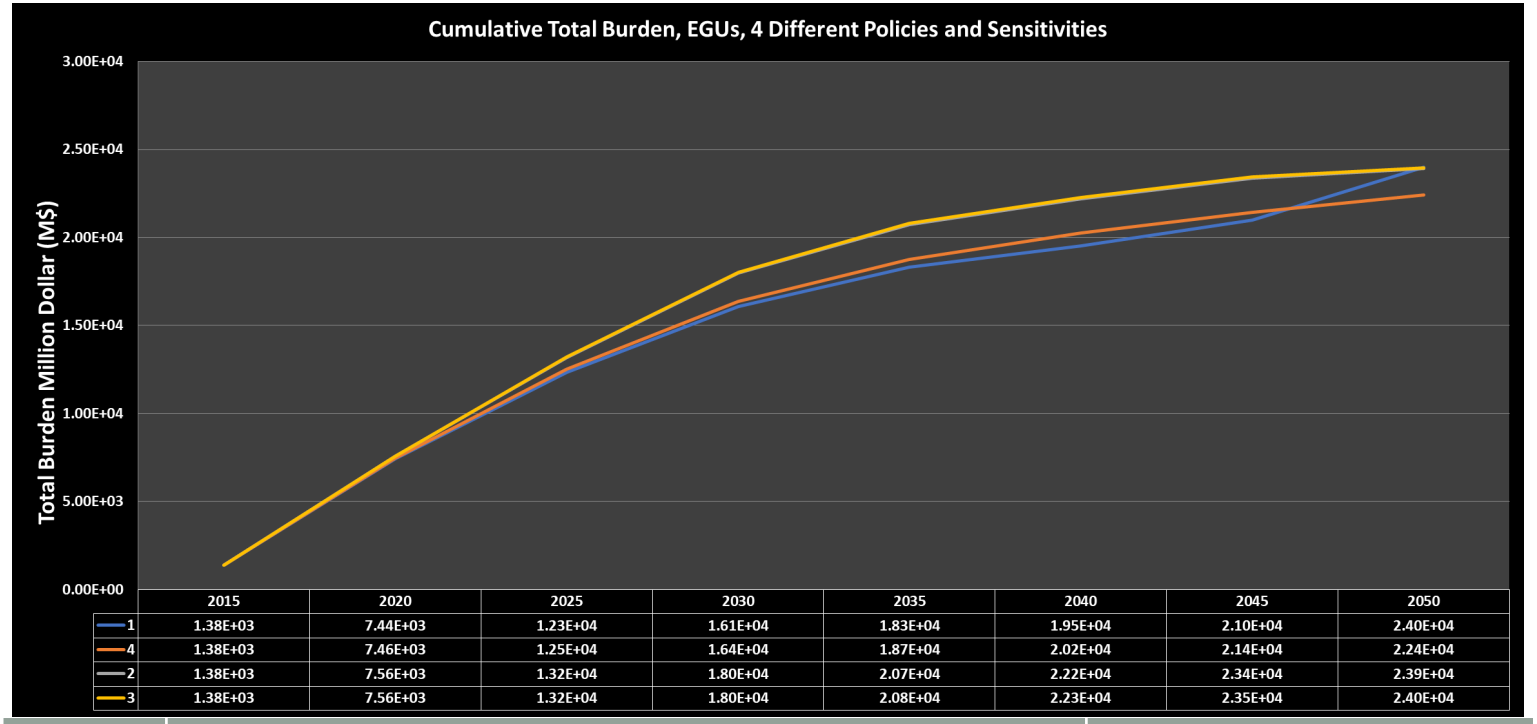
National Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	1.38E+03	1.10E+03	9.01E+02	6.42E+02	3.21E+02	1.91E+02	3.58E+02	7.64E+02
4	1.38E+03	1.10E+03	9.51E+02	6.50E+02	3.55E+02	2.64E+02	2.17E+02	1.84E+02
2	1.38E+03	1.14E+03	1.12E+03	8.50E+02	3.48E+02	2.57E+02	2.19E+02	3.05E+01
3	1.38E+03	1.14E+03	1.12E+03	8.52E+02	3.60E+02	2.57E+02	2.17E+02	2.71E+01

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

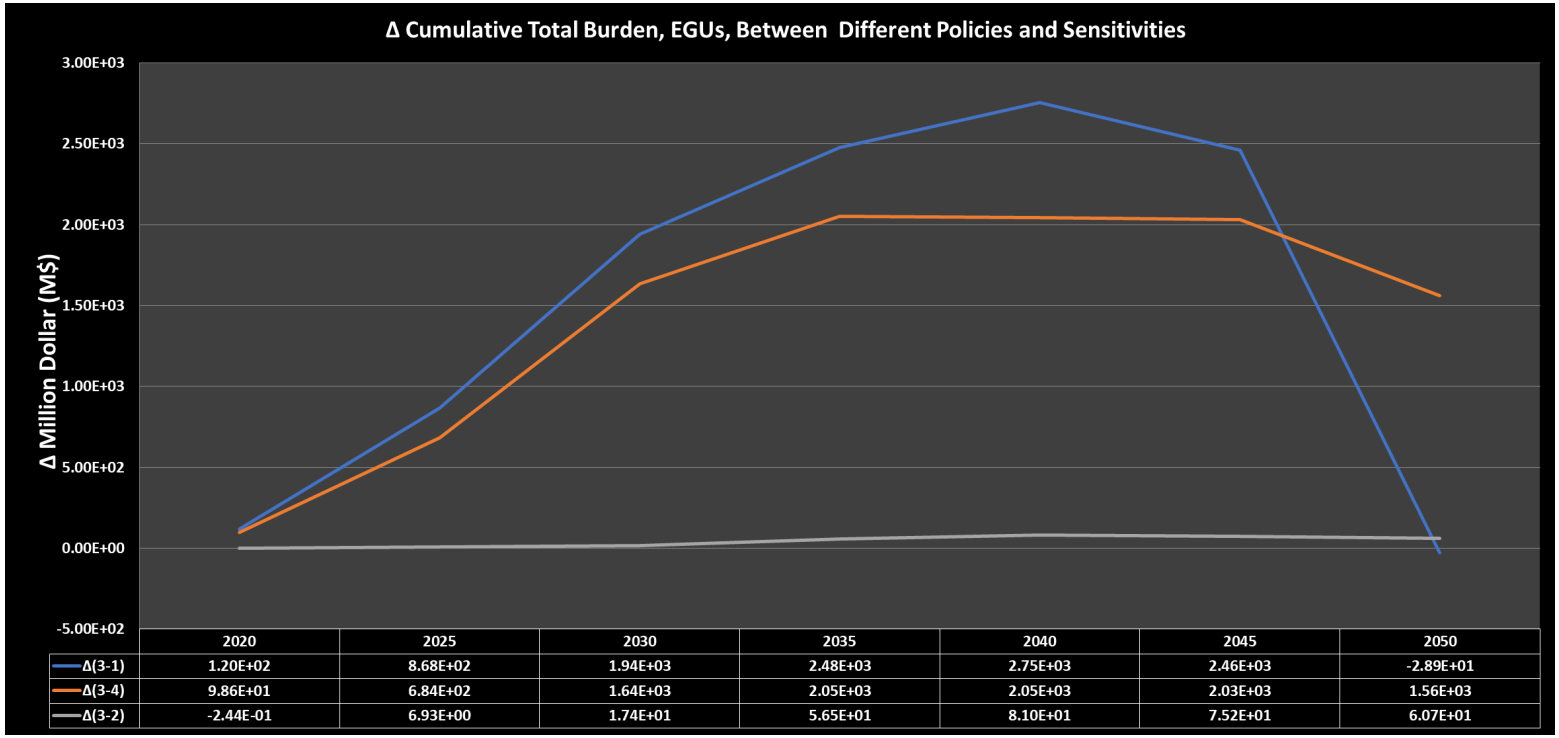
Cumulative National Total Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	1.38E+03	7.44E+03	1.23E+04	1.61E+04	1.83E+04	1.95E+04	2.10E+04	2.40E+04
4	1.38E+03	7.46E+03	1.25E+04	1.64E+04	1.87E+04	2.02E+04	2.14E+04	2.24E+04
2	1.38E+03	7.56E+03	1.32E+04	1.80E+04	2.07E+04	2.22E+04	2.34E+04	2.39E+04
3	1.38E+03	7.56E+03	1.32E+04	1.80E+04	2.08E+04	2.23E+04	2.35E+04	2.40E+04

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Cumulative National Burden – Difference Between Policies ($M) (2015-2050)

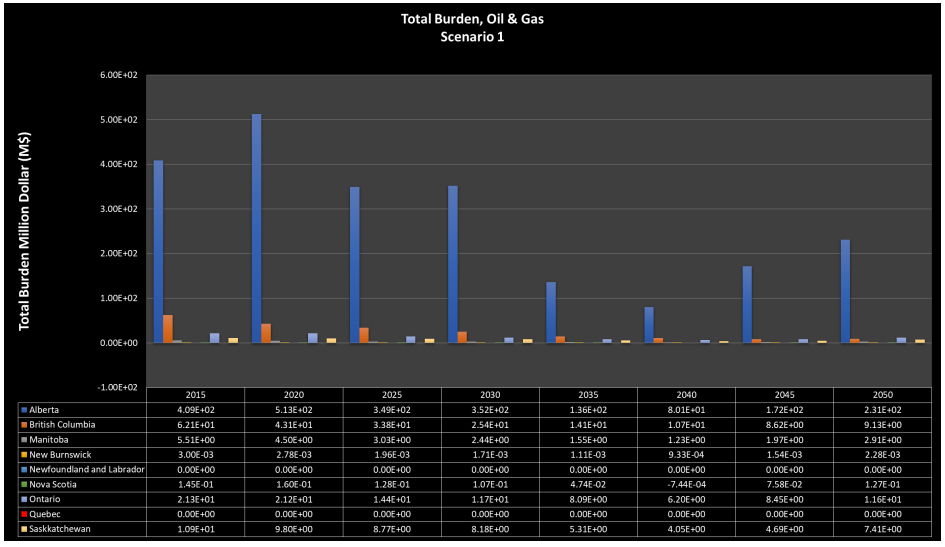


	2020	2025	2030	2035	2040	2045	2050
Δ(3-1)	1.20E+02	8.68E+02	1.94E+03	2.48E+03	2.75E+03	2.46E+03	-2.89E+01
Δ(3-4)	9.86E+01	6.84E+02	1.64E+03	2.05E+03	2.05E+03	2.03E+03	1.56E+03
Δ(3-2)	-2.44E-01	6.93E+00	1.74E+01	5.65E+01	8.10E+01	7.52E+01	6.07E+01

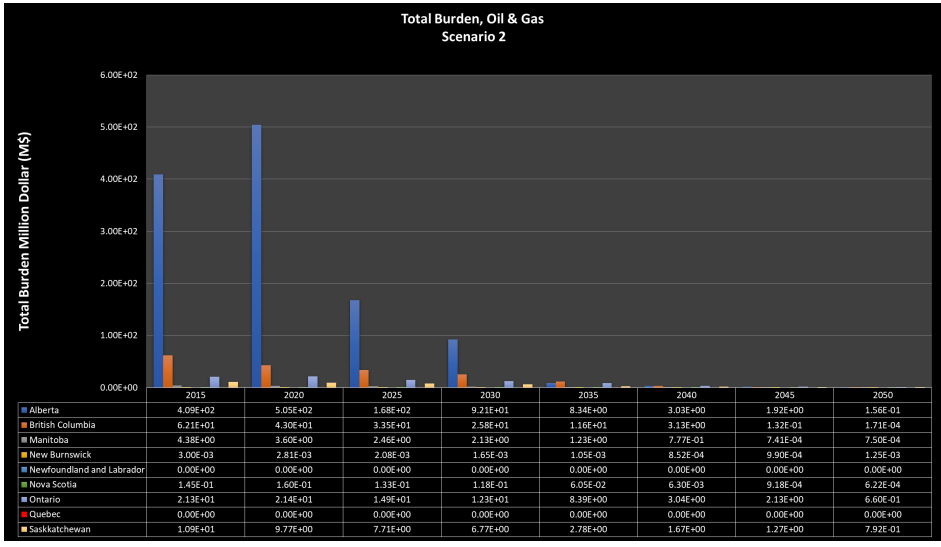
ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Oil & Gas (OGs)

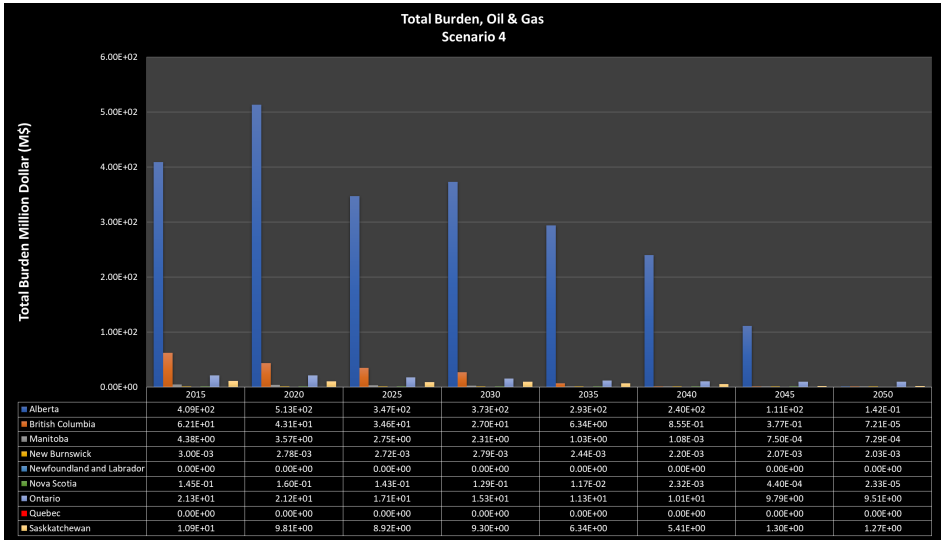
Total Burden ($M)



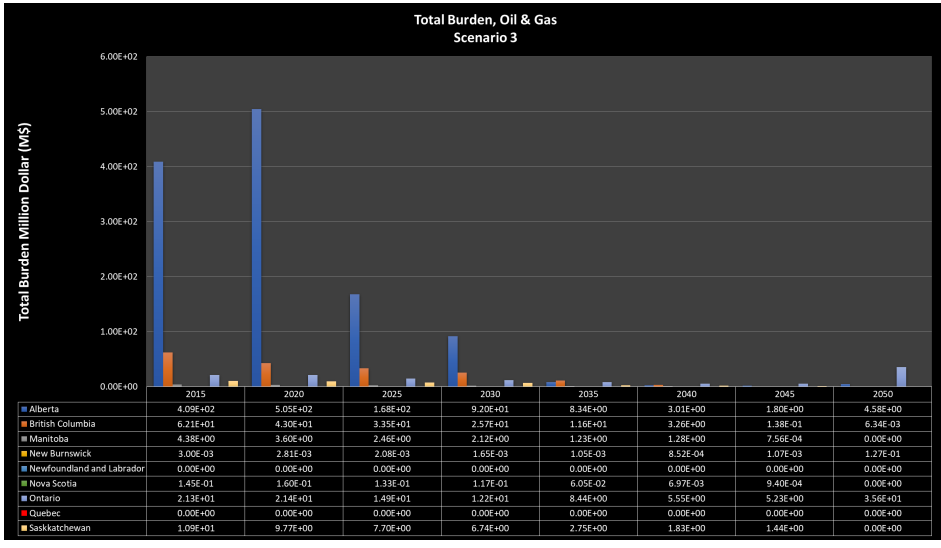
	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.09E+02	5.13E+02	3.49E+02	3.52E+02	1.36E+02	8.01E+01	1.72E+02	2.31E+02
British Columbia	6.21E+01	4.31E+01	3.38E+01	2.54E+01	1.41E+01	1.07E+01	8.62E+00	9.13E+00
Manitoba	5.51E+00	4.50E+00	3.03E+00	2.44E+00	1.55E+00	1.23E+00	1.97E+00	2.91E+00
New Burnswick	3.00E-03	2.78E-03	1.96E-03	1.71E-03	1.11E-03	9.33E-04	1.54E-03	2.28E-03
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	1.45E-01	1.60E-01	1.28E-01	1.07E-01	4.74E-02	-7.44E-04	7.58E-02	1.27E-01
Ontario	2.13E+01	2.12E+01	1.44E+01	1.17E+01	8.09E+00	6.20E+00	8.45E+00	1.16E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	1.09E+01	9.80E+00	8.77E+00	8.18E+00	5.31E+00	4.05E+00	4.69E+00	7.41E+00



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.09E+02	5.05E+02	1.68E+02	9.21E+01	8.34E+00	3.03E+00	1.92E+00	1.56E-01
British Columbia	6.21E+01	4.30E+01	3.35E+01	2.58E+01	1.16E+01	3.13E+00	1.32E-01	1.71E-04
Manitoba	4.38E+00	3.60E+00	2.46E+00	2.13E+00	1.23E+00	7.77E-01	7.41E-04	7.50E-04
New Burnswick	3.00E-03	2.81E-03	2.08E-03	1.65E-03	1.05E-03	8.52E-04	9.90E-04	1.25E-03
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	1.45E-01	1.60E-01	1.33E-01	1.18E-01	6.05E-02	6.30E-03	9.18E-04	6.22E-04
Ontario	2.13E+01	2.14E+01	1.49E+01	1.23E+01	8.39E+00	3.04E+00	2.13E+00	6.60E-01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	1.09E+01	9.77E+00	7.71E+00	6.77E+00	2.78E+00	1.67E+00	1.27E+00	7.92E-01

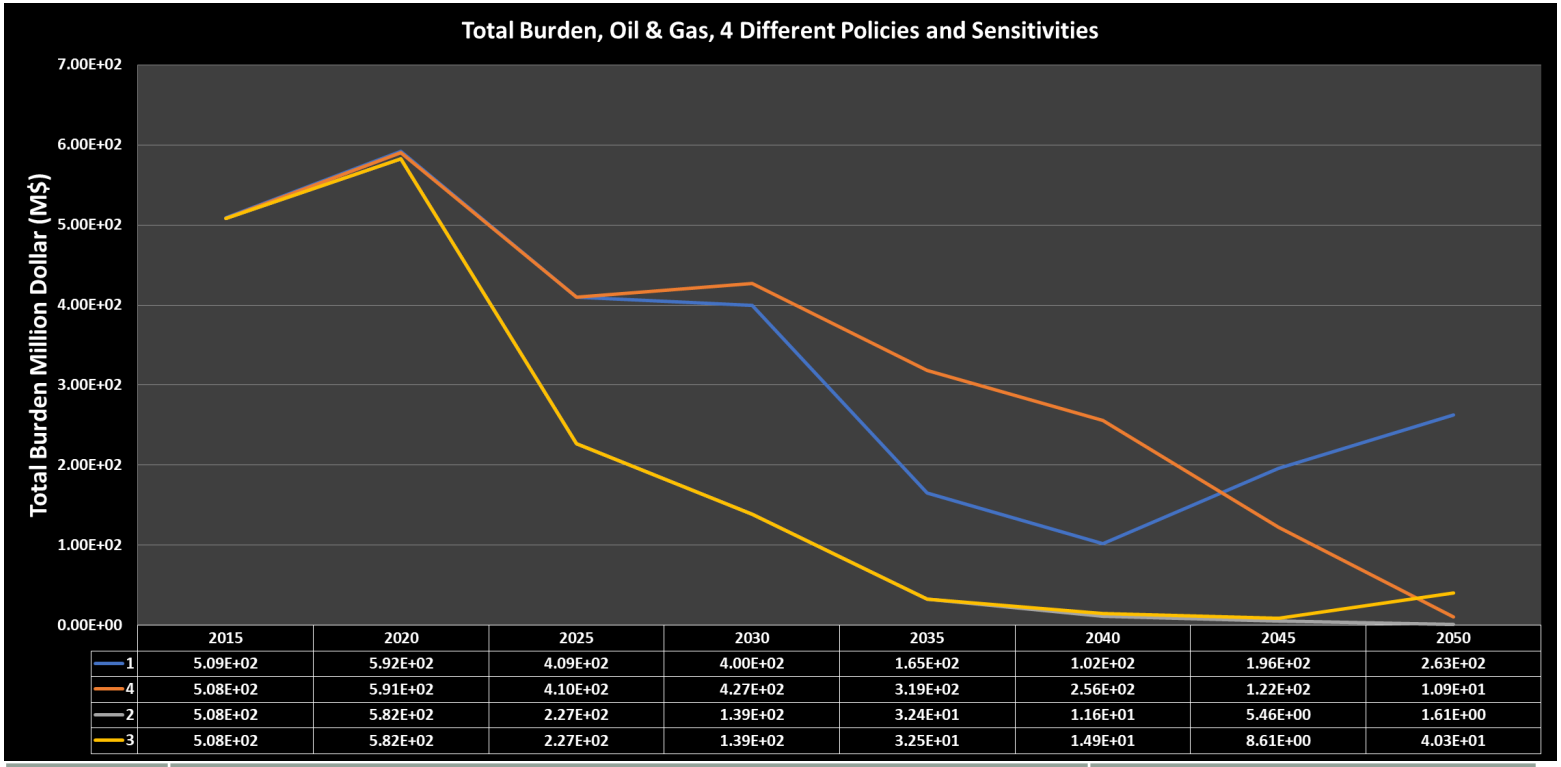


	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.09E+02	5.13E+02	3.47E+02	3.73E+02	2.93E+02	2.40E+02	1.11E+02	1.42E-01
British Columbia	6.21E+01	4.31E+01	3.46E+01	2.70E+01	6.34E+00	8.55E-01	3.77E-01	7.21E-05
Manitoba	4.38E+00	3.57E+00	2.75E+00	2.31E+00	1.03E+00	1.08E-03	7.50E-04	7.29E-04
New Burnswick	3.00E-03	2.78E-03	2.72E-03	2.79E-03	2.44E-03	2.20E-03	2.07E-03	2.03E-03
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	1.45E-01	1.60E-01	1.43E-01	1.29E-01	1.17E-02	2.32E-03	4.40E-04	2.33E-05
Ontario	2.13E+01	2.12E+01	1.71E+01	1.53E+01	1.13E+01	1.01E+01	9.79E+00	9.51E+00
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	1.09E+01	9.81E+00	8.92E+00	9.30E+00	6.34E+00	5.41E+00	1.30E+00	1.27E+00



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	4.09E+02	5.05E+02	1.68E+02	9.20E+01	8.34E+00	3.01E+00	1.80E+00	4.58E+00
British Columbia	6.21E+01	4.30E+01	3.35E+01	2.57E+01	1.16E+01	3.26E+00	1.38E-01	6.34E-03
Manitoba	4.38E+00	3.60E+00	2.46E+00	2.12E+00	1.23E+00	1.28E+00	7.56E-04	0.00E+00
New Burnswick	3.00E-03	2.81E-03	2.08E-03	1.65E-03	1.05E-03	8.52E-04	1.07E-03	1.27E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	1.45E-01	1.60E-01	1.33E-01	1.17E-01	6.05E-02	6.97E-03	9.40E-04	0.00E+00
Ontario	2.13E+01	2.14E+01	1.49E+01	1.22E+01	8.44E+00	5.55E+00	5.23E+00	3.56E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	1.09E+01	9.77E+00	7.70E+00	6.74E+00	2.75E+00	1.83E+00	1.44E+00	0.00E+00

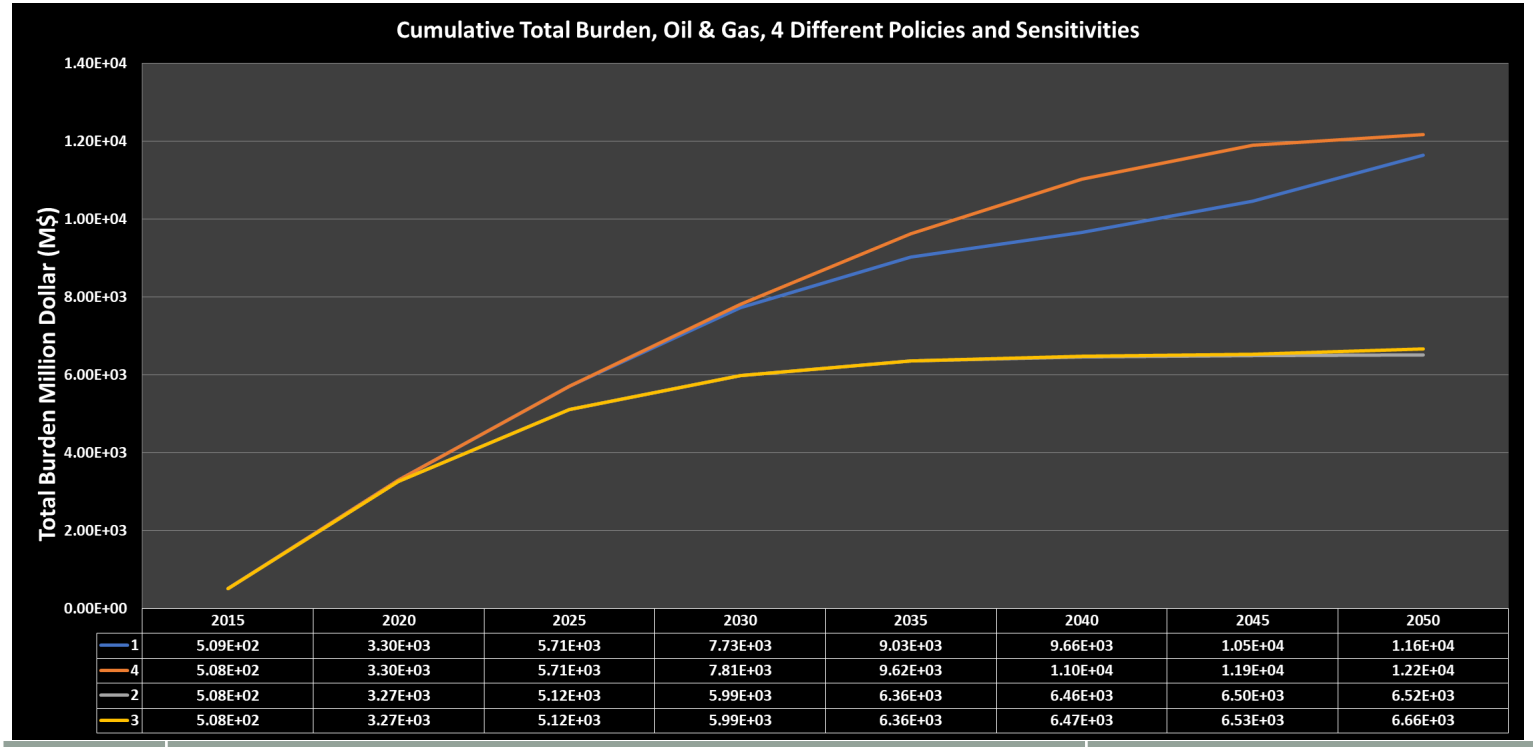
National Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	5.09E+02	5.92E+02	4.09E+02	4.00E+02	1.65E+02	1.02E+02	1.96E+02	2.63E+02
4	5.08E+02	5.91E+02	4.10E+02	4.27E+02	3.19E+02	2.56E+02	1.22E+02	1.09E+01
2	5.08E+02	5.82E+02	2.27E+02	1.39E+02	3.24E+01	1.16E+01	5.46E+00	1.61E+00
3	5.08E+02	5.82E+02	2.27E+02	1.39E+02	3.25E+01	1.49E+01	8.61E+00	4.03E+01

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

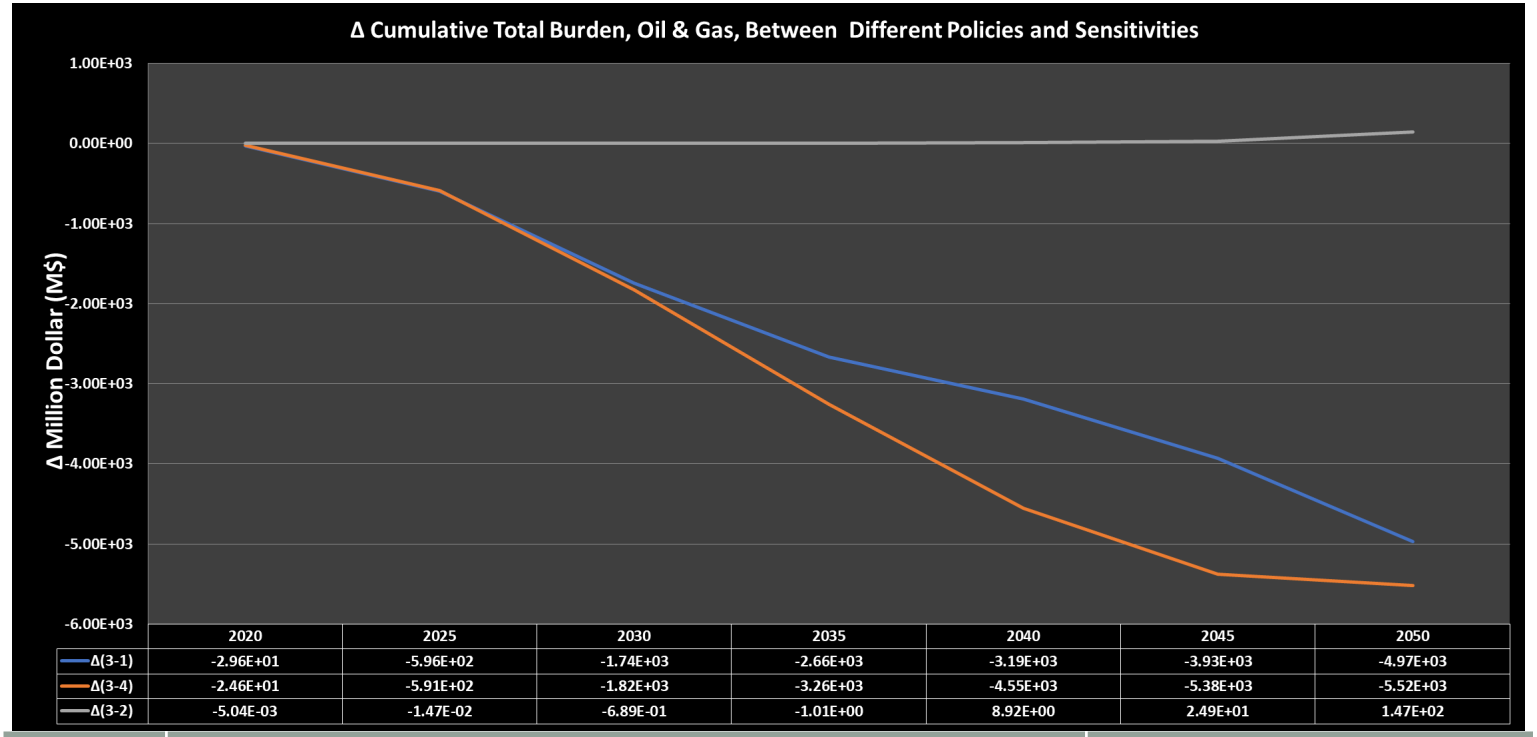
Cumulative National Total Burden ($M) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	5.09E+02	3.30E+03	5.71E+03	7.73E+03	9.03E+03	9.66E+03	1.05E+04	1.16E+04
4	5.08E+02	3.30E+03	5.71E+03	7.81E+03	9.62E+03	1.10E+04	1.19E+04	1.22E+04
2	5.08E+02	3.27E+03	5.12E+03	5.99E+03	6.36E+03	6.46E+03	6.50E+03	6.52E+03
3	5.08E+02	3.27E+03	5.12E+03	5.99E+03	6.36E+03	6.47E+03	6.53E+03	6.66E+03

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Cumulative National Burden – Difference Between Policies ($M) (2015-2050)

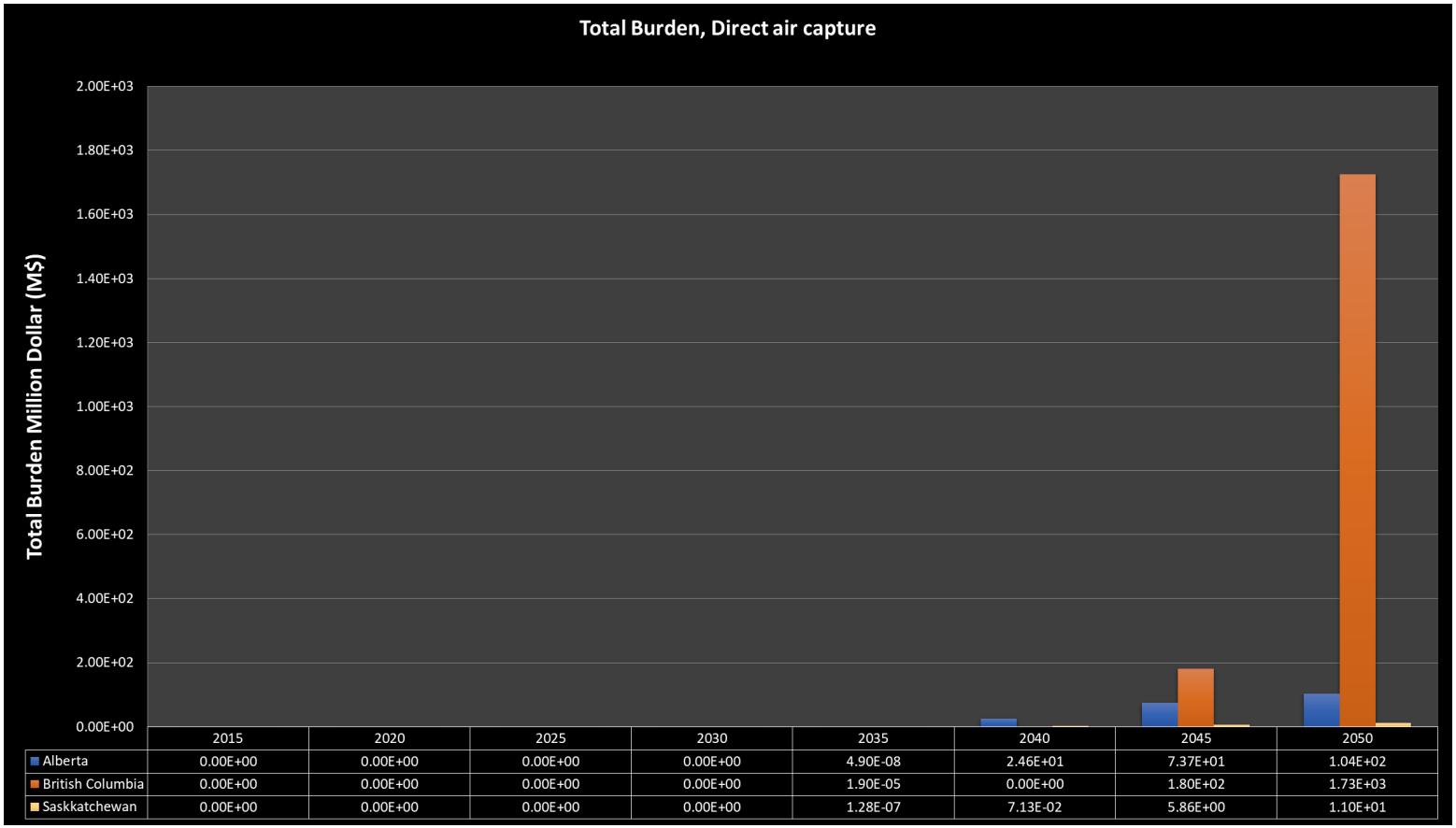


	2020	2025	2030	2035	2040	2045	2050
Δ(3-1)	-2.96E+01	-5.96E+02	-1.74E+03	-2.66E+03	-3.19E+03	-3.93E+03	-4.97E+03
Δ(3-4)	-2.46E+01	-5.91E+02	-1.82E+03	-3.26E+03	-4.55E+03	-5.38E+03	-5.52E+03
Δ(3-2)	-5.04E-03	-1.47E-02	-6.89E-01	-1.01E+00	8.92E+00	2.49E+01	1.47E+02

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

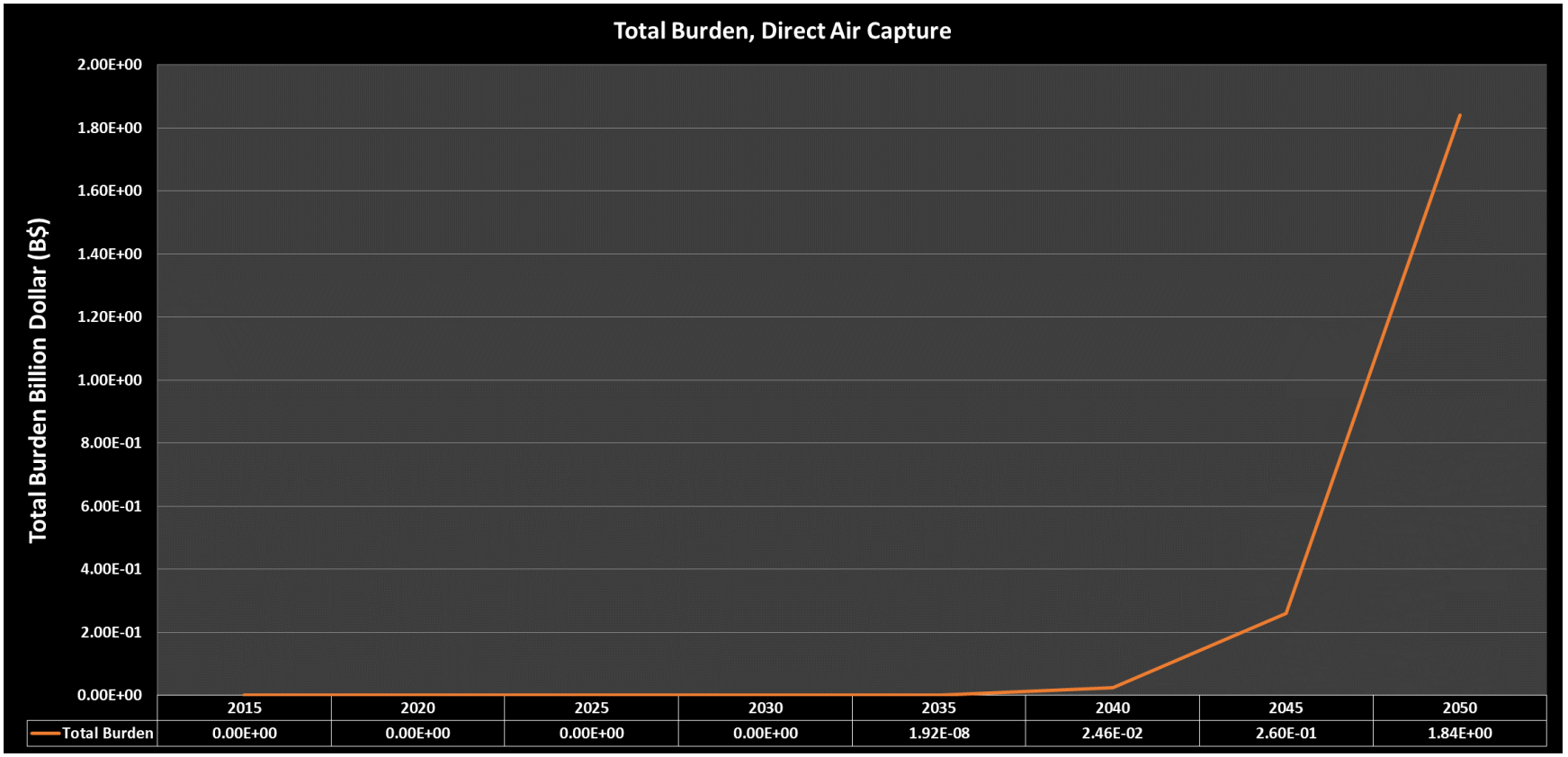
Direct Air Capture (DC)

Total Burden ($M)

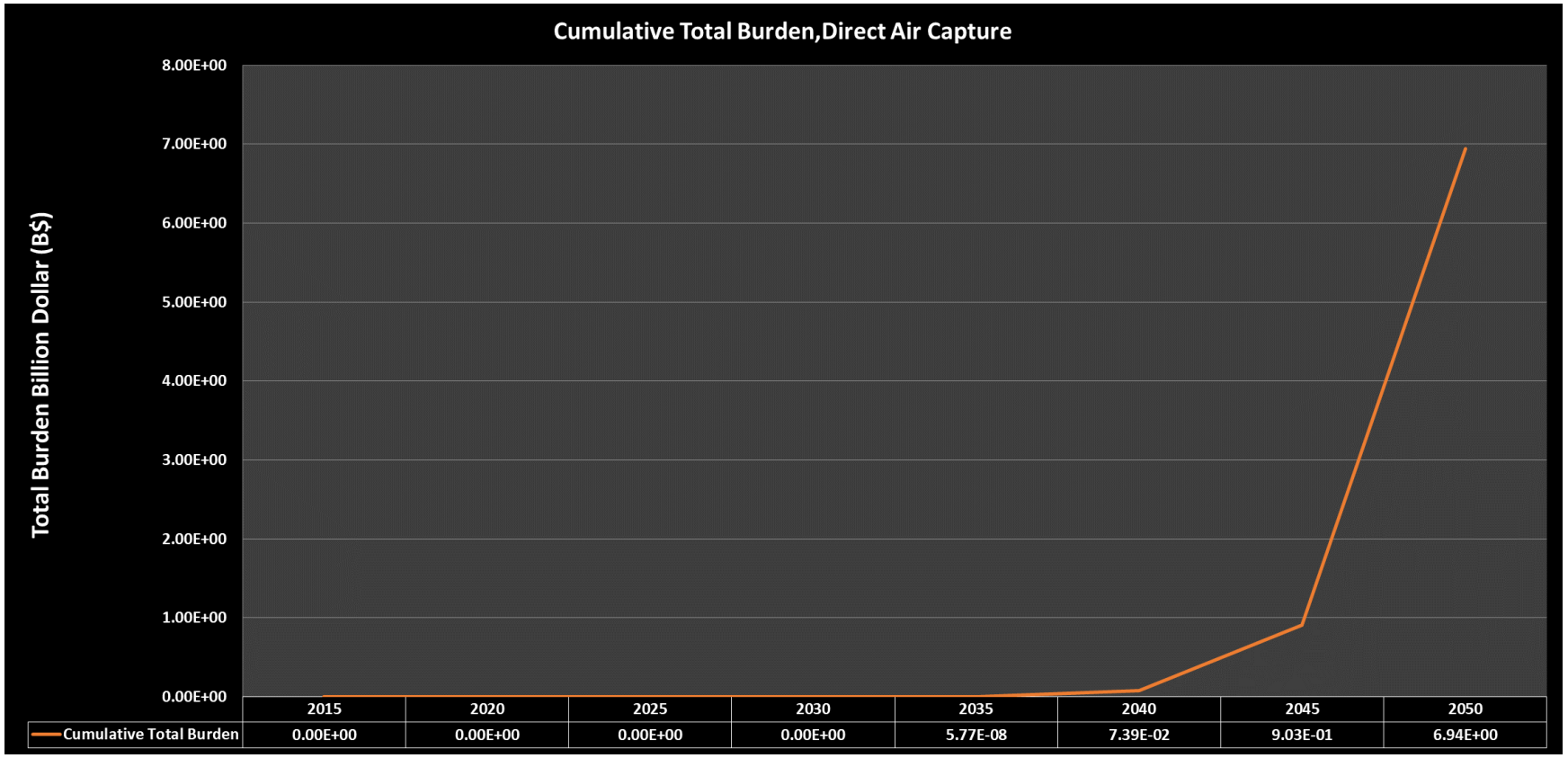


	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.90E-08	2.46E+01	7.37E+01	1.04E+02
British Columbia	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-05	0.00E+00	1.80E+02	1.73E+03
Saskkatchewan	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-07	7.13E-02	5.86E+00	1.10E+01

National Burden ($B) (2015-2050)

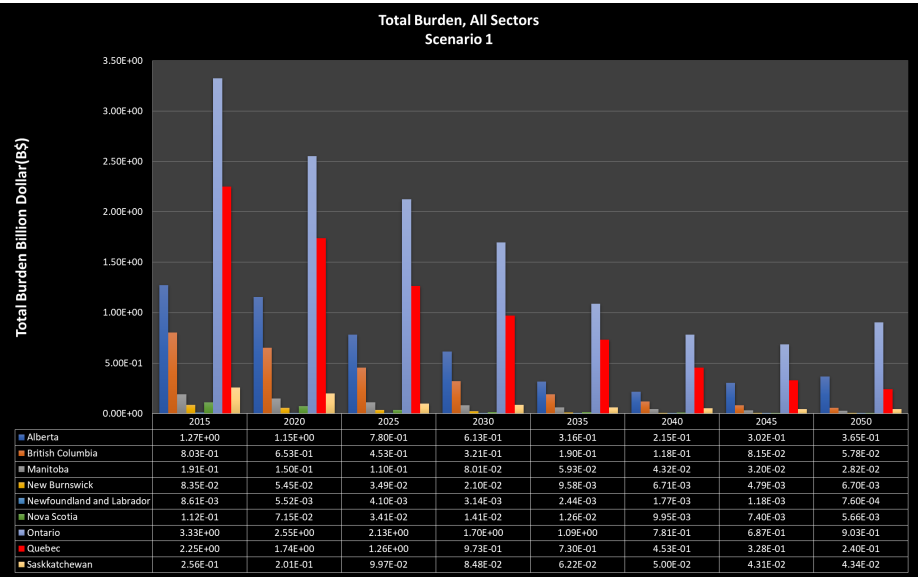


Cumulative National Total Burden ($B) (2015-2050)

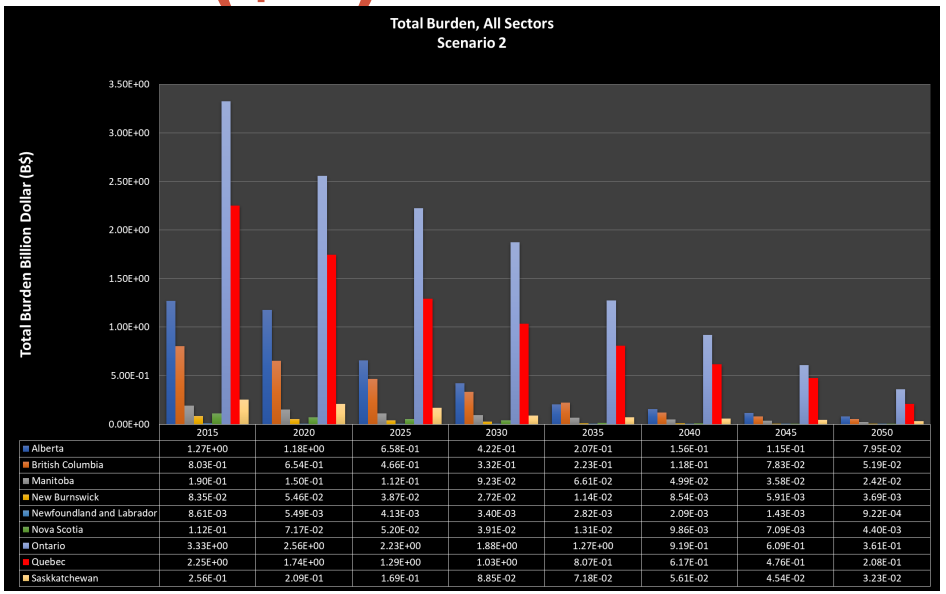


All Sectors

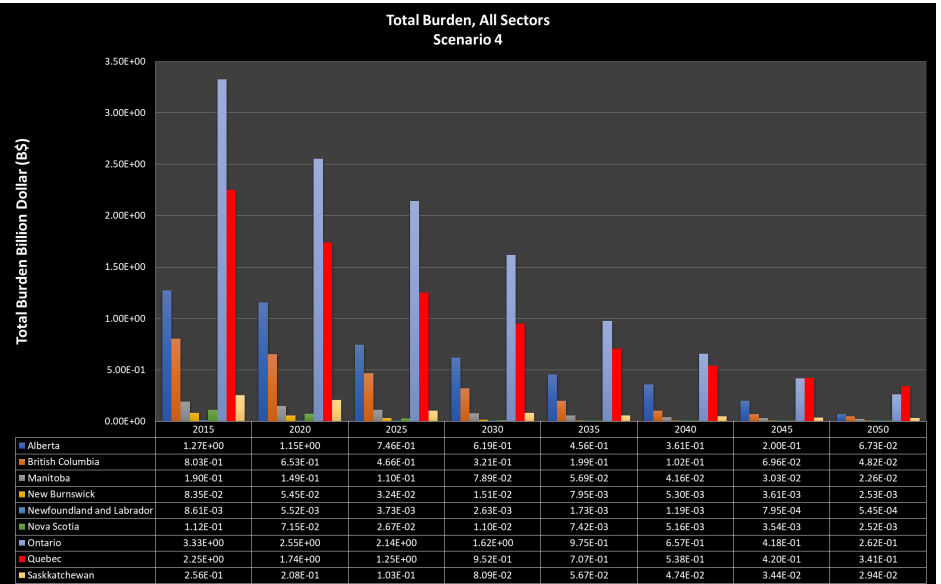
Total Burden ($B)



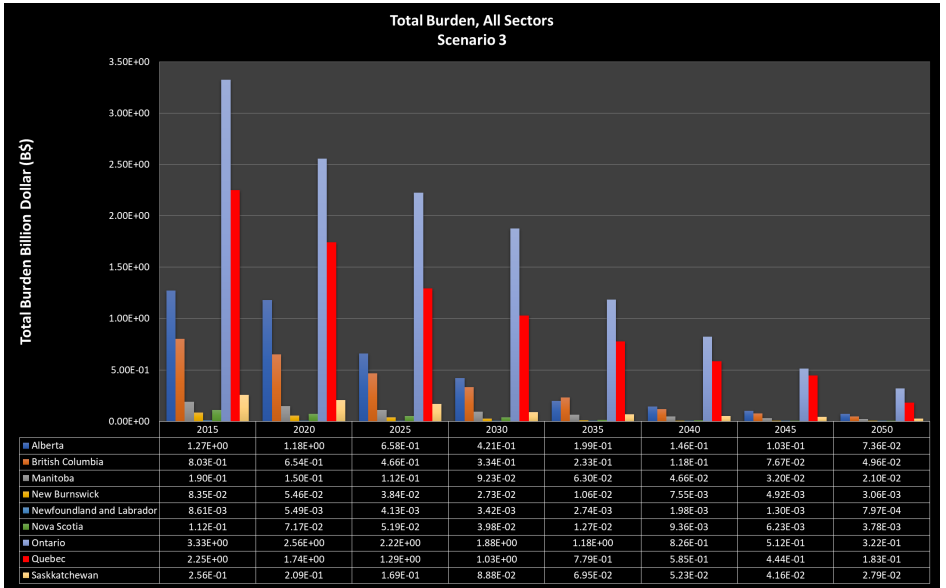
	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+00	1.15E+00	7.80E-01	6.13E-01	3.16E-01	2.15E-01	3.02E-01	3.65E-01
British Columbia	8.03E-01	6.53E-01	4.53E-01	3.21E-01	1.90E-01	1.18E-01	8.15E-02	5.78E-02
Manitoba	1.91E-01	1.50E-01	1.10E-01	8.01E-02	5.93E-02	4.32E-02	3.20E-02	2.82E-02
New Burnswick	8.35E-02	5.45E-02	3.49E-02	2.10E-02	9.58E-03	6.71E-03	4.79E-03	6.70E-03
Newfoundland and Labrador	8.61E-03	5.52E-03	4.10E-03	3.14E-03	2.44E-03	1.77E-03	1.18E-03	7.60E-04
Nova Scotia	1.12E-01	7.15E-02	3.41E-02	1.41E-02	1.26E-02	9.95E-03	7.40E-03	5.66E-03
Ontario	3.33E+00	2.55E+00	2.13E+00	1.70E+00	1.09E+00	7.81E-01	6.87E-01	9.03E-01
Quebec	2.25E+00	1.74E+00	1.26E+00	9.73E-01	7.30E-01	4.53E-01	3.28E-01	2.40E-01
Saskkatchewan	2.56E-01	2.01E-01	9.97E-02	8.48E-02	6.22E-02	5.00E-02	4.31E-02	4.34E-02



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+00	1.18E+00	6.58E-01	4.22E-01	2.07E-01	1.56E-01	1.15E-01	7.95E-02
British Columbia	8.03E-01	6.54E-01	4.66E-01	3.32E-01	2.23E-01	1.18E-01	7.83E-02	5.19E-02
Manitoba	1.90E-01	1.50E-01	1.12E-01	9.23E-02	6.61E-02	4.99E-02	3.58E-02	2.42E-02
New Burnswick	8.35E-02	5.46E-02	3.87E-02	2.72E-02	1.14E-02	8.54E-03	5.91E-03	3.69E-03
Newfoundland and Labrador	8.61E-03	5.49E-03	4.13E-03	3.40E-03	2.82E-03	2.09E-03	1.43E-03	9.22E-04
Nova Scotia	1.12E-01	7.17E-02	5.20E-02	3.91E-02	1.31E-02	9.86E-03	7.09E-03	4.40E-03
Ontario	3.33E+00	2.56E+00	2.23E+00	1.88E+00	1.27E+00	9.19E-01	6.09E-01	3.61E-01
Quebec	2.25E+00	1.74E+00	1.29E+00	1.03E+00	8.07E-01	6.17E-01	4.76E-01	2.08E-01
Saskkatchewan	2.56E-01	2.09E-01	1.69E-01	8.85E-02	7.18E-02	5.61E-02	4.54E-02	3.23E-02

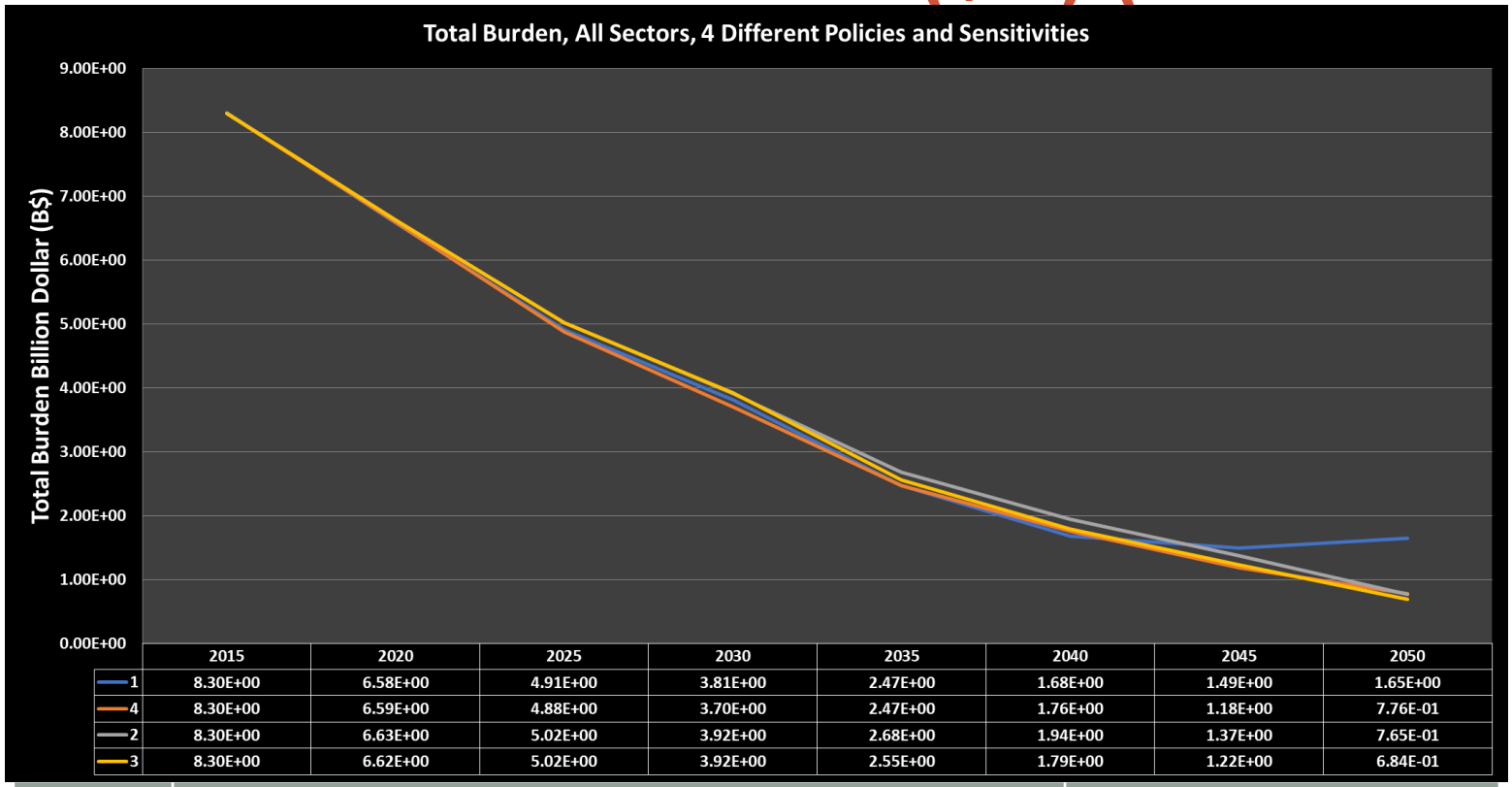


	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+00	1.15E+00	7.46E-01	6.19E-01	4.56E-01	3.61E-01	2.00E-01	6.73E-02
British Columbia	8.03E-01	6.53E-01	4.66E-01	3.21E-01	1.99E-01	1.02E-01	6.96E-02	4.82E-02
Manitoba	1.90E-01	1.49E-01	1.10E-01	7.89E-02	5.69E-02	4.16E-02	3.03E-02	2.26E-02
New Burnswick	8.35E-02	5.45E-02	3.24E-02	1.51E-02	7.95E-03	5.30E-03	3.61E-03	2.53E-03
Newfoundland and Labrador	8.61E-03	5.52E-03	3.73E-03	2.63E-03	1.73E-03	1.19E-03	7.95E-04	5.45E-04
Nova Scotia	1.12E-01	7.15E-02	2.67E-02	1.10E-02	7.42E-03	5.16E-03	3.54E-03	2.52E-03
Ontario	3.33E+00	2.55E+00	2.14E+00	1.62E+00	9.75E-01	6.57E-01	4.18E-01	2.62E-01
Quebec	2.25E+00	1.74E+00	1.25E+00	9.52E-01	7.07E-01	5.38E-01	4.20E-01	3.41E-01
Saskkatchewan	2.56E-01	2.08E-01	1.03E-01	8.09E-02	5.67E-02	4.74E-02	3.44E-02	2.94E-02



	2015	2020	2025	2030	2035	2040	2045	2050
Alberta	1.27E+00	1.18E+00	6.58E-01	4.21E-01	1.99E-01	1.46E-01	1.03E-01	7.36E-02
British Columbia	8.03E-01	6.54E-01	4.66E-01	3.34E-01	2.33E-01	1.18E-01	7.67E-02	4.96E-02
Manitoba	1.90E-01	1.50E-01	1.12E-01	9.23E-02	6.30E-02	4.66E-02	3.20E-02	2.10E-02
New Burnswick	8.35E-02	5.46E-02	3.84E-02	2.73E-02	1.06E-02	7.55E-03	4.92E-03	3.06E-03
Newfoundland and Labrador	8.61E-03	5.49E-03	4.13E-03	3.42E-03	2.74E-03	1.98E-03	1.30E-03	7.97E-04
Nova Scotia	1.12E-01	7.17E-02	5.19E-02	3.98E-02	1.27E-02	9.36E-03	6.23E-03	3.78E-03
Ontario	3.33E+00	2.56E+00	2.22E+00	1.88E+00	1.18E+00	8.26E-01	5.12E-01	3.22E-01
Quebec	2.25E+00	1.74E+00	1.29E+00	1.03E+00	7.79E-01	5.85E-01	4.44E-01	1.83E-01
Saskkatchewan	2.56E-01	2.09E-01	1.69E-01	8.88E-02	6.95E-02	5.23E-02	4.16E-02	2.79E-02

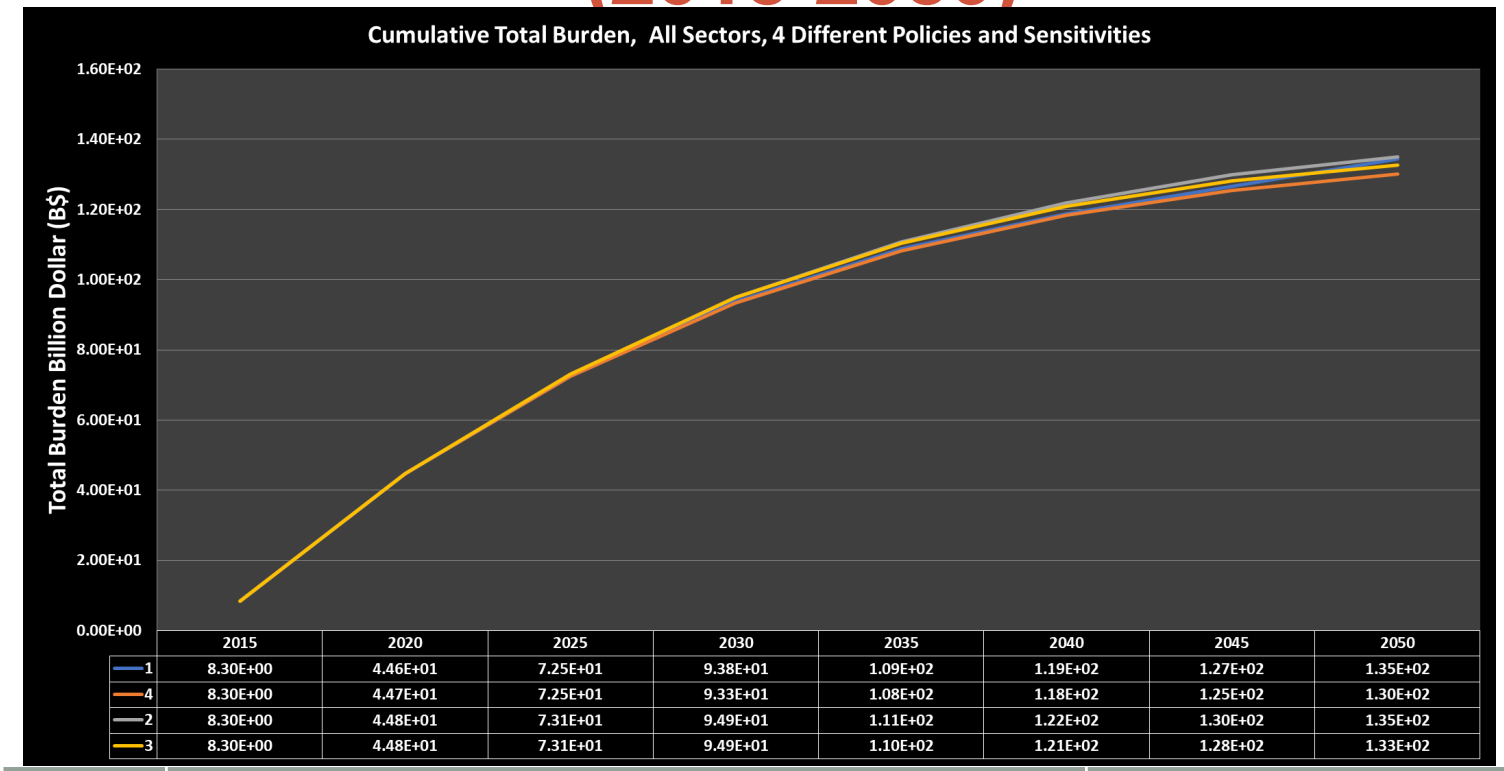
National Total Burden ($B) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	8.30E+00	6.58E+00	4.91E+00	3.81E+00	2.47E+00	1.68E+00	1.49E+00	1.65E+00
4	8.30E+00	6.59E+00	4.88E+00	3.70E+00	2.47E+00	1.76E+00	1.18E+00	7.76E-01
2	8.30E+00	6.63E+00	5.02E+00	3.92E+00	2.68E+00	1.94E+00	1.37E+00	7.65E-01
3	8.30E+00	6.62E+00	5.02E+00	3.92E+00	2.55E+00	1.79E+00	1.22E+00	6.84E-01

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

Cumulative National Total Burden ($B) (2015-2050)



	2015	2020	2025	2030	2035	2040	2045	2050
1	8.30E+00	4.46E+01	7.25E+01	9.38E+01	1.09E+02	1.19E+02	1.27E+02	1.35E+02
4	8.30E+00	4.47E+01	7.25E+01	9.33E+01	1.08E+02	1.18E+02	1.25E+02	1.30E+02
2	8.30E+00	4.48E+01	7.31E+01	9.49E+01	1.11E+02	1.22E+02	1.30E+02	1.35E+02
3	8.30E+00	4.48E+01	7.31E+01	9.49E+01	1.10E+02	1.21E+02	1.28E+02	1.33E+02

ID	Policy	Sensitivity
1	low ev cost	p04-cap+row+fast
2	ccs/dac unavail; new nuclear avail	p04-cap+row+fast
3	ccs/dac unavail; new nuclear avail;low ev cost	p04-cap+row+fast
4	ccs/dac unavail; new nuclear avail;low ev cost	p03-cap+fast

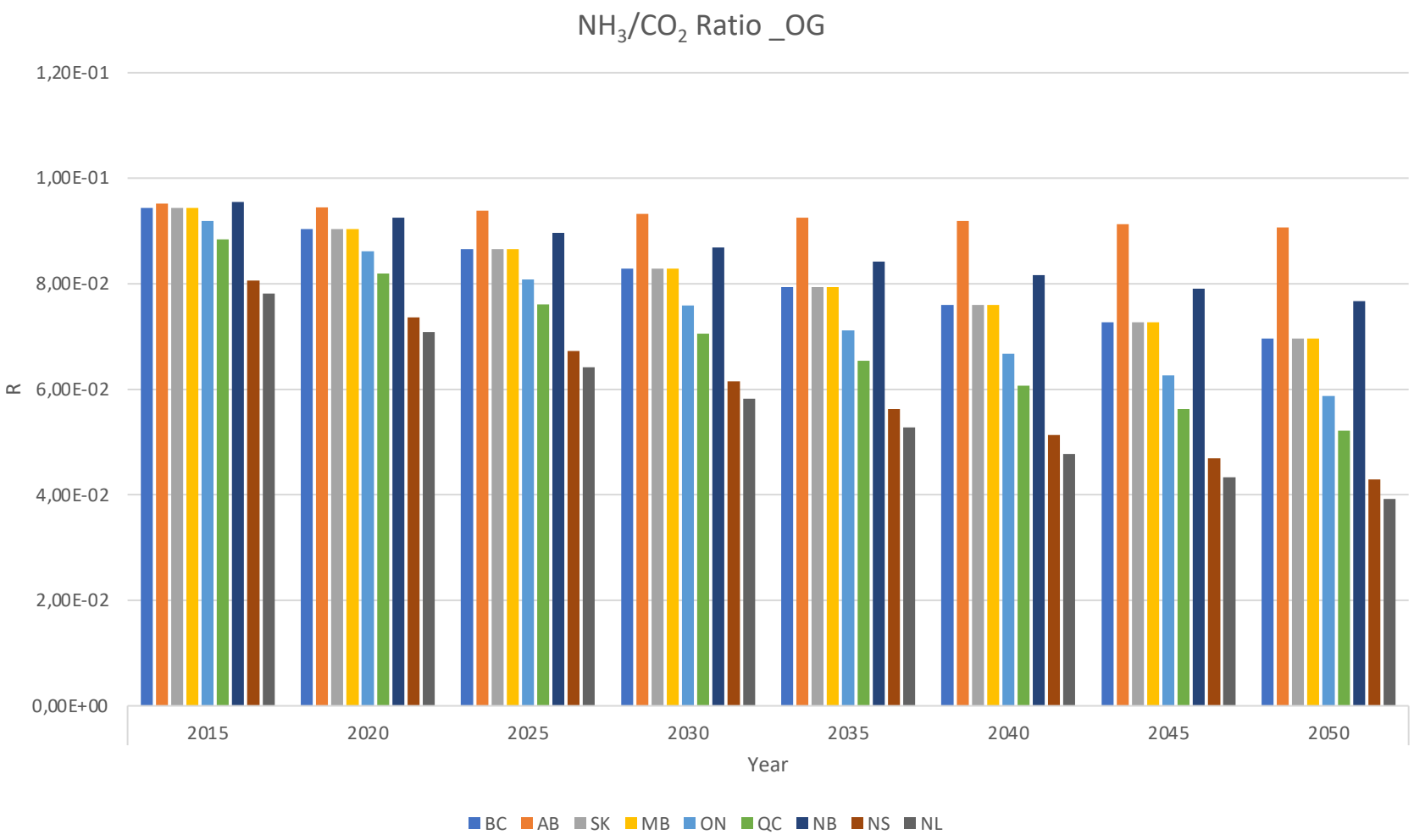
EXTRA

EXTRA

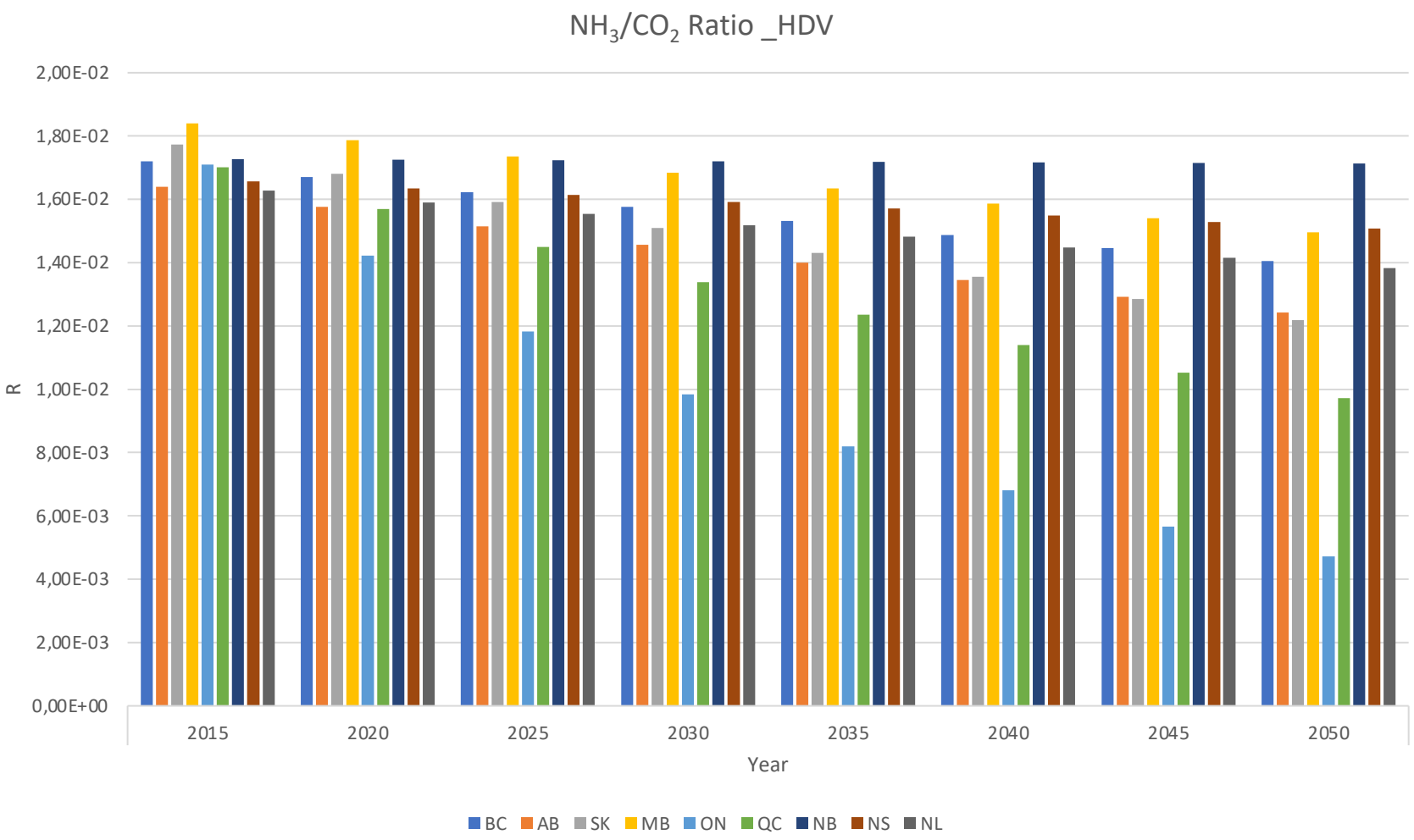
Intensity Ratios

NH_3

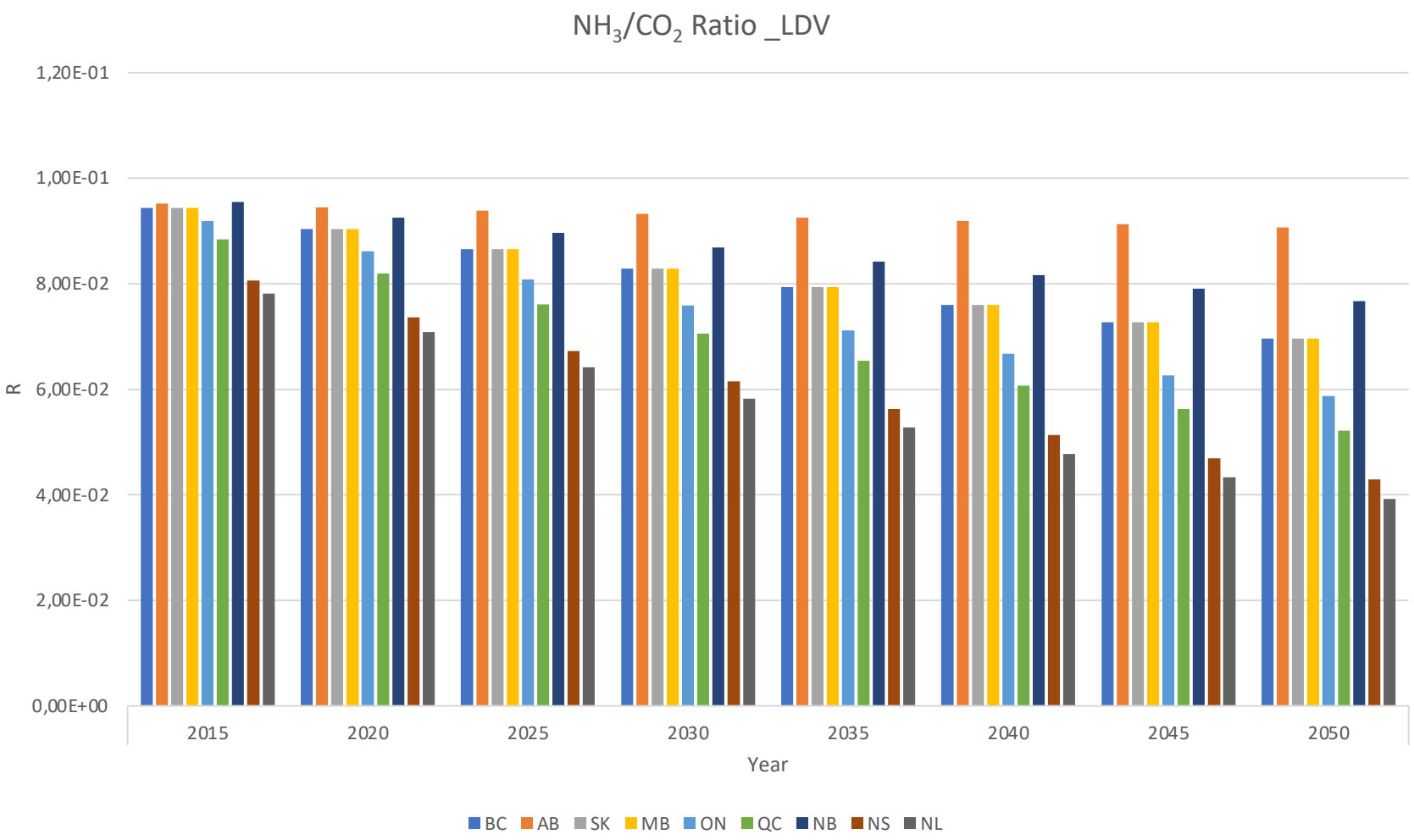
NH_3/CO_2 Ratio _OG



NH_3/CO_2 Ratio _HDV

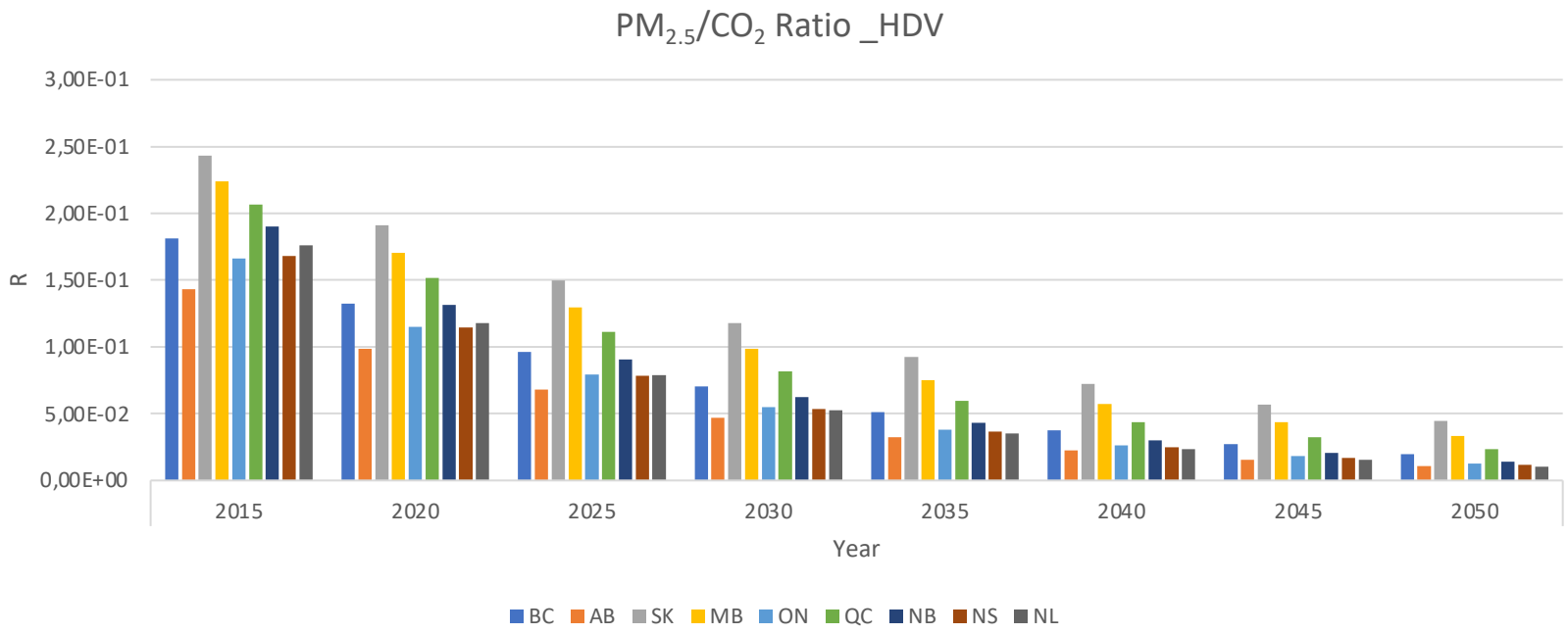


NH_3/CO_2 Ratio _LDV

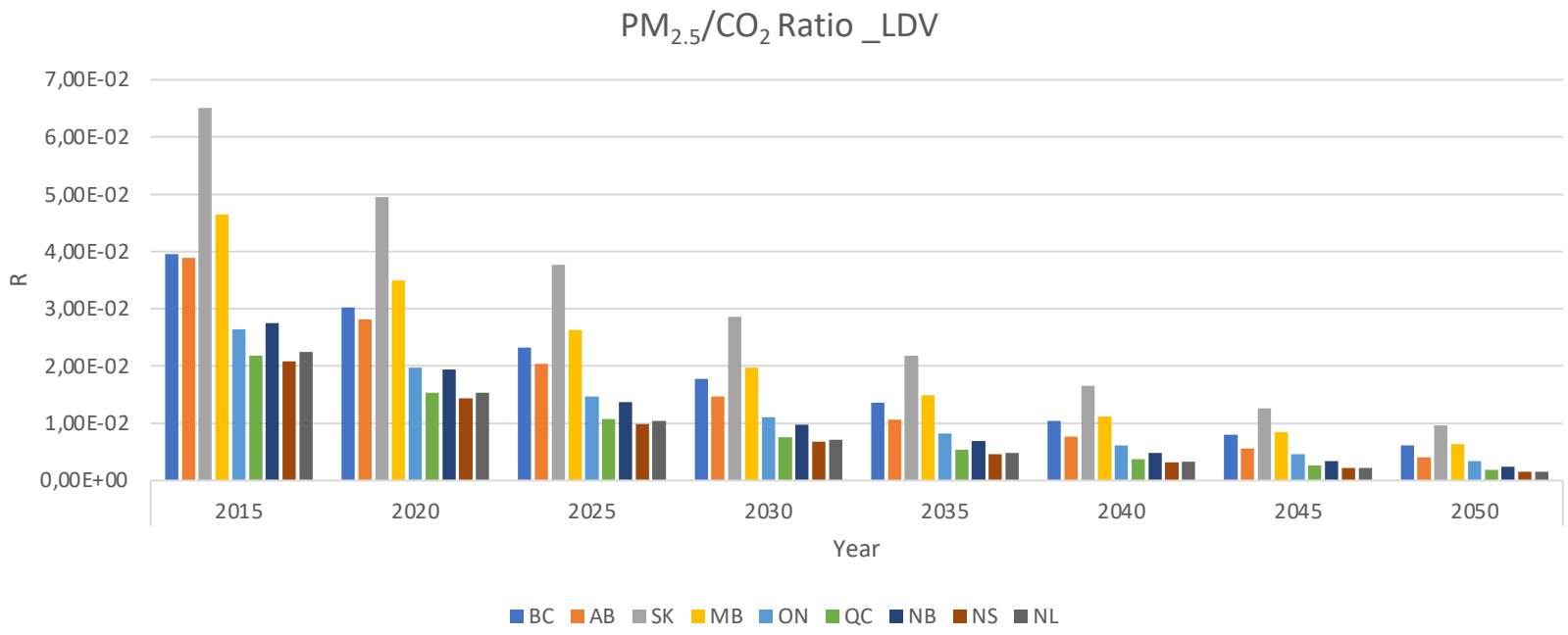


$PM_{2.5}$

$PM_{2.5}/CO_2$ Ratio _HDV

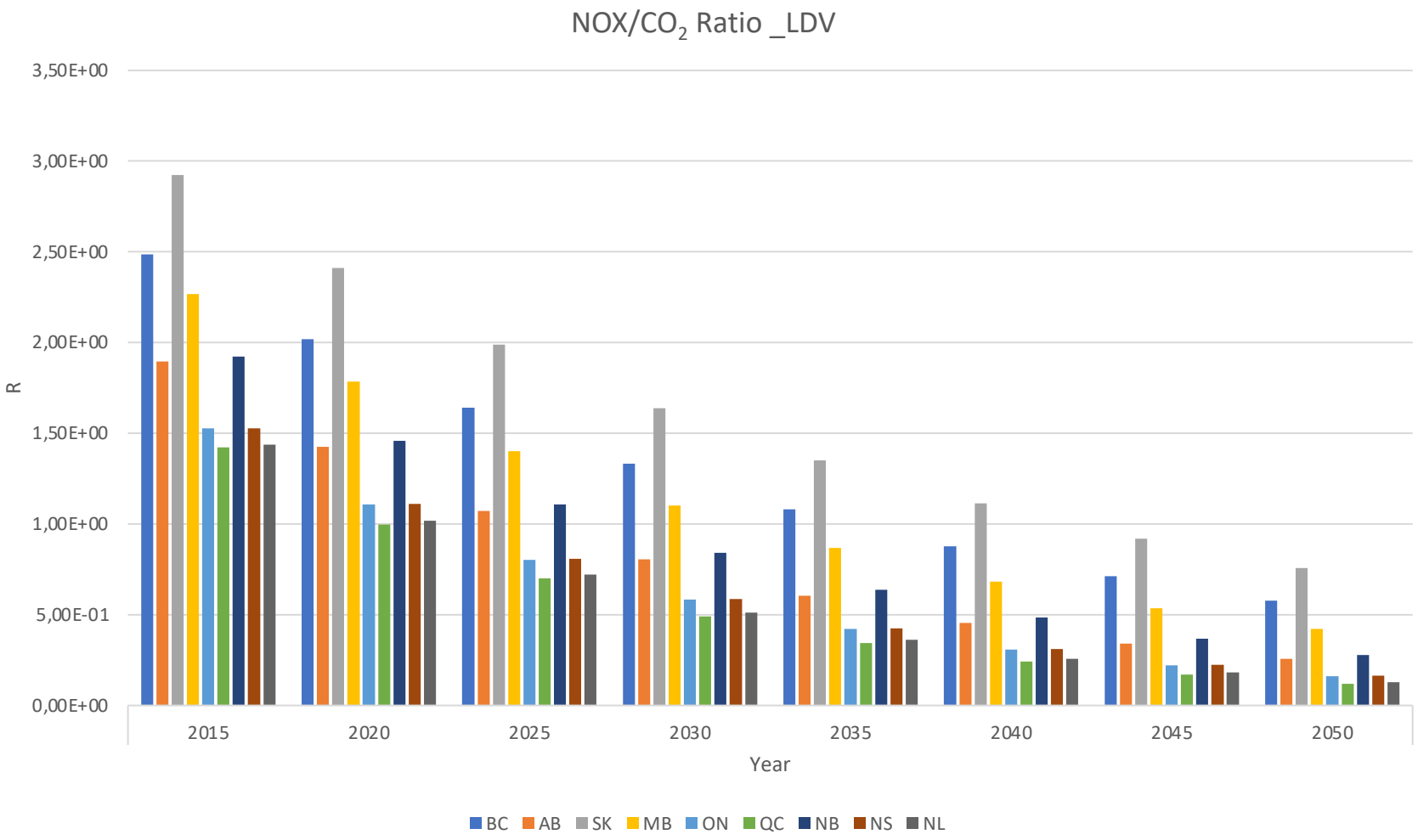


$PM_{2.5}/CO_2$ Ratio _LDV

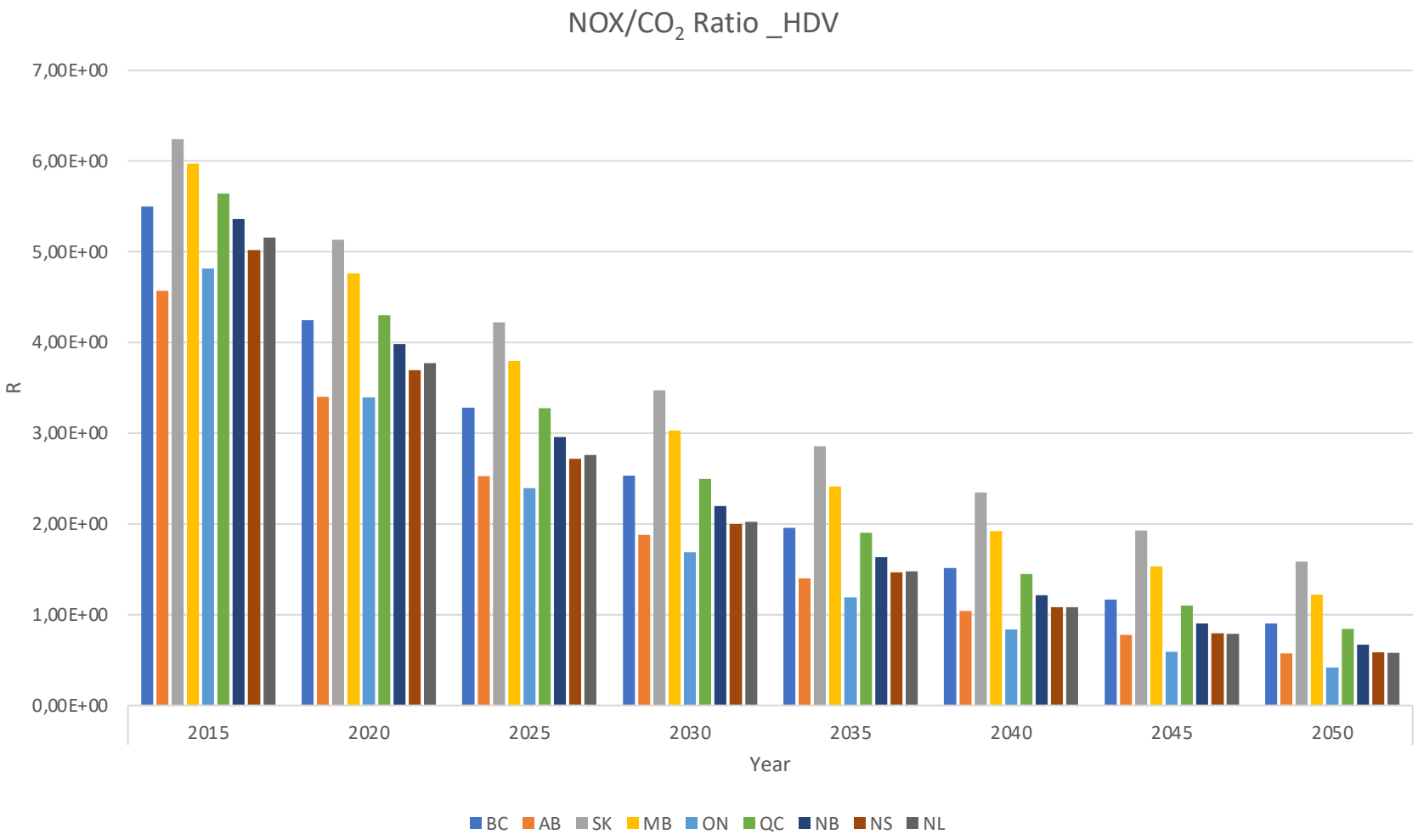


NO_X

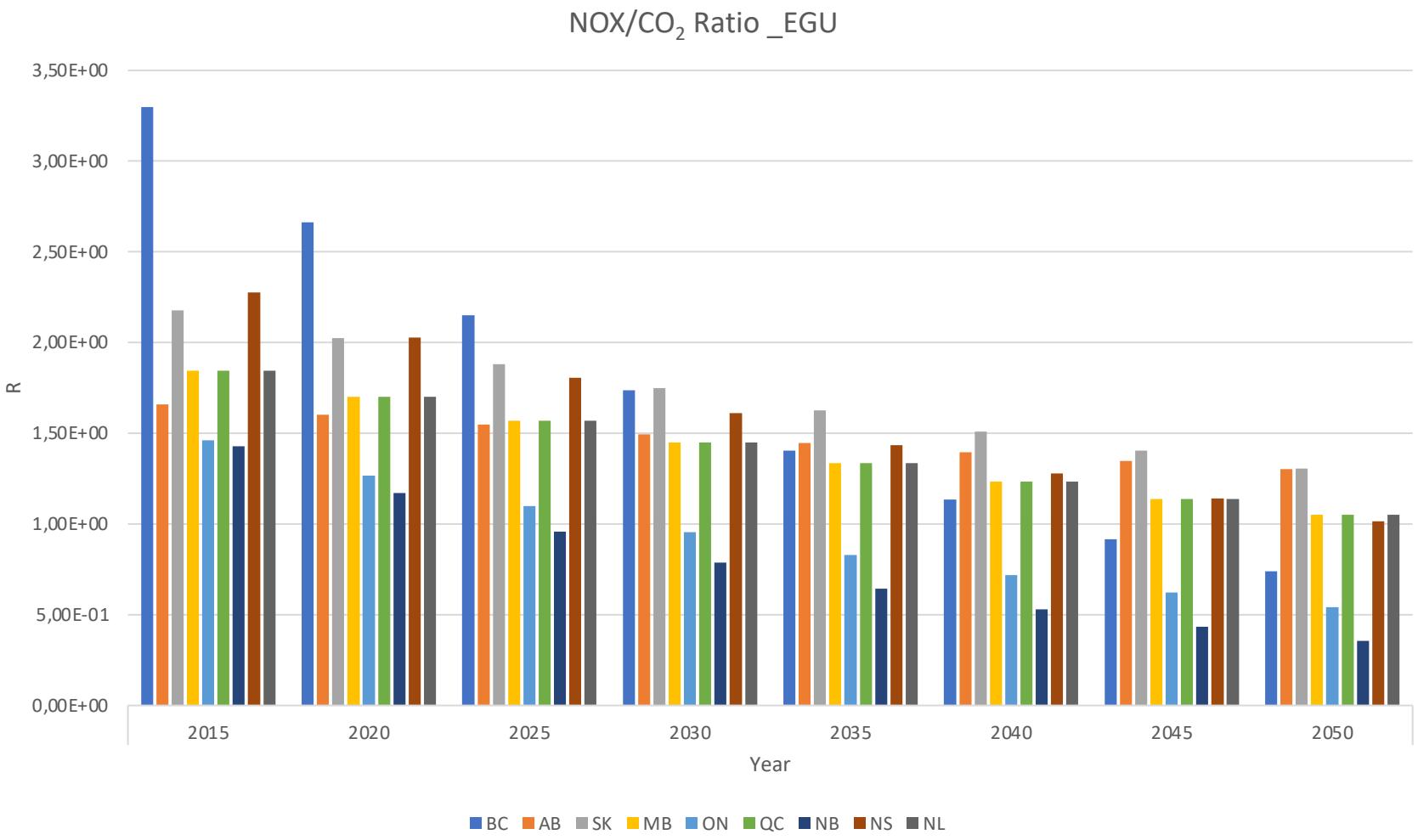
NOX/CO_2 Ratio _LDV



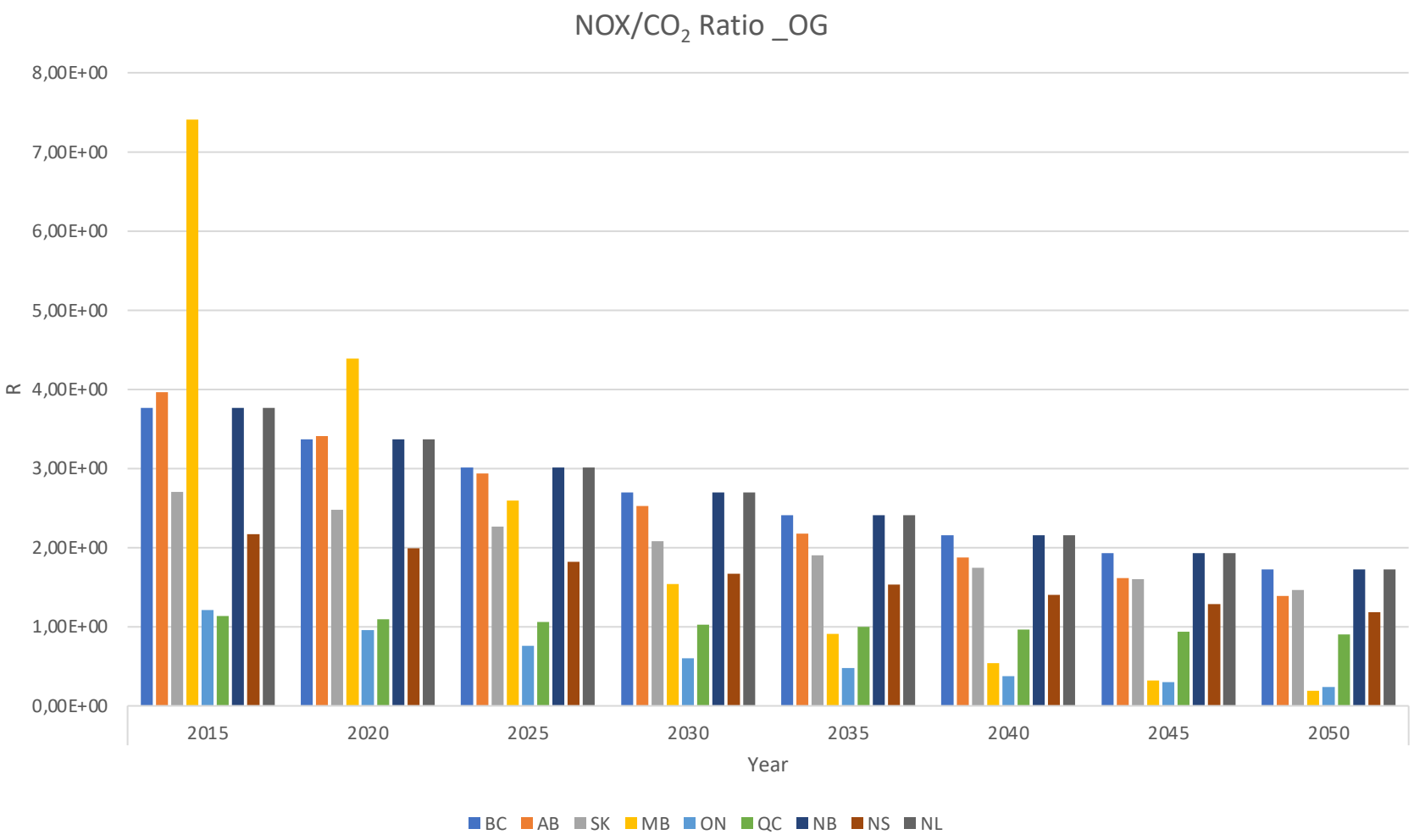
NOX/CO_2 Ratio _HDV



NOX/CO_2 Ratio _EGU

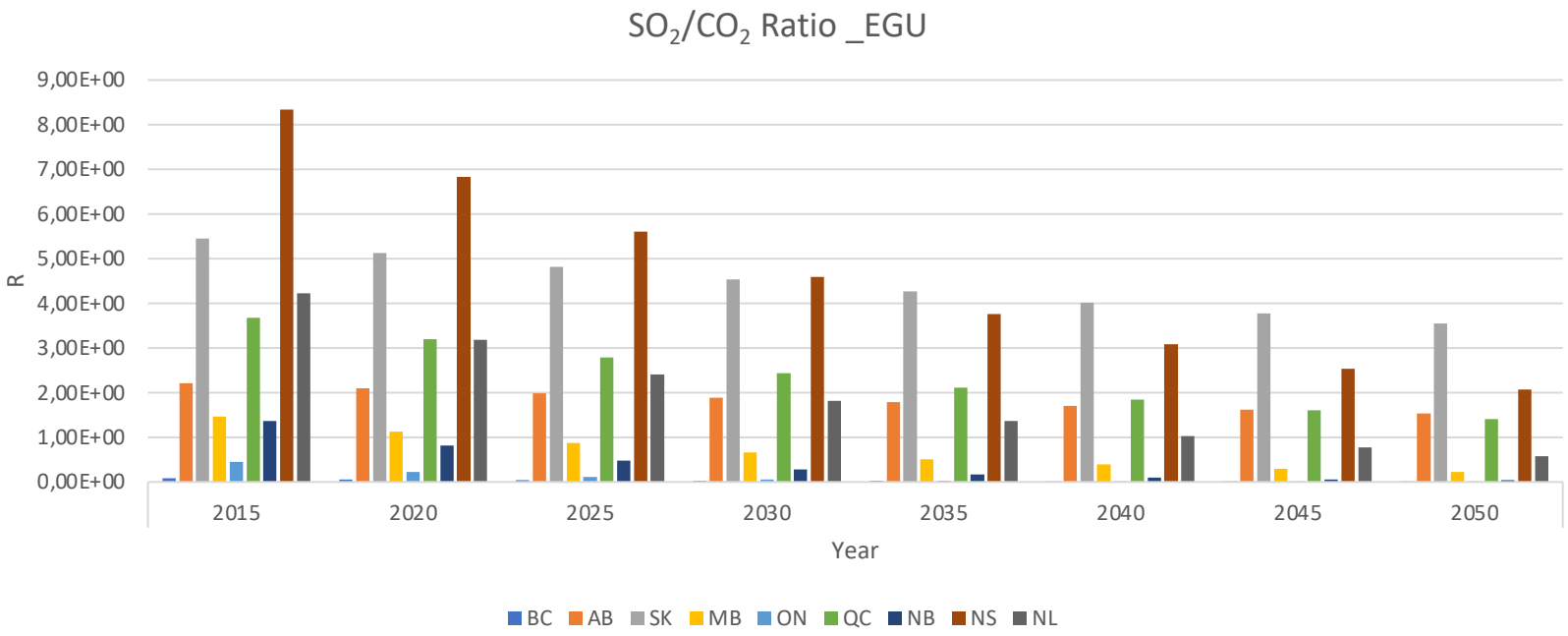


NOX/CO_2 Ratio _OG

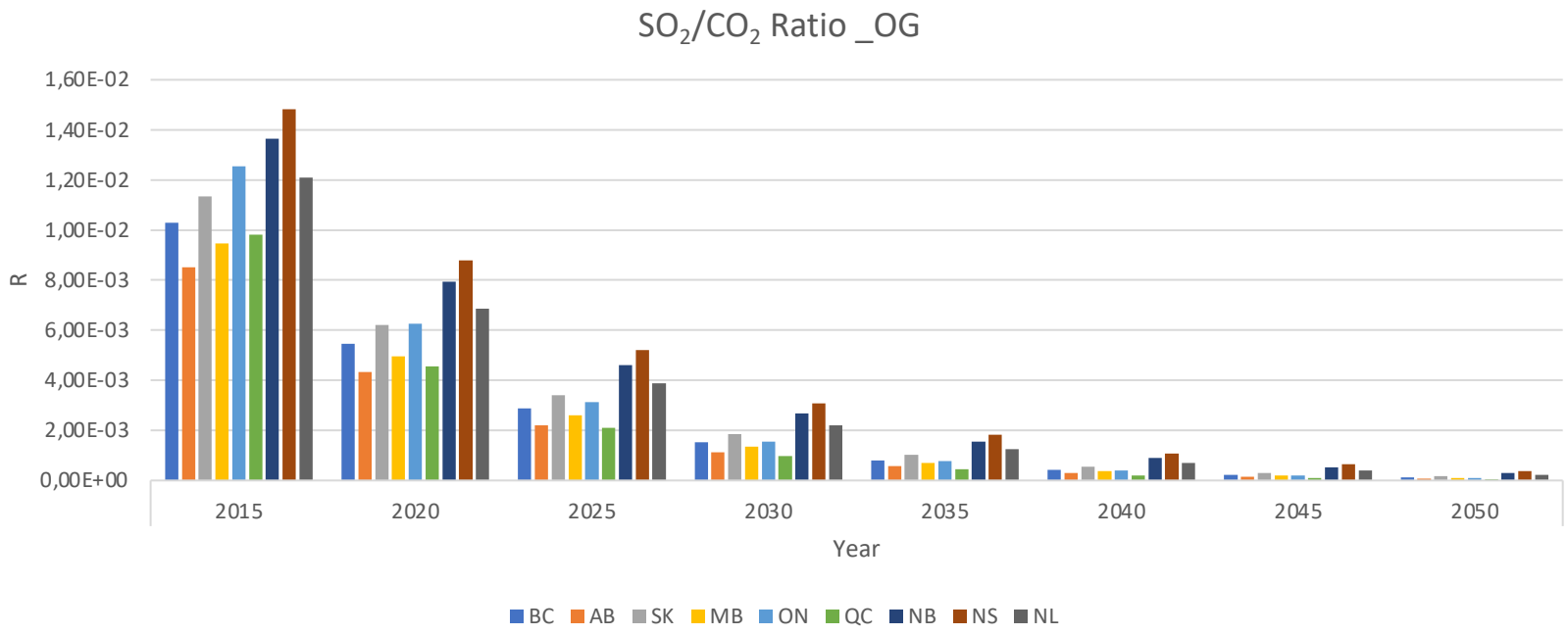


SO_2

SO_2/CO_2 Ratio _EGU



SO_2/CO_2 Ratio _OG

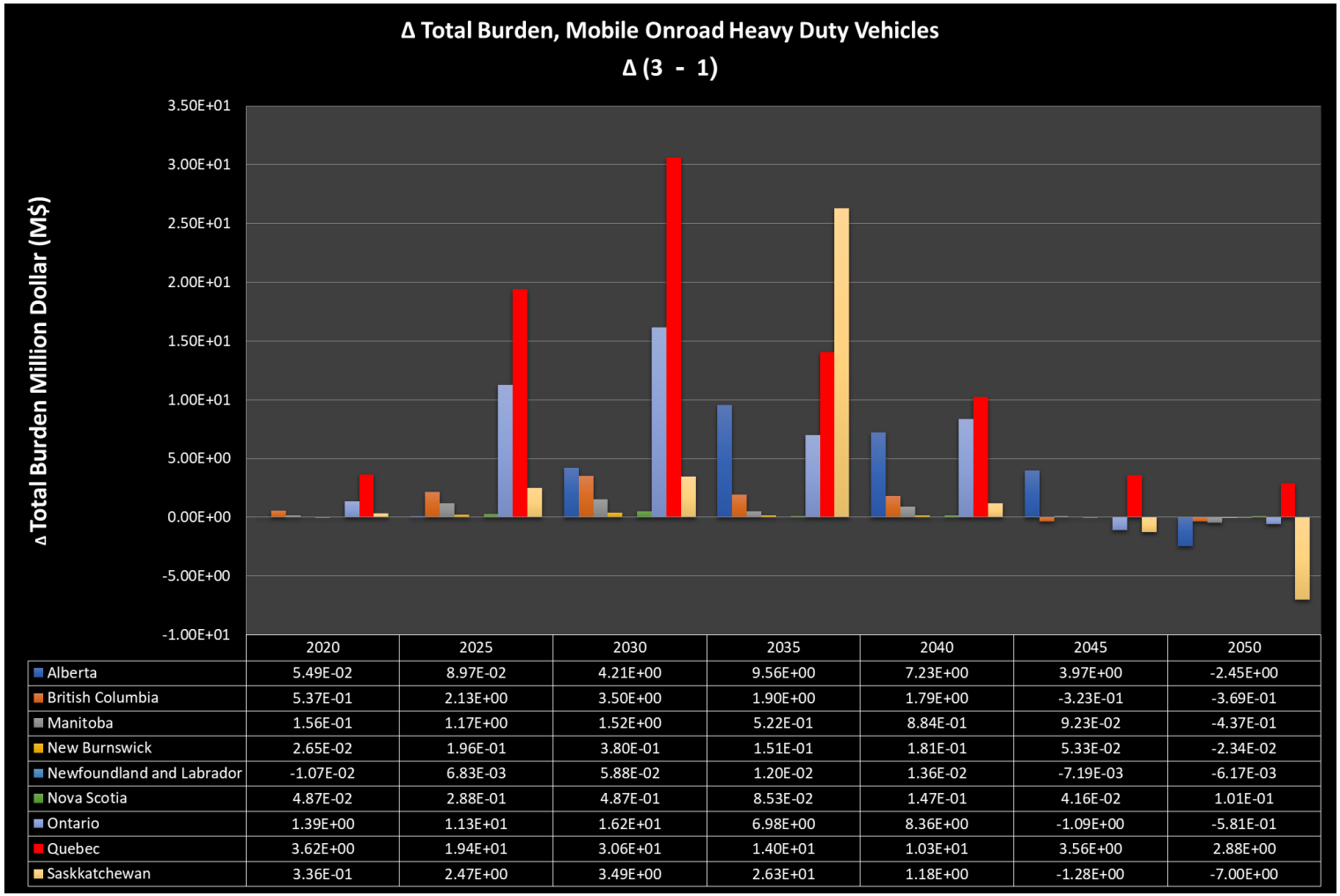


EXTRA

Burdens – inter-scenario comparisons

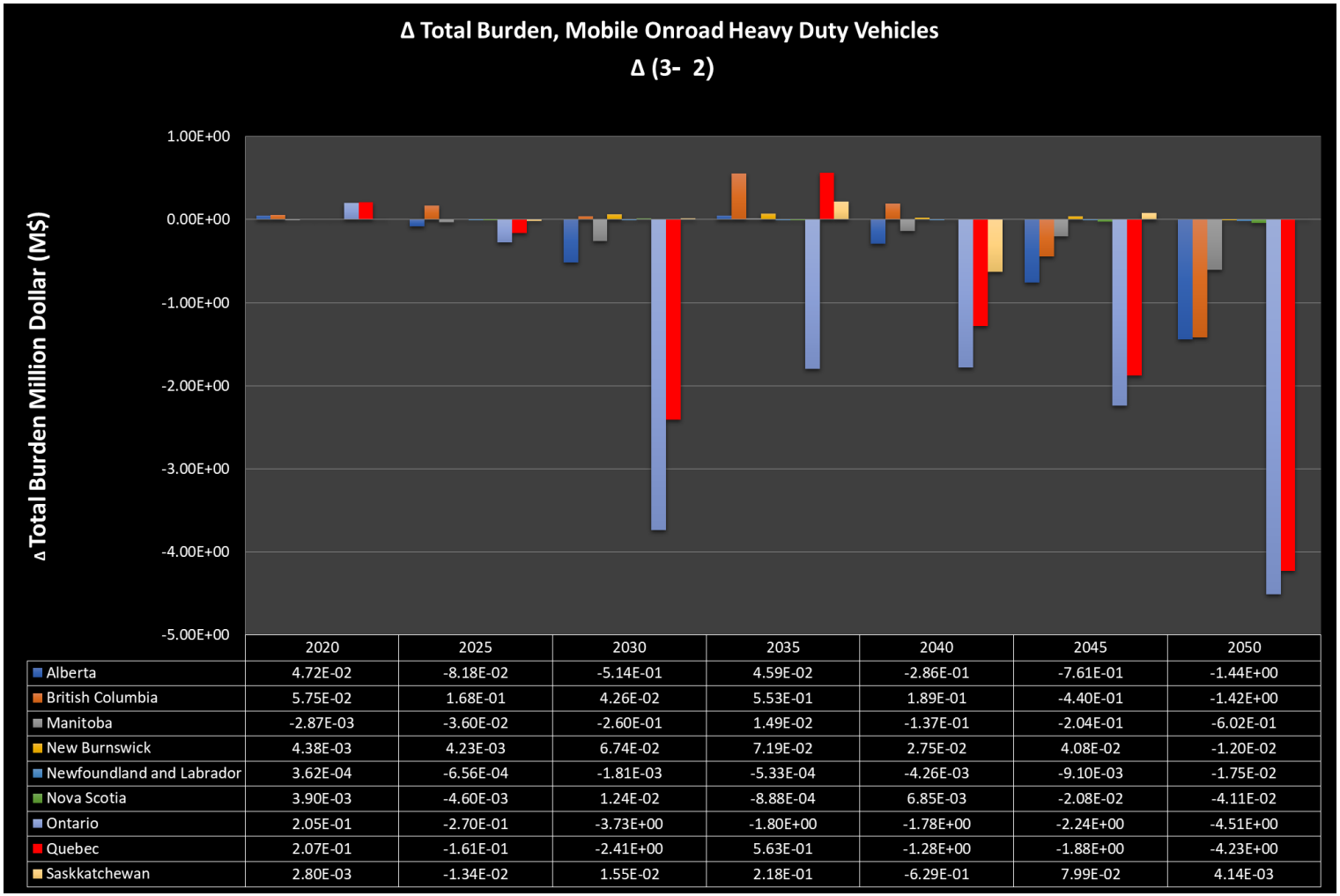
Heavy Duty Vehicles (HDVs)

Provincial Total Burden (M$) Difference Between 3 & 1 (2015-2050)



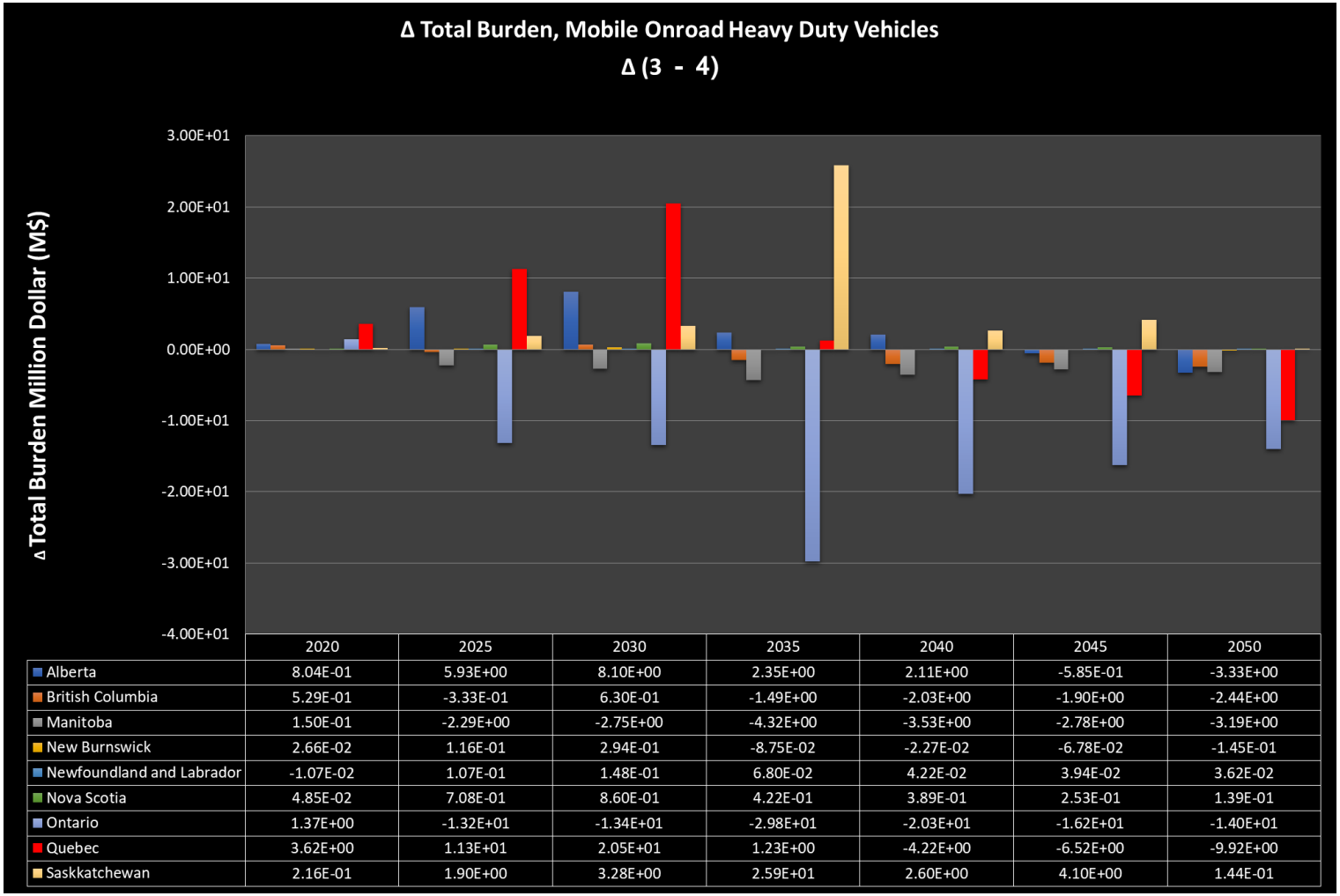
	2020	2025	2030	2035	2040	2045	2050
Alberta	5.49E-02	8.97E-02	4.21E+00	9.56E+00	7.23E+00	3.97E+00	-2.45E+00
British Columbia	5.37E-01	2.13E+00	3.50E+00	1.90E+00	1.79E+00	-3.23E-01	-3.69E-01
Manitoba	1.56E-01	1.17E+00	1.52E+00	5.22E-01	8.84E-01	9.23E-02	-4.37E-01
New Burnswick	2.65E-02	1.96E-01	3.80E-01	1.51E-01	1.81E-01	5.33E-02	-2.34E-02
Newfoundland and Labrador	-1.07E-02	6.83E-03	5.88E-02	1.20E-02	1.36E-02	-7.19E-03	-6.17E-03
Nova Scotia	4.87E-02	2.88E-01	4.87E-01	8.53E-02	1.47E-01	4.16E-02	1.01E-01
Ontario	1.39E+00	1.13E+01	1.62E+01	6.98E+00	8.36E+00	-1.09E+00	-5.81E-01
Quebec	3.62E+00	1.94E+01	3.06E+01	1.40E+01	1.03E+01	3.56E+00	2.88E+00
Saskkatchewan	3.36E-01	2.47E+00	3.49E+00	2.63E+01	1.18E+00	-1.28E+00	-7.00E+00

Provincial Total Burden (M$) Difference Between 3 & 2 (2015-2050)



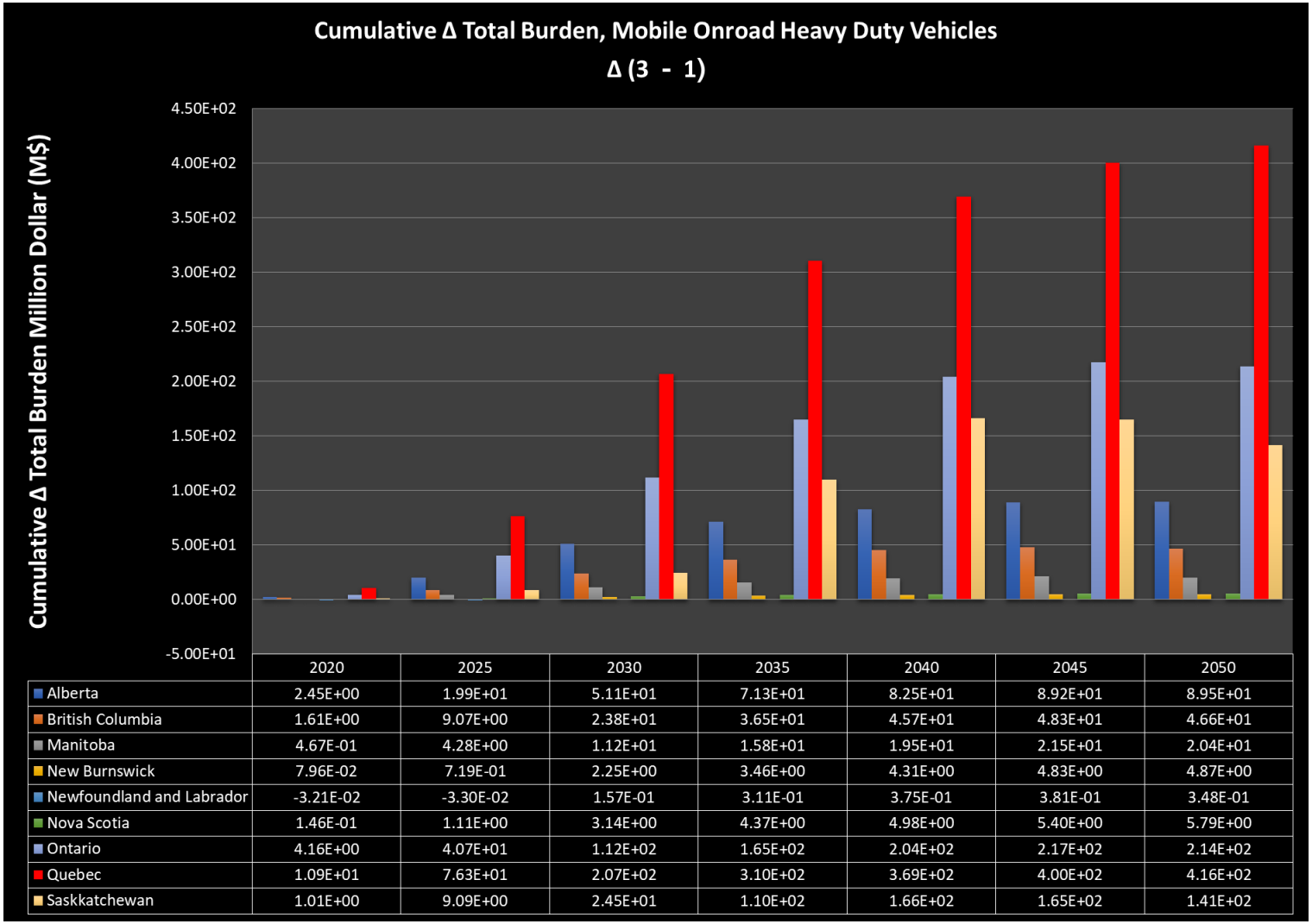
	2020	2025	2030	2035	2040	2045	2050
Alberta	4.72E-02	-8.18E-02	-5.14E-01	4.59E-02	-2.86E-01	-7.61E-01	-1.44E+00
British Columbia	5.75E-02	1.68E-01	4.26E-02	5.53E-01	1.89E-01	-4.40E-01	-1.42E+00
Manitoba	-2.87E-03	-3.60E-02	-2.60E-01	1.49E-02	-1.37E-01	-2.04E-01	-6.02E-01
New Burnswick	4.38E-03	4.23E-03	6.74E-02	7.19E-02	2.75E-02	4.08E-02	-1.20E-02
Newfoundland and Labrador	3.62E-04	-6.56E-04	-1.81E-03	-5.33E-04	-4.26E-03	-9.10E-03	-1.75E-02
Nova Scotia	3.90E-03	-4.60E-03	1.24E-02	-8.88E-04	6.85E-03	-2.08E-02	-4.11E-02
Ontario	2.05E-01	-2.70E-01	-3.73E+00	-1.80E+00	-1.78E+00	-2.24E+00	-4.51E+00
Quebec	2.07E-01	-1.61E-01	-2.41E+00	5.63E-01	-1.28E+00	-1.88E+00	-4.23E+00
Saskkatchewan	2.80E-03	-1.34E-02	1.55E-02	2.18E-01	-6.29E-01	7.99E-02	4.14E-03

Provincial Total Burden (M$) Difference Between 3 & 4 (2015-2050)



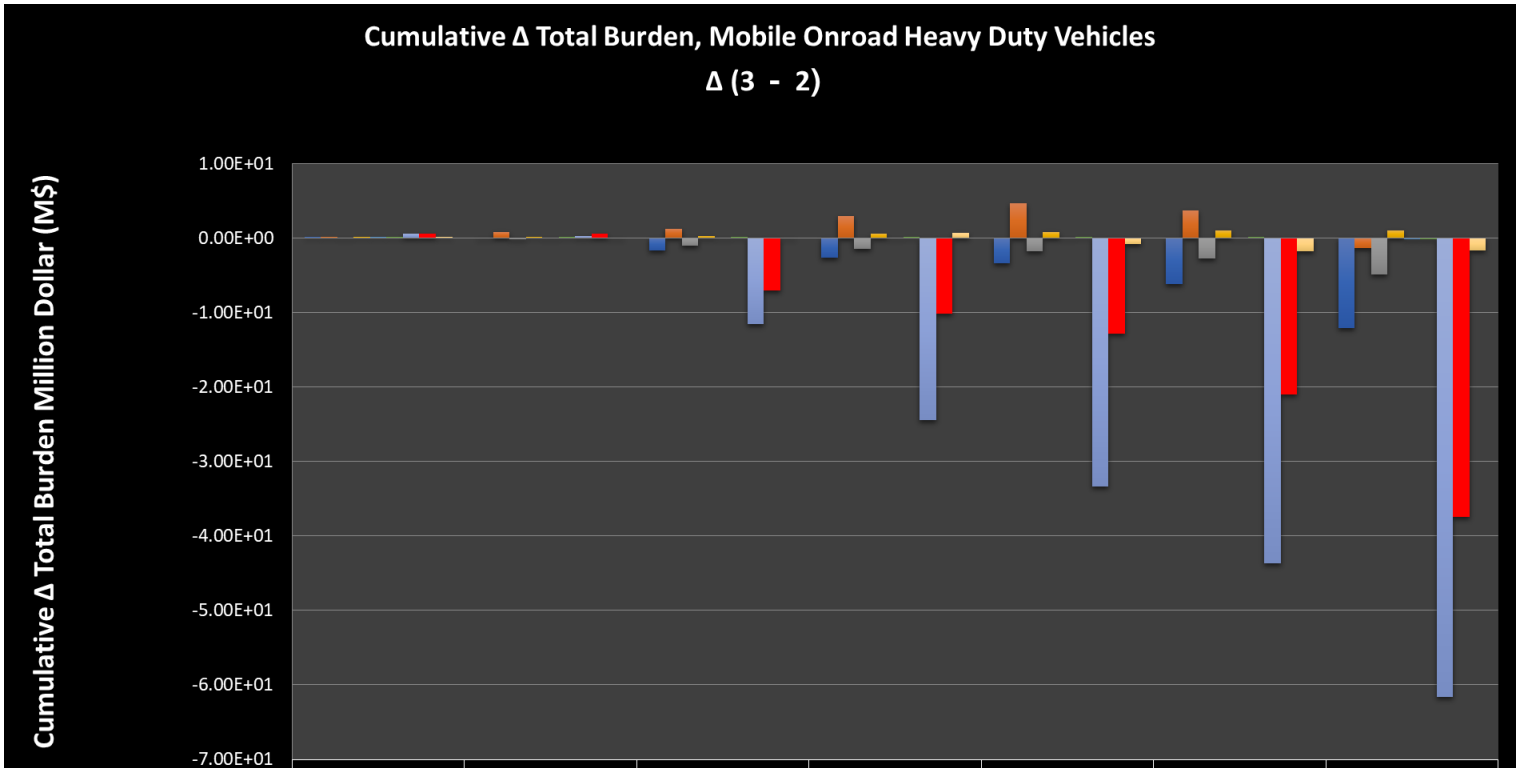
	2020	2025	2030	2035	2040	2045	2050
Alberta	8.04E-01	5.93E+00	8.10E+00	2.35E+00	2.11E+00	-5.85E-01	-3.33E+00
British Columbia	5.29E-01	-3.33E-01	6.30E-01	-1.49E+00	-2.03E+00	-1.90E+00	-2.44E+00
Manitoba	1.50E-01	-2.29E+00	-2.75E+00	-4.32E+00	-3.53E+00	-2.78E+00	-3.19E+00
New Burnswick	2.66E-02	1.16E-01	2.94E-01	-8.75E-02	-2.27E-02	-6.78E-02	-1.45E-01
Newfoundland and Labrador	-1.07E-02	1.07E-01	1.48E-01	6.80E-02	4.22E-02	3.94E-02	3.62E-02
Nova Scotia	4.85E-02	7.08E-01	8.60E-01	4.22E-01	3.89E-01	2.53E-01	1.39E-01
Ontario	1.37E+00	-1.32E+01	-1.34E+01	-2.98E+01	-2.03E+01	-1.62E+01	-1.40E+01
Quebec	3.62E+00	1.13E+01	2.05E+01	1.23E+00	-4.22E+00	-6.52E+00	-9.92E+00
Saskkatchewan	2.16E-01	1.90E+00	3.28E+00	2.59E+01	2.60E+00	4.10E+00	1.44E-01

Provincial Cumulative Total Burden (M$) Difference Between 3 & 1 (2015-2050)



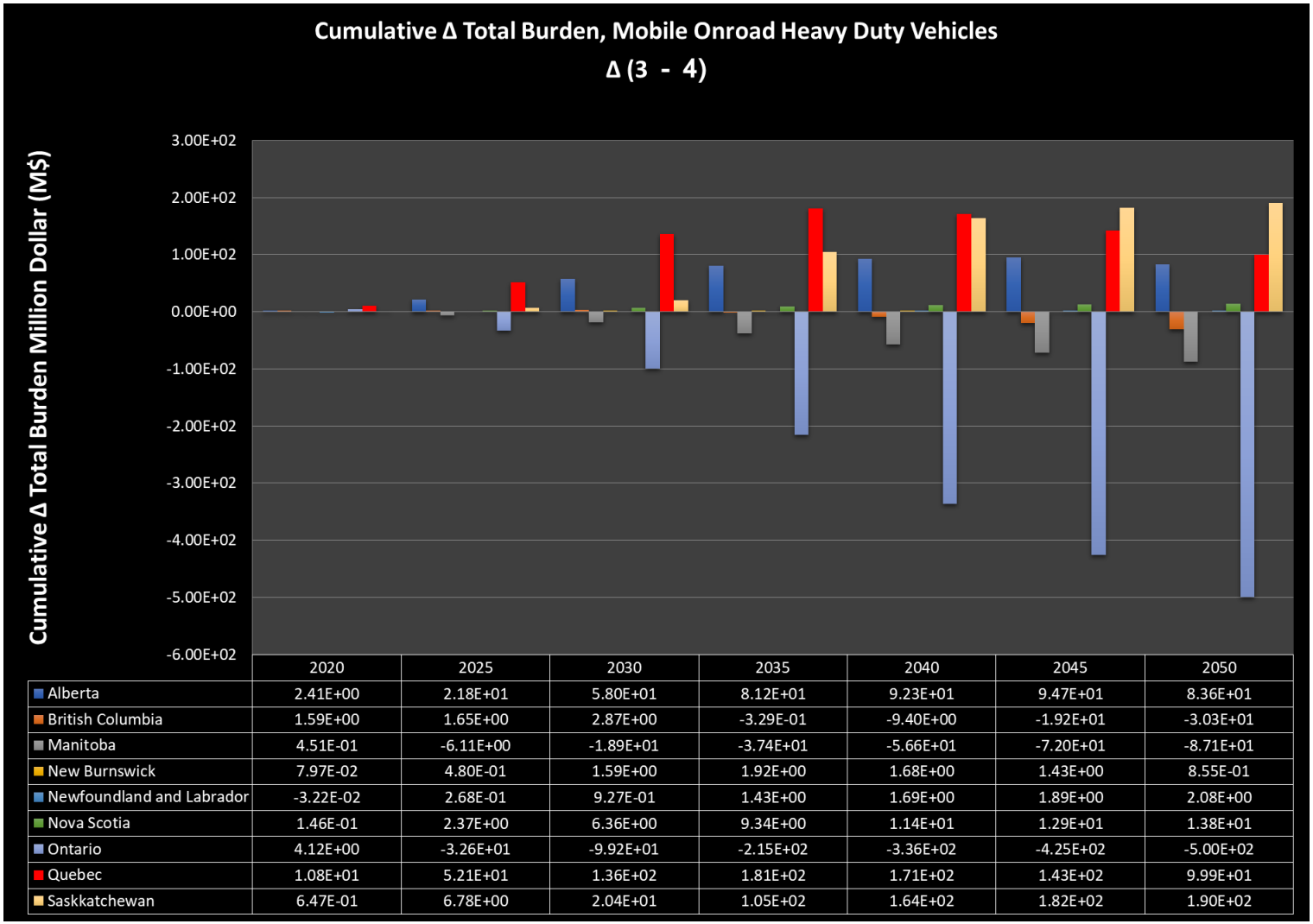
	2020	2025	2030	2035	2040	2045	2050
Alberta	2.45E+00	1.99E+01	5.11E+01	7.13E+01	8.25E+01	8.92E+01	8.95E+01
British Columbia	1.61E+00	9.07E+00	2.38E+01	3.65E+01	4.57E+01	4.83E+01	4.66E+01
Manitoba	4.67E-01	4.28E+00	1.12E+01	1.58E+01	1.95E+01	2.15E+01	2.04E+01
New Burnswick	7.96E-02	7.19E-01	2.25E+00	3.46E+00	4.31E+00	4.83E+00	4.87E+00
Newfoundland and Labrador	-3.21E-02	-3.30E-02	1.57E-01	3.11E-01	3.75E-01	3.81E-01	3.48E-01
Nova Scotia	1.46E-01	1.11E+00	3.14E+00	4.37E+00	4.98E+00	5.40E+00	5.79E+00
Ontario	4.16E+00	4.07E+01	1.12E+02	1.65E+02	2.04E+02	2.17E+02	2.14E+02
Quebec	1.09E+01	7.63E+01	2.07E+02	3.10E+02	3.69E+02	4.00E+02	4.16E+02
Saskkatchewan	1.01E+00	9.09E+00	2.45E+01	1.10E+02	1.66E+02	1.65E+02	1.41E+02

Provincial Cumulative Total Burden (M$) Difference Between 3 & 2 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	1.42E-01	-9.46E-03	-1.72E+00	-2.61E+00	-3.37E+00	-6.23E+00	-1.21E+01
British Columbia	1.73E-01	7.92E-01	1.26E+00	3.00E+00	4.67E+00	3.73E+00	-1.39E+00
Manitoba	-8.62E-03	-1.22E-01	-9.75E-01	-1.45E+00	-1.83E+00	-2.72E+00	-4.93E+00
New Burnswick	1.31E-02	3.46E-02	2.45E-01	5.95E-01	8.21E-01	9.99E-01	1.04E+00
Newfoundland and Labrador	1.09E-03	-1.60E-04	-6.91E-03	-1.21E-02	-2.60E-02	-6.18E-02	-1.33E-01
Nova Scotia	1.17E-02	5.72E-03	3.38E-02	5.60E-02	7.47E-02	2.60E-02	-1.39E-01
Ontario	6.16E-01	2.16E-01	-1.15E+01	-2.44E+01	-3.33E+01	-4.36E+01	-6.17E+01
Quebec	6.20E-01	5.49E-01	-7.00E+00	-1.01E+01	-1.29E+01	-2.11E+01	-3.75E+01
Saskkatchewan	8.40E-03	-2.62E-02	-6.37E-03	6.78E-01	-7.73E-01	-1.79E+00	-1.62E+00

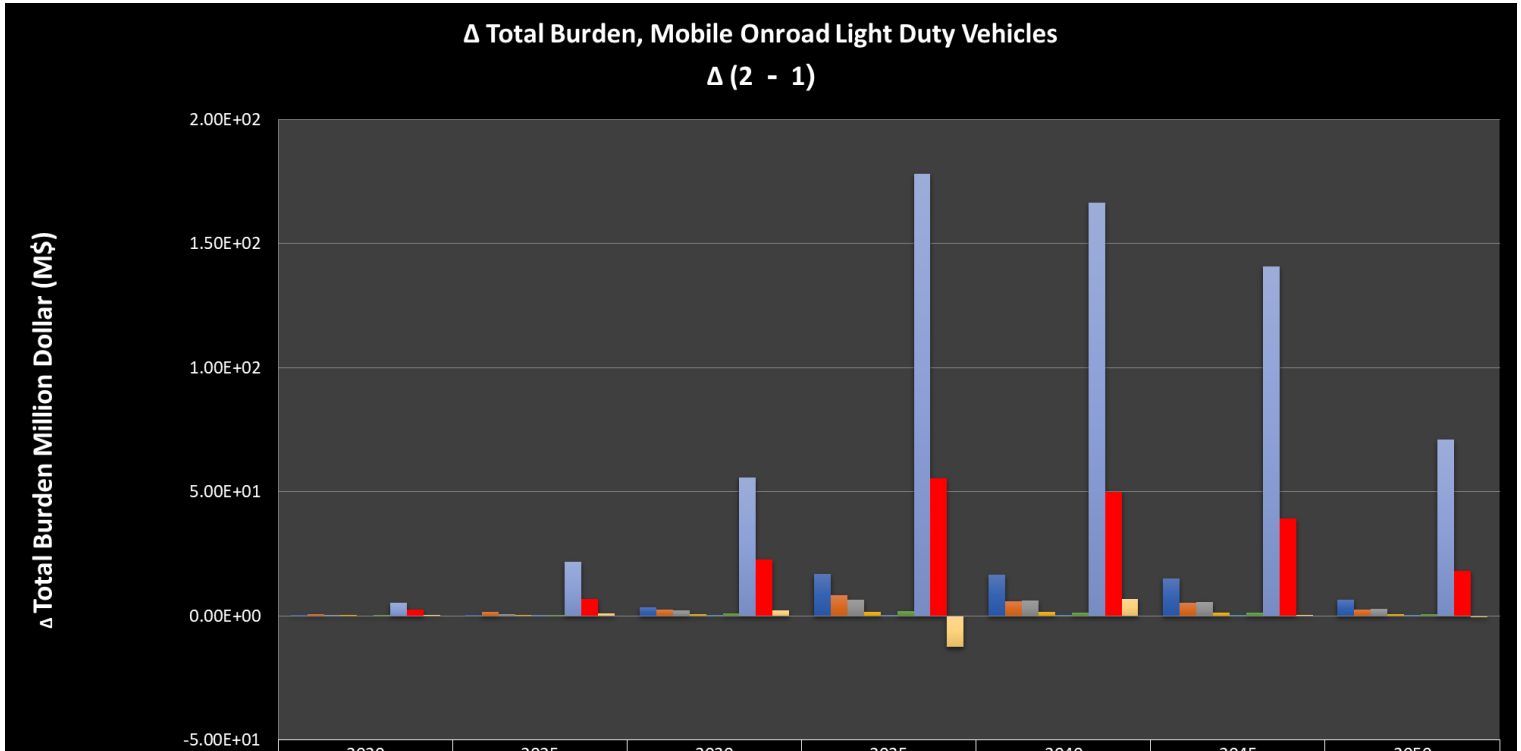
Provincial Cumulative Total Burden (M$) Difference Between 3 & 4 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	2.41E+00	2.18E+01	5.80E+01	8.12E+01	9.23E+01	9.47E+01	8.36E+01
British Columbia	1.59E+00	1.65E+00	2.87E+00	-3.29E-01	-9.40E+00	-1.92E+01	-3.03E+01
Manitoba	4.51E-01	-6.11E+00	-1.89E+01	-3.74E+01	-5.66E+01	-7.20E+01	-8.71E+01
New Burnswick	7.97E-02	4.80E-01	1.59E+00	1.92E+00	1.68E+00	1.43E+00	8.55E-01
Newfoundland and Labrador	-3.22E-02	2.68E-01	9.27E-01	1.43E+00	1.69E+00	1.89E+00	2.08E+00
Nova Scotia	1.46E-01	2.37E+00	6.36E+00	9.34E+00	1.14E+01	1.29E+01	1.38E+01
Ontario	4.12E+00	-3.26E+01	-9.92E+01	-2.15E+02	-3.36E+02	-4.25E+02	-5.00E+02
Quebec	1.08E+01	5.21E+01	1.36E+02	1.81E+02	1.71E+02	1.43E+02	9.99E+01
Saskkatchewan	6.47E-01	6.78E+00	2.04E+01	1.05E+02	1.64E+02	1.82E+02	1.90E+02

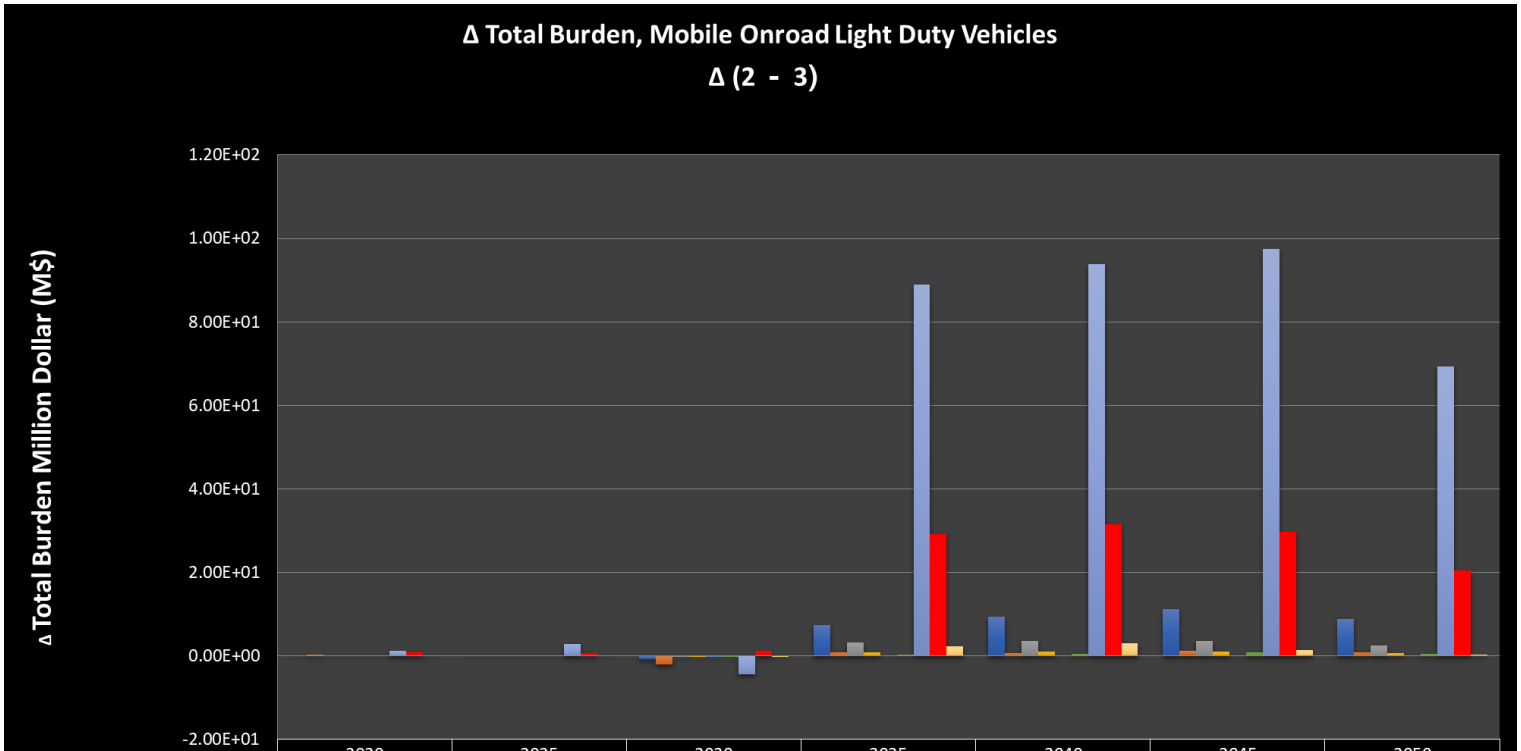
Light Duty Vehicles (LDVs)

Provincial Total Burden (M$) Difference Between 2 & 1 (2015-2050)



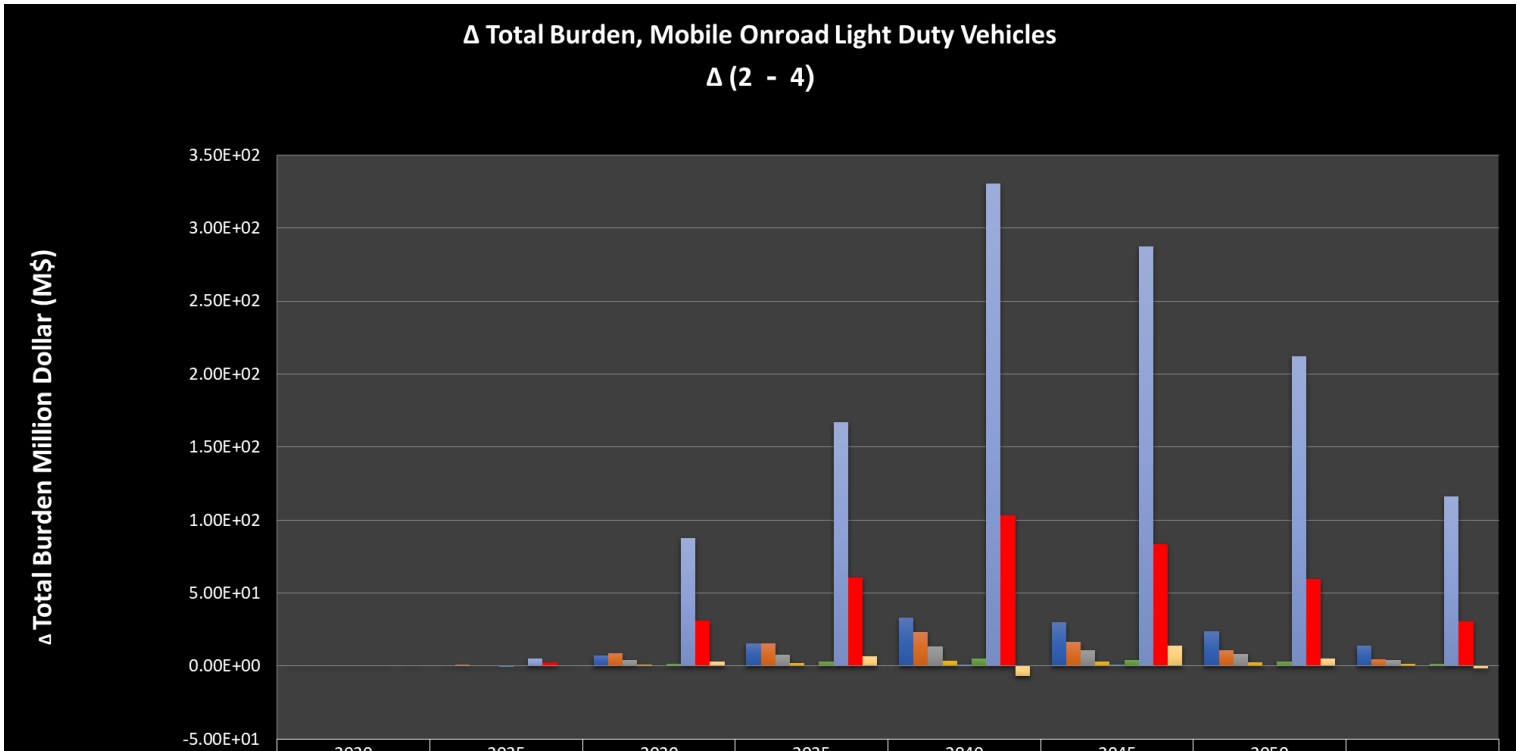
	2020	2025	2030	2035	2040	2045	2050
Alberta	1.18E-01	2.89E-01	3.50E+00	1.69E+01	1.66E+01	1.52E+01	6.44E+00
British Columbia	7.30E-01	1.50E+00	2.63E+00	8.19E+00	5.82E+00	5.21E+00	2.52E+00
Manitoba	1.75E-01	7.68E-01	2.30E+00	6.65E+00	6.13E+00	5.47E+00	2.78E+00
New Burnswick	2.74E-02	1.61E-01	5.63E-01	1.72E+00	1.68E+00	1.44E+00	7.41E-01
Newfoundland and Labrador	-1.68E-02	2.38E-02	2.05E-01	3.71E-01	3.02E-01	2.40E-01	1.51E-01
Nova Scotia	4.10E-02	2.32E-01	1.09E+00	1.80E+00	1.43E+00	1.38E+00	7.28E-01
Ontario	5.16E+00	2.18E+01	5.59E+01	1.78E+02	1.66E+02	1.41E+02	7.11E+01
Quebec	2.56E+00	6.86E+00	2.26E+01	5.55E+01	4.98E+01	3.93E+01	1.82E+01
Saskkatchewan	2.37E-01	8.69E-01	2.21E+00	-1.25E+01	6.72E+00	4.45E-01	-4.13E-01

Provincial Total Burden (M$) Difference Between 2 & 3 (2015-2050)



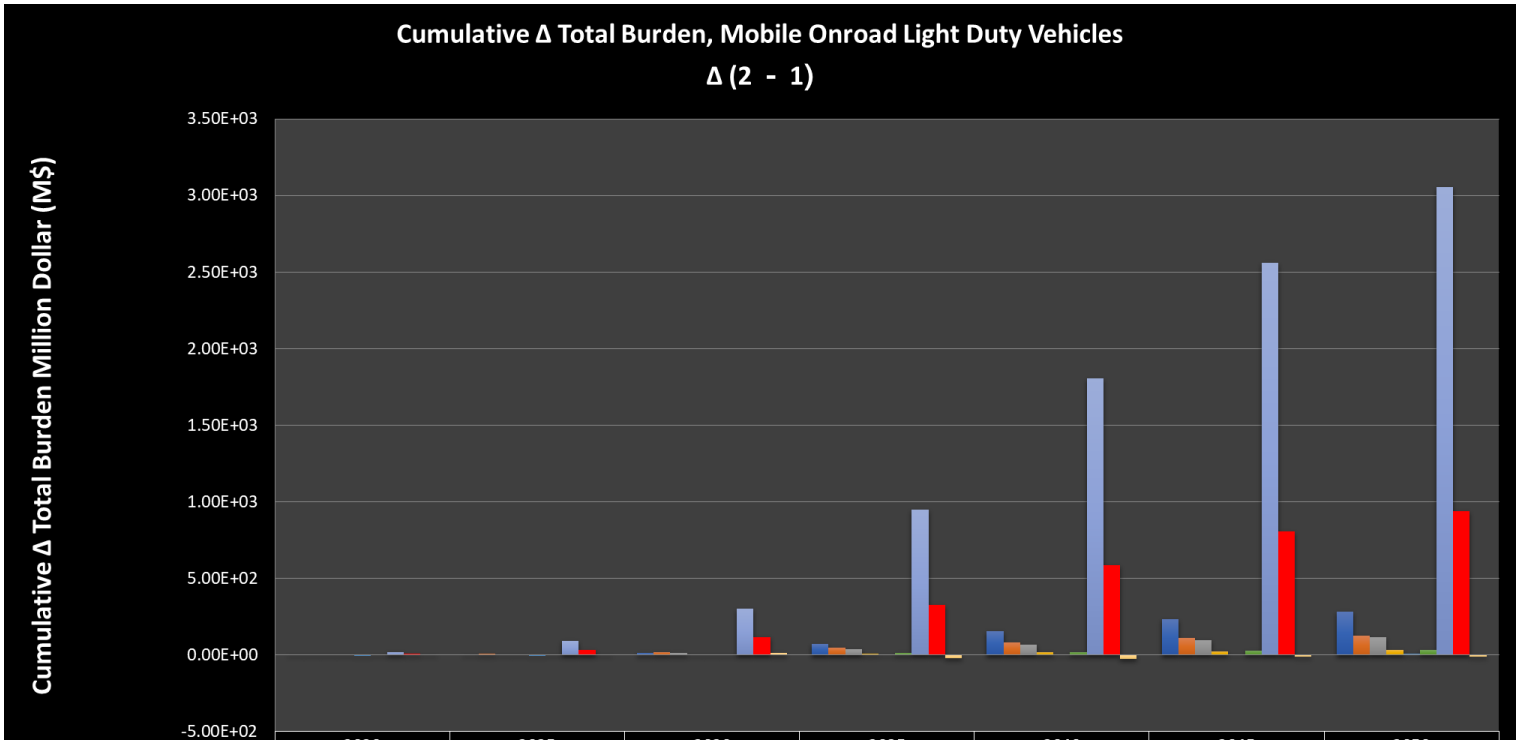
	2020	2025	2030	2035	2040	2045	2050
Alberta	6.34E-02	2.00E-01	-7.16E-01	7.38E+00	9.40E+00	1.12E+01	8.89E+00
British Columbia	2.60E-01	9.26E-02	-2.11E+00	8.43E-01	6.66E-01	1.25E+00	8.94E-01
Manitoba	2.38E-02	9.49E-02	-2.26E-01	3.18E+00	3.68E+00	3.66E+00	2.53E+00
New Burnswick	5.69E-03	2.26E-02	-4.31E-02	8.42E-01	1.01E+00	1.03E+00	7.39E-01
Newfoundland and Labrador	1.02E-03	3.79E-03	-2.20E-02	7.90E-02	1.05E-01	1.19E-01	1.08E-01
Nova Scotia	4.58E-03	1.63E-02	-1.48E-01	3.53E-01	5.00E-01	8.34E-01	5.86E-01
Ontario	1.22E+00	2.82E+00	-4.48E+00	8.89E+01	9.39E+01	9.74E+01	6.93E+01
Quebec	9.27E-01	6.57E-01	1.20E+00	2.92E+01	3.16E+01	2.98E+01	2.05E+01
Saskkatchewan	2.63E-02	7.64E-02	-2.77E-01	2.33E+00	3.01E+00	1.46E+00	2.75E-01

Provincial Total Burden (M$) Difference Between 2 & 4 (2015-2050)



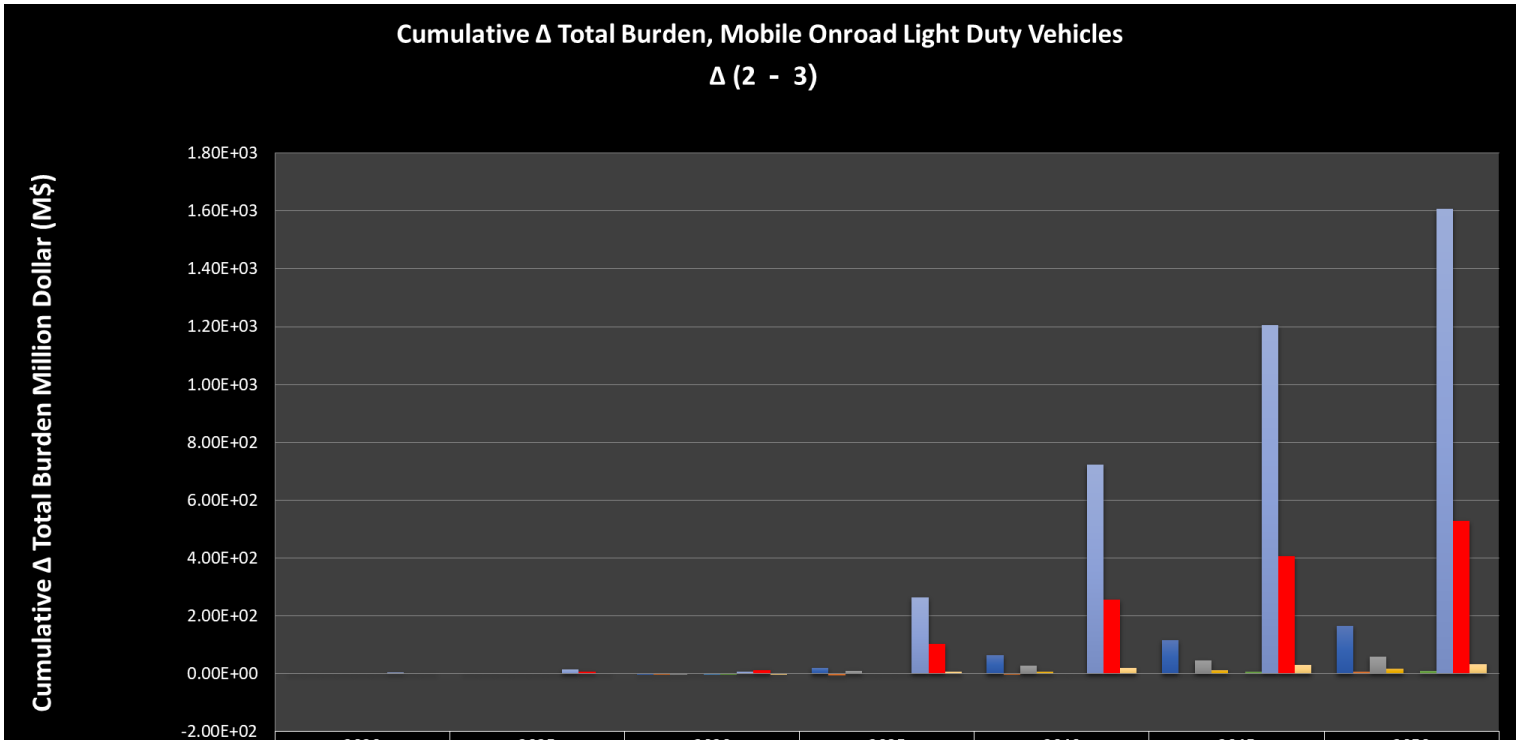
	2020	2025	2030	2035	2040	2045	2050	
Alberta	0.00E+00	1.13E-01	7.44E+00	1.57E+01	3.32E+01	2.98E+01	2.39E+01	1.40E+01
British Columbia	0.00E+00	7.30E-01	8.85E+00	1.54E+01	2.34E+01	1.67E+01	1.09E+01	4.74E+00
Manitoba	0.00E+00	1.71E-01	4.00E+00	7.70E+00	1.34E+01	1.09E+01	8.11E+00	4.14E+00
New Burnswick	0.00E+00	2.72E-02	9.61E-01	1.98E+00	3.59E+00	3.29E+00	2.42E+00	1.29E+00
Newfoundland and Labrador	0.00E+00	-1.68E-02	2.90E-01	6.28E-01	1.02E+00	8.45E-01	5.82E-01	3.24E-01
Nova Scotia	0.00E+00	4.07E-02	1.38E+00	3.04E+00	5.18E+00	4.31E+00	3.27E+00	1.70E+00
Ontario	0.00E+00	5.12E+00	8.79E+01	1.67E+02	3.31E+02	2.87E+02	2.12E+02	1.16E+02
Quebec	0.00E+00	2.56E+00	3.11E+01	6.08E+01	1.03E+02	8.36E+01	5.94E+01	3.04E+01
Saskkatchewan	0.00E+00	1.93E-01	3.09E+00	6.55E+00	-6.71E+00	1.41E+01	5.10E+00	-1.70E+00

Provincial Cumulative Total Burden (M$) Difference Between 2 & 1 (2015-2050)



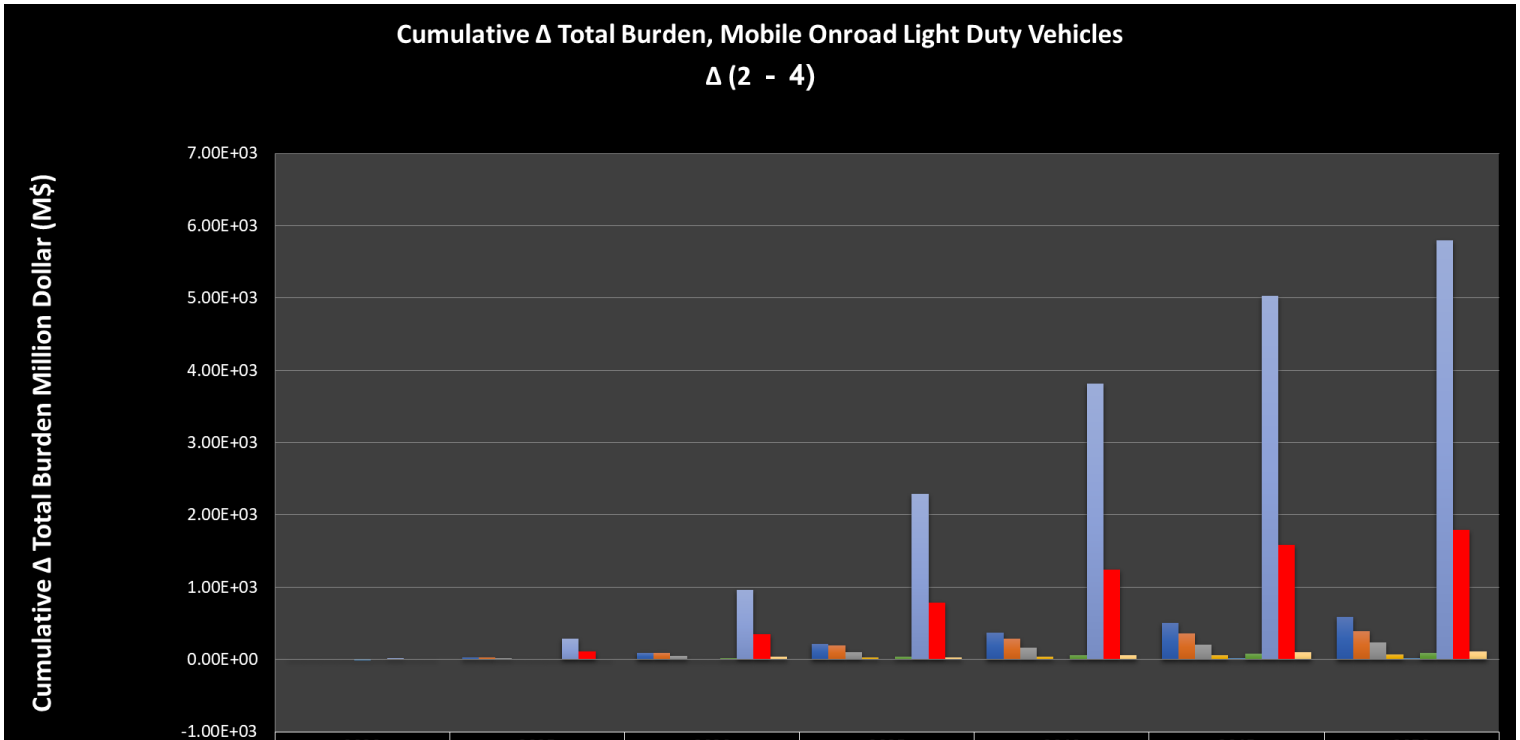
	2020	2025	2030	2035	2040	2045	2050
Alberta	3.55E-01	1.46E+00	1.25E+01	7.04E+01	1.54E+02	2.33E+02	2.83E+02
British Columbia	2.19E+00	8.15E+00	1.90E+01	4.88E+01	8.27E+01	1.10E+02	1.28E+02
Manitoba	5.24E-01	3.18E+00	1.16E+01	3.62E+01	6.79E+01	9.66E+01	1.16E+02
New Burnswick	8.23E-02	6.21E-01	2.63E+00	8.91E+00	1.74E+01	2.50E+01	3.01E+01
Newfoundland and Labrador	-5.04E-02	-1.26E-02	6.50E-01	2.17E+00	3.82E+00	5.14E+00	6.08E+00
Nova Scotia	1.23E-01	9.01E-01	4.64E+00	1.22E+01	2.01E+01	2.71E+01	3.21E+01
Ontario	1.55E+01	9.13E+01	3.03E+02	9.48E+02	1.80E+03	2.56E+03	3.05E+03
Quebec	7.69E+00	3.34E+01	1.15E+02	3.27E+02	5.87E+02	8.05E+02	9.38E+02
Saskkatchewan	7.10E-01	3.79E+00	1.22E+01	-2.08E+01	-2.56E+01	-1.09E+01	-1.12E+01

Provincial Cumulative Total Burden (M$) Difference Between 2 & 3 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	1.90E-01	9.16E-01	-8.32E-01	1.99E+01	6.29E+01	1.15E+02	1.65E+02
British Columbia	7.79E-01	1.58E+00	-4.58E+00	-6.28E+00	-2.60E+00	2.49E+00	7.68E+00
Manitoba	7.13E-02	4.04E-01	-8.43E-02	9.00E+00	2.64E+01	4.47E+01	5.96E+01
New Burnswick	1.71E-02	9.63E-02	1.21E-02	2.45E+00	7.17E+00	1.23E+01	1.66E+01
Newfoundland and Labrador	3.05E-03	1.64E-02	-4.18E-02	1.51E-01	6.23E-01	1.19E+00	1.75E+00
Nova Scotia	1.37E-02	7.19E-02	-3.40E-01	4.24E-01	2.63E+00	6.14E+00	9.56E+00
Ontario	3.65E+00	1.45E+01	6.76E+00	2.64E+02	7.24E+02	1.20E+03	1.61E+03
Quebec	2.78E+00	6.61E+00	1.15E+01	1.02E+02	2.55E+02	4.08E+02	5.29E+02
Saskkatchewan	7.88E-02	3.61E-01	-3.16E-01	6.11E+00	1.98E+01	3.02E+01	3.39E+01

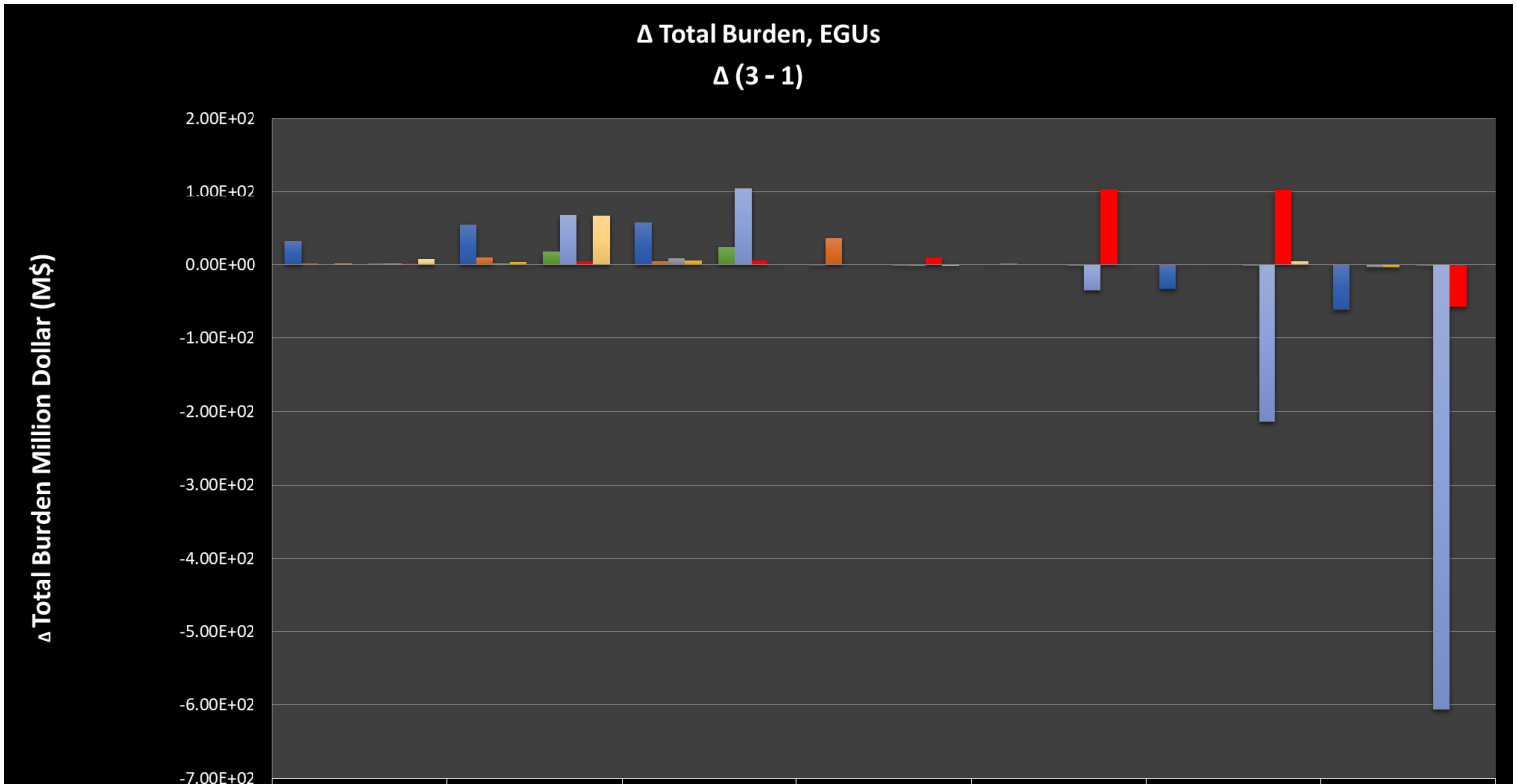
Provincial Cumulative Total Burden (M$) Difference Between 2 & 4 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	3.39E-01	2.29E+01	8.50E+01	2.16E+02	3.72E+02	5.03E+02	5.93E+02
British Columbia	2.19E+00	3.02E+01	9.40E+01	1.95E+02	2.92E+02	3.58E+02	3.94E+02
Manitoba	5.14E-01	1.28E+01	4.39E+01	9.94E+01	1.59E+02	2.05E+02	2.34E+02
New Burnswick	8.17E-02	3.02E+00	1.09E+01	2.56E+01	4.26E+01	5.65E+01	6.52E+01
Newfoundland and Labrador	-5.05E-02	7.86E-01	3.25E+00	7.57E+00	1.22E+01	1.56E+01	1.77E+01
Nova Scotia	1.22E-01	4.34E+00	1.62E+01	3.79E+01	6.12E+01	7.96E+01	9.12E+01
Ontario	1.54E+01	2.89E+02	9.65E+02	2.29E+03	3.81E+03	5.02E+03	5.80E+03
Quebec	7.67E+00	1.06E+02	3.51E+02	7.81E+02	1.24E+03	1.58E+03	1.79E+03
Saskkatchewan	5.78E-01	1.02E+01	3.61E+01	2.90E+01	5.80E+01	1.02E+02	1.07E+02

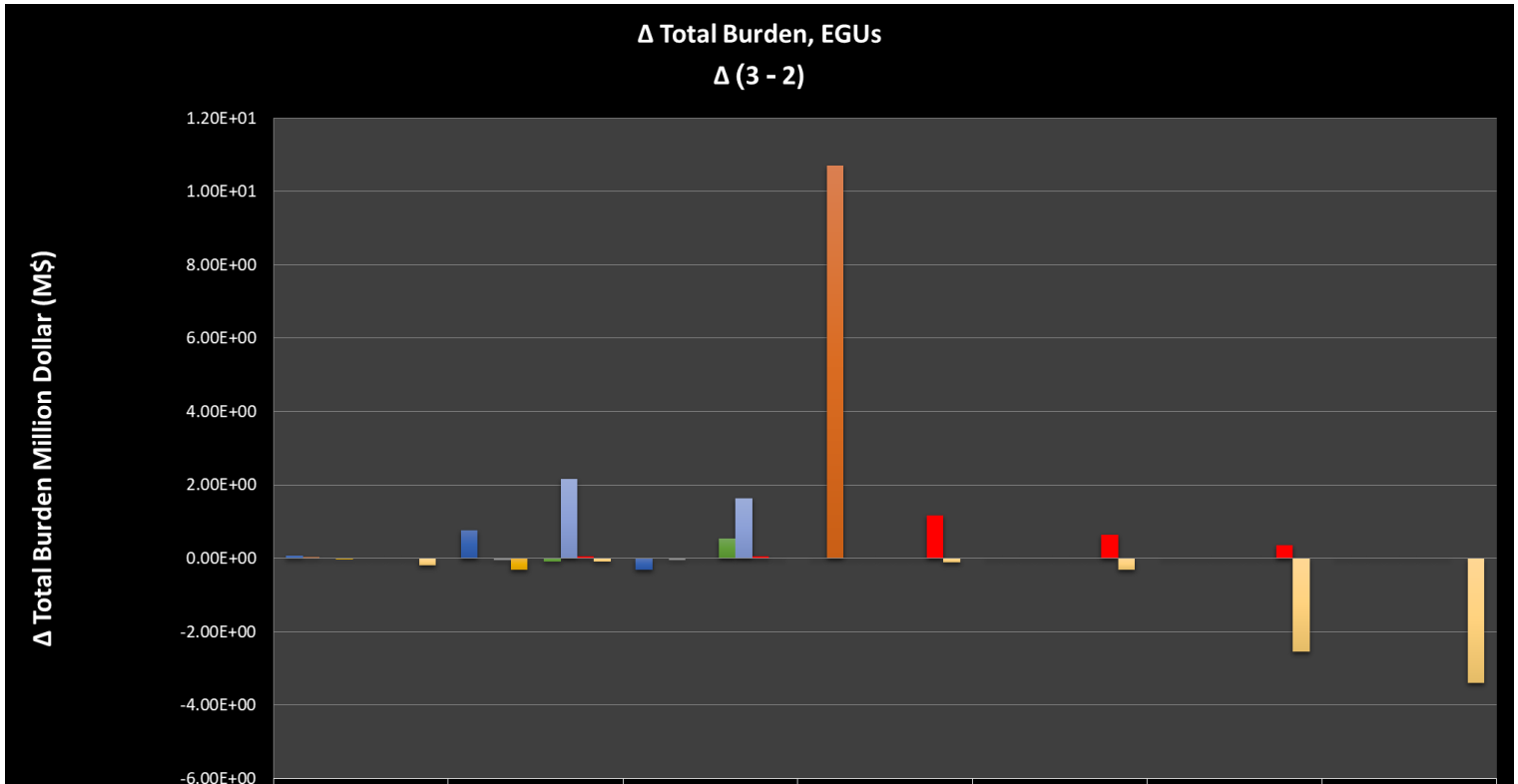
Electricity Generating Units (EGUs)

Provincial Total Burden (M$) Difference Between 3 & 1 (2015-2050)



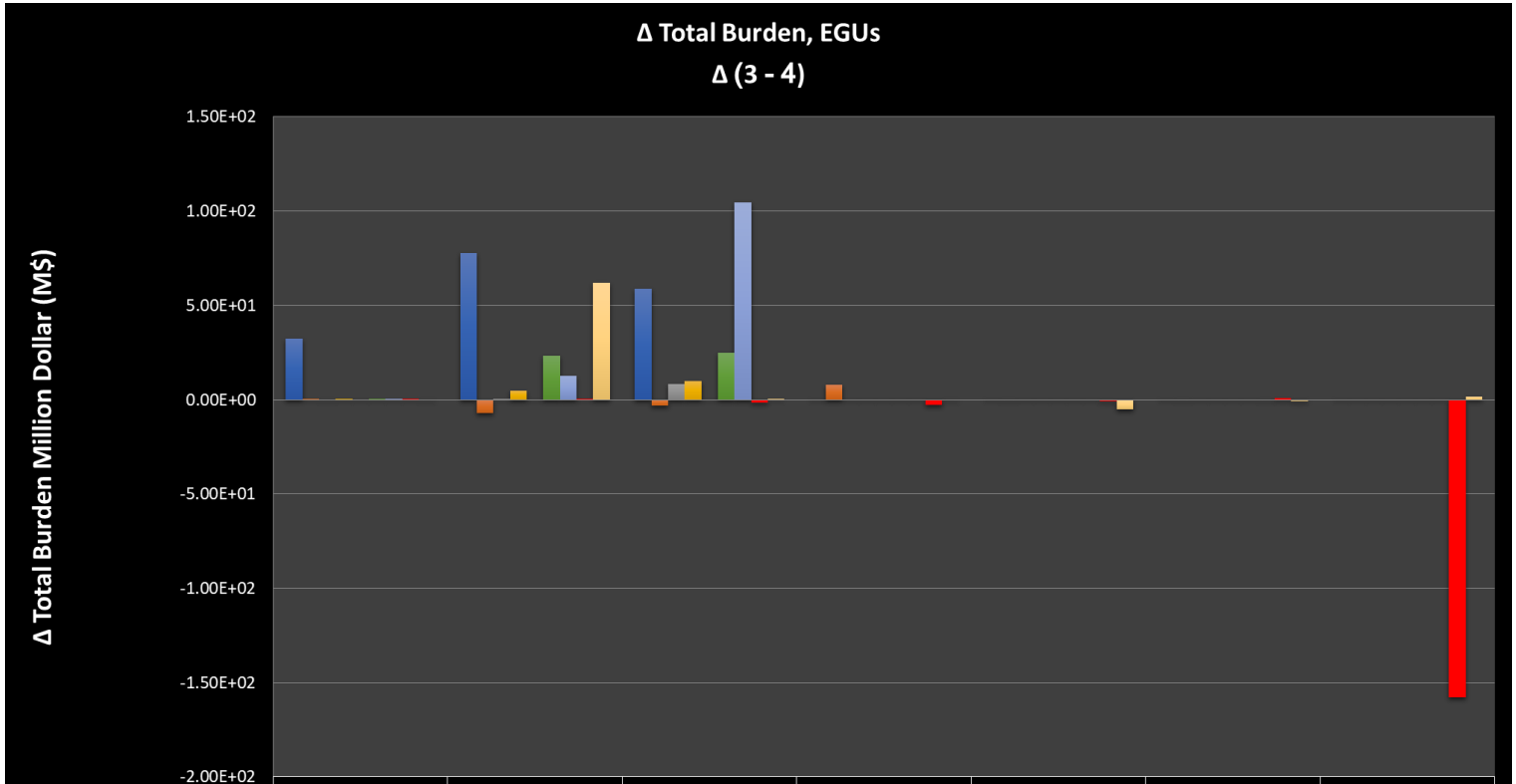
	2020	2025	2030	2035	2040	2045	2050
Alberta	3.19E+01	5.40E+01	5.75E+01	-1.24E+00	-9.70E-01	-3.27E+01	-6.20E+01
British Columbia	1.48E-01	9.42E+00	4.56E+00	3.59E+01	2.93E-01	-3.63E-02	-2.78E-01
Manitoba	-4.57E-03	1.89E-02	8.41E+00	0.00E+00	0.00E+00	0.00E+00	-4.07E+00
New Burnswick	3.42E-02	3.15E+00	5.29E+00	0.00E+00	0.00E+00	-3.23E-01	-3.75E+00
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.70E-02	1.73E+01	2.39E+01	-1.43E+00	-1.67E+00	-1.68E+00	-2.00E+00
Ontario	2.65E-01	6.76E+01	1.05E+02	-1.92E+00	-3.52E+01	-2.14E+02	-6.07E+02
Quebec	1.74E-03	4.75E+00	5.73E+00	9.05E+00	1.04E+02	1.03E+02	-5.74E+01
Saskkatchewan	7.46E+00	6.66E+01	-5.26E-01	-1.59E+00	-3.36E-01	4.06E+00	-4.61E-01

Provincial Total Burden (M$) Difference Between 3 & 2 (2015-2050)



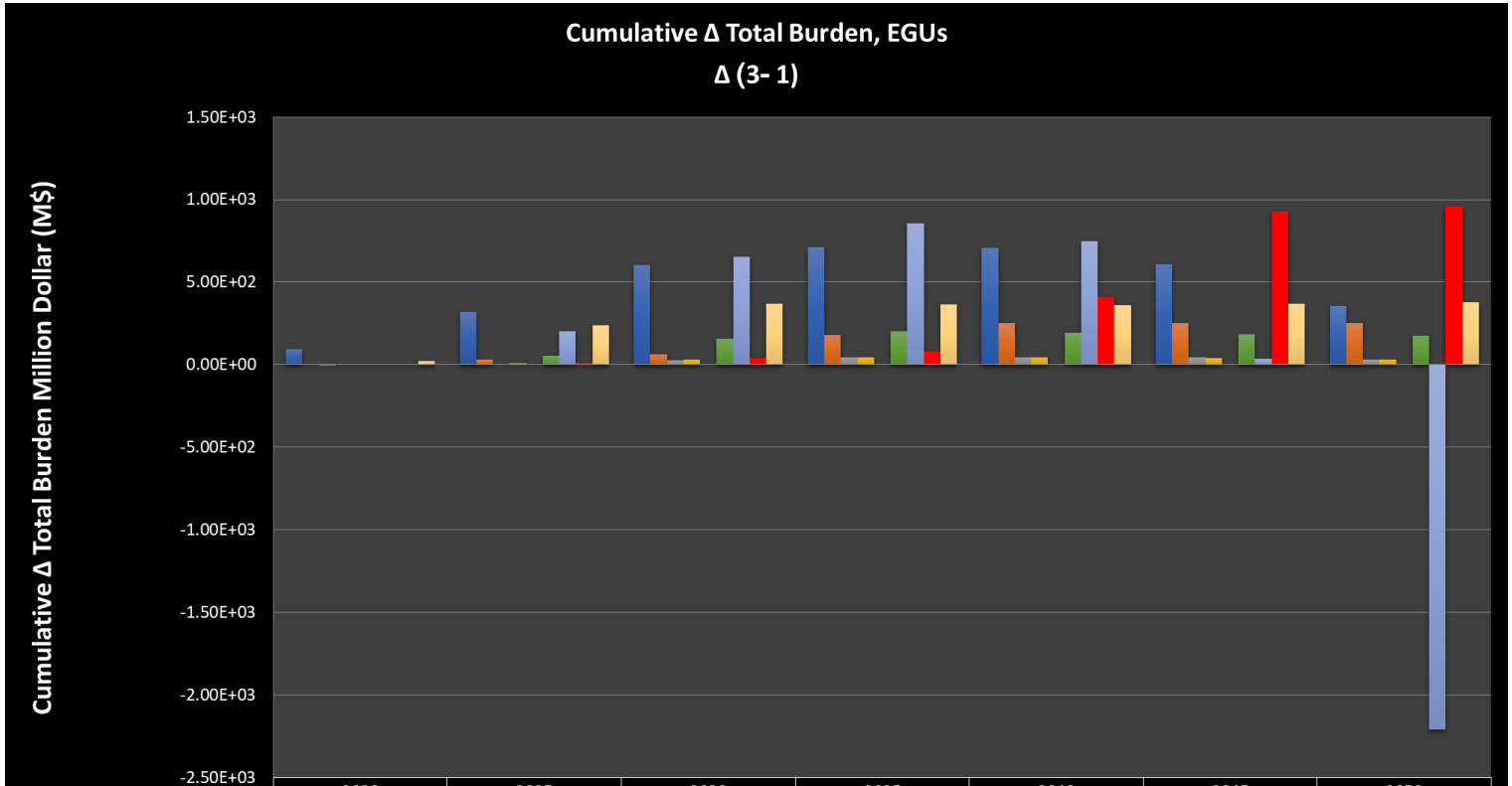
	2020	2025	2030	2035	2040	2045	2050
Alberta	7.56E-02	7.56E-01	-3.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	2.56E-02	1.55E-02	1.03E-02	1.07E+01	6.92E-03	0.00E+00	0.00E+00
Manitoba	8.53E-03	-4.05E-02	-4.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	-1.21E-02	-3.16E-01	1.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	3.22E-03	-8.68E-02	5.37E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	1.53E-02	2.16E+00	1.63E+00	3.98E-13	0.00E+00	0.00E+00	0.00E+00
Quebec	2.70E-04	4.89E-02	5.10E-02	1.17E+00	6.47E-01	3.66E-01	0.00E+00
Saskkatchewan	-1.98E-01	-8.76E-02	1.20E-02	-1.06E-01	-3.10E-01	-2.54E+00	-3.40E+00

Provincial Total Burden (M$) Difference Between 3 & 4 (2015-2050)



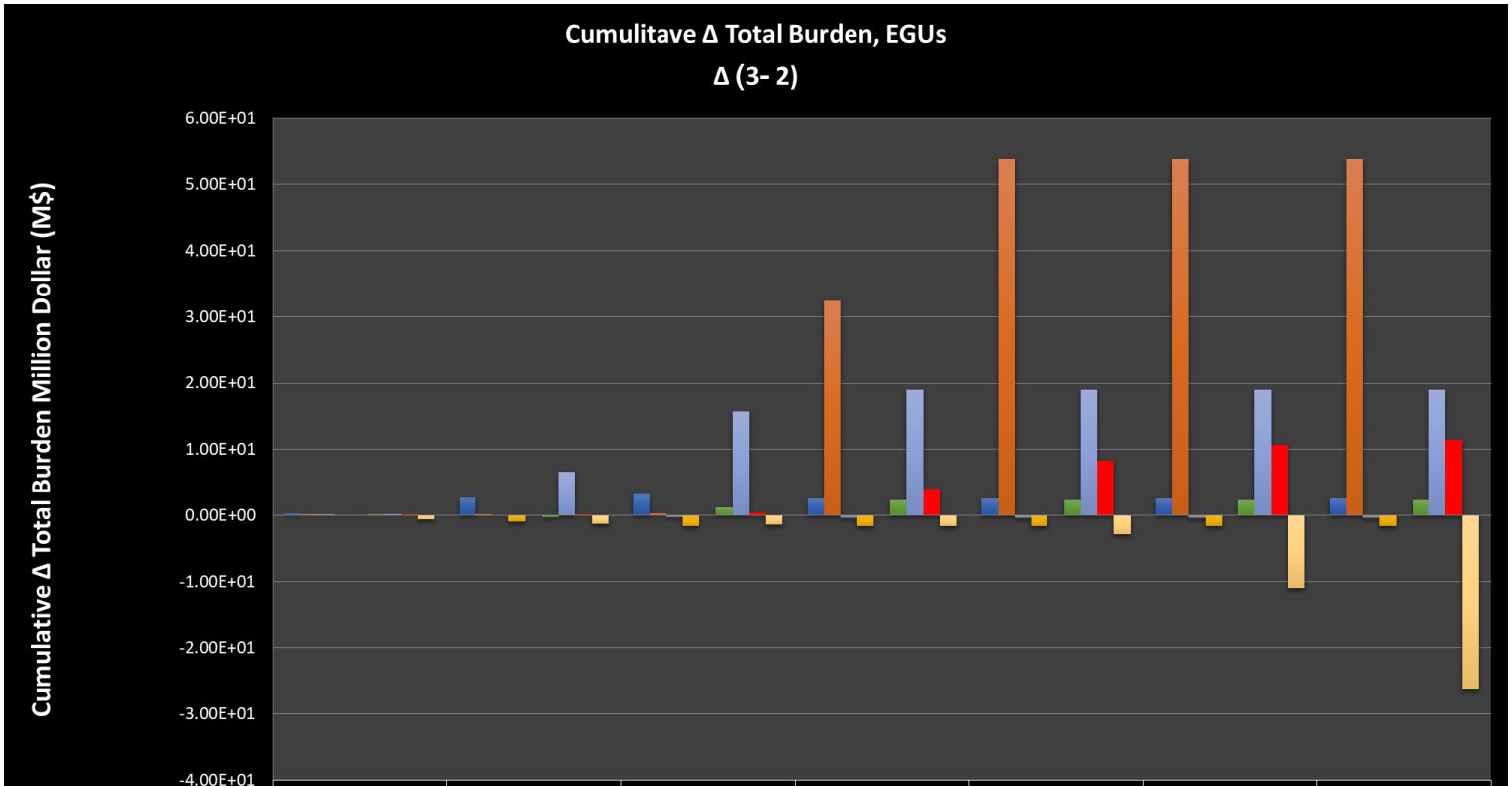
	2020	2025	2030	2035	2040	2045	2050
Alberta	3.24E+01	7.78E+01	5.90E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	1.56E-01	-7.25E+00	-3.29E+00	8.02E+00	-7.98E-02	-4.01E-01	0.00E+00
Manitoba	-5.21E-03	2.17E-02	8.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	3.77E-02	4.91E+00	9.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.65E-02	2.31E+01	2.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	2.66E-01	1.27E+01	1.04E+02	4.55E-13	0.00E+00	-5.68E-14	0.00E+00
Quebec	1.87E-03	7.69E-03	-1.69E+00	-2.68E+00	-8.22E-01	7.18E-01	-1.58E+02
Saskkatchewan	-9.10E-02	6.18E+01	2.90E-01	-4.20E-01	-5.28E+00	-7.06E-01	1.55E+00

Provincial Cumulative Total Burden (M$) Difference Between 3 & 1 (2015-2050)



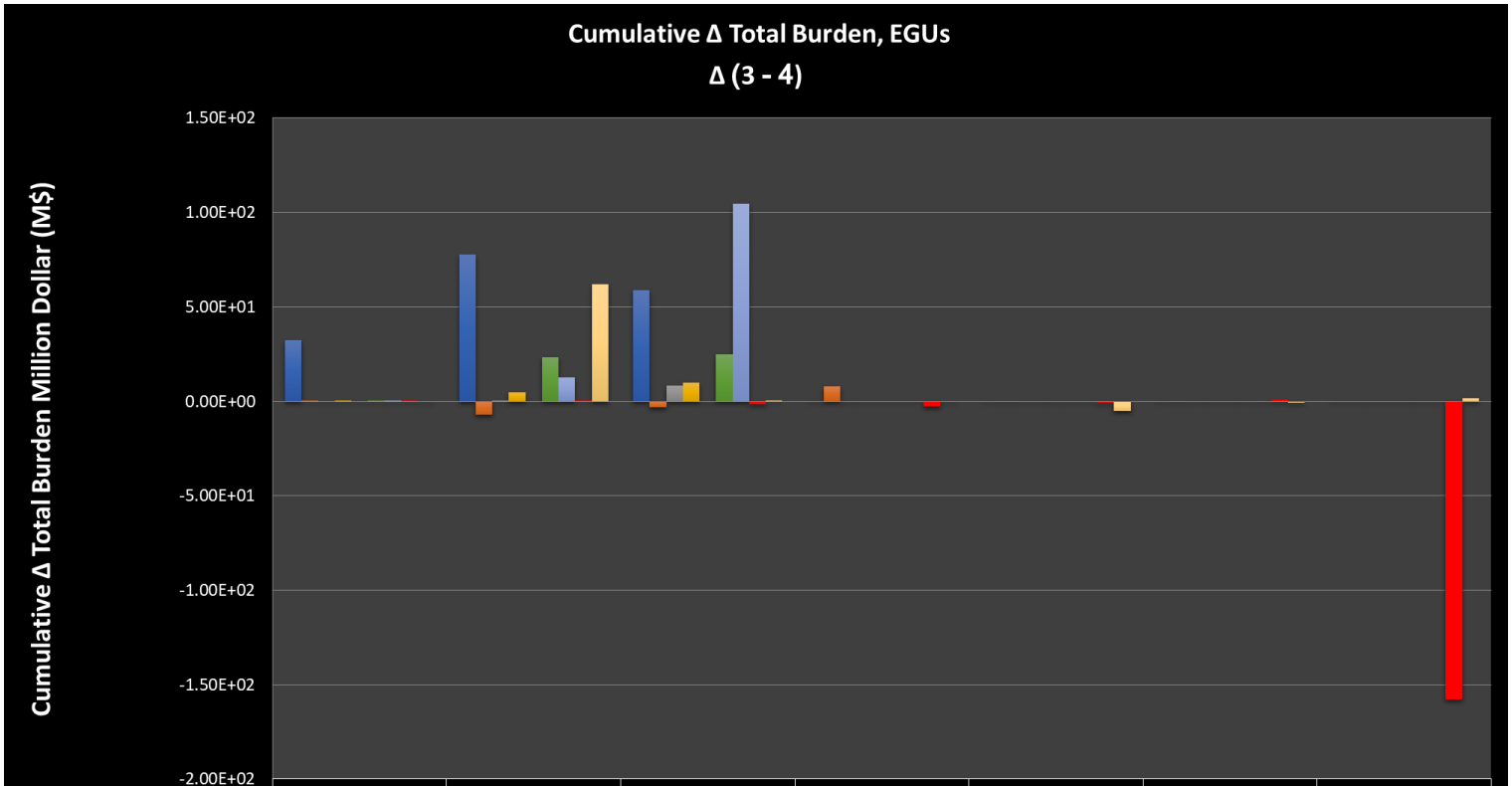
	2020	2025	2030	2035	2040	2045	2050
Alberta	9.56E+01	3.21E+02	6.02E+02	7.13E+02	7.08E+02	6.08E+02	3.56E+02
British Columbia	4.45E-01	2.90E+01	6.15E+01	1.78E+02	2.51E+02	2.52E+02	2.51E+02
Manitoba	-1.37E-02	3.38E-02	2.53E+01	4.21E+01	4.21E+01	4.21E+01	2.99E+01
New Burnswick	1.03E-01	9.61E+00	3.18E+01	4.23E+01	4.23E+01	4.14E+01	2.95E+01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	2.61E-01	5.22E+01	1.59E+02	2.02E+02	1.94E+02	1.86E+02	1.76E+02
Ontario	7.96E-01	2.04E+02	6.53E+02	8.57E+02	7.48E+02	3.66E+01	-2.21E+03
Quebec	5.22E-03	1.43E+01	4.10E+01	7.96E+01	4.10E+02	9.27E+02	9.61E+02
Saskkatchewan	2.24E+01	2.37E+02	3.69E+02	3.63E+02	3.59E+02	3.70E+02	3.77E+02

Provincial Cumulative Total Burden (M$) Difference Between 3 & 2 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	2.27E-01	2.65E+00	3.20E+00	2.56E+00	2.56E+00	2.56E+00	2.56E+00
British Columbia	7.69E-02	1.75E-01	2.37E-01	3.24E+01	5.38E+01	5.38E+01	5.38E+01
Manitoba	2.56E-02	-7.90E-02	-2.98E-01	-3.91E-01	-3.91E-01	-3.91E-01	-3.91E-01
New Burnswick	-3.63E-02	-1.01E+00	-1.64E+00	-1.63E+00	-1.63E+00	-1.63E+00	-1.63E+00
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	9.67E-03	-2.44E-01	1.19E+00	2.27E+00	2.27E+00	2.27E+00	2.27E+00
Ontario	4.60E-02	6.54E+00	1.57E+01	1.90E+01	1.90E+01	1.90E+01	1.90E+01
Quebec	8.09E-04	1.48E-01	3.99E-01	4.00E+00	8.28E+00	1.07E+01	1.14E+01
Saskkatchewan	-5.94E-01	-1.25E+00	-1.39E+00	-1.69E+00	-2.83E+00	-1.11E+01	-2.63E+01

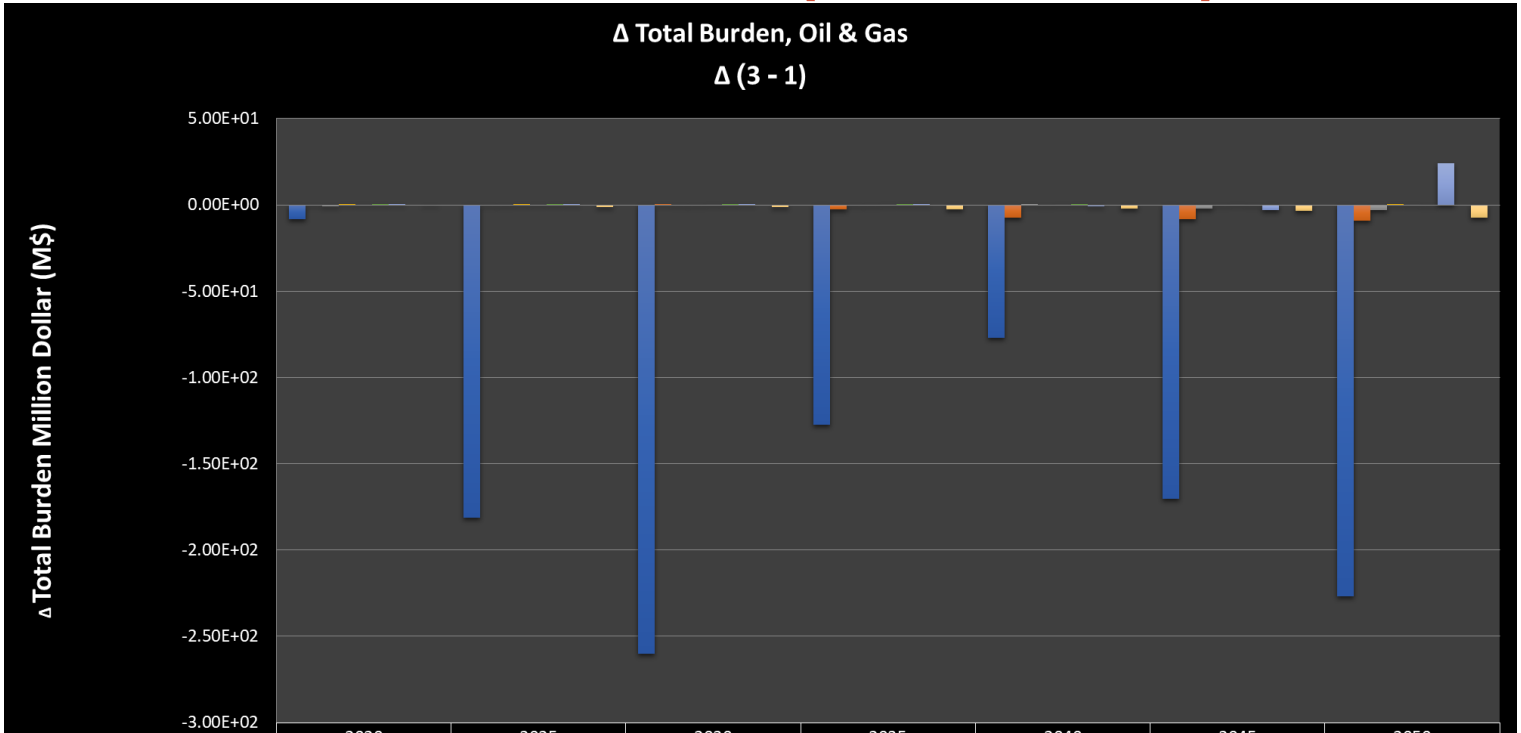
Provincial Cumulative Total Burden (M$) Difference Between 3 & 4 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	3.24E+01	7.78E+01	5.90E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
British Columbia	1.56E-01	-7.25E+00	-3.29E+00	8.02E+00	-7.98E-02	-4.01E-01	0.00E+00
Manitoba	-5.21E-03	2.17E-02	8.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
New Burnswick	3.77E-02	4.91E+00	9.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.65E-02	2.31E+01	2.48E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ontario	2.66E-01	1.27E+01	1.04E+02	4.55E-13	0.00E+00	-5.68E-14	0.00E+00
Quebec	1.87E-03	7.69E-03	-1.69E+00	-2.68E+00	-8.22E-01	7.18E-01	-1.58E+02
Saskkatchewan	-9.10E-02	6.18E+01	2.90E-01	-4.20E-01	-5.28E+00	-7.06E-01	1.55E+00

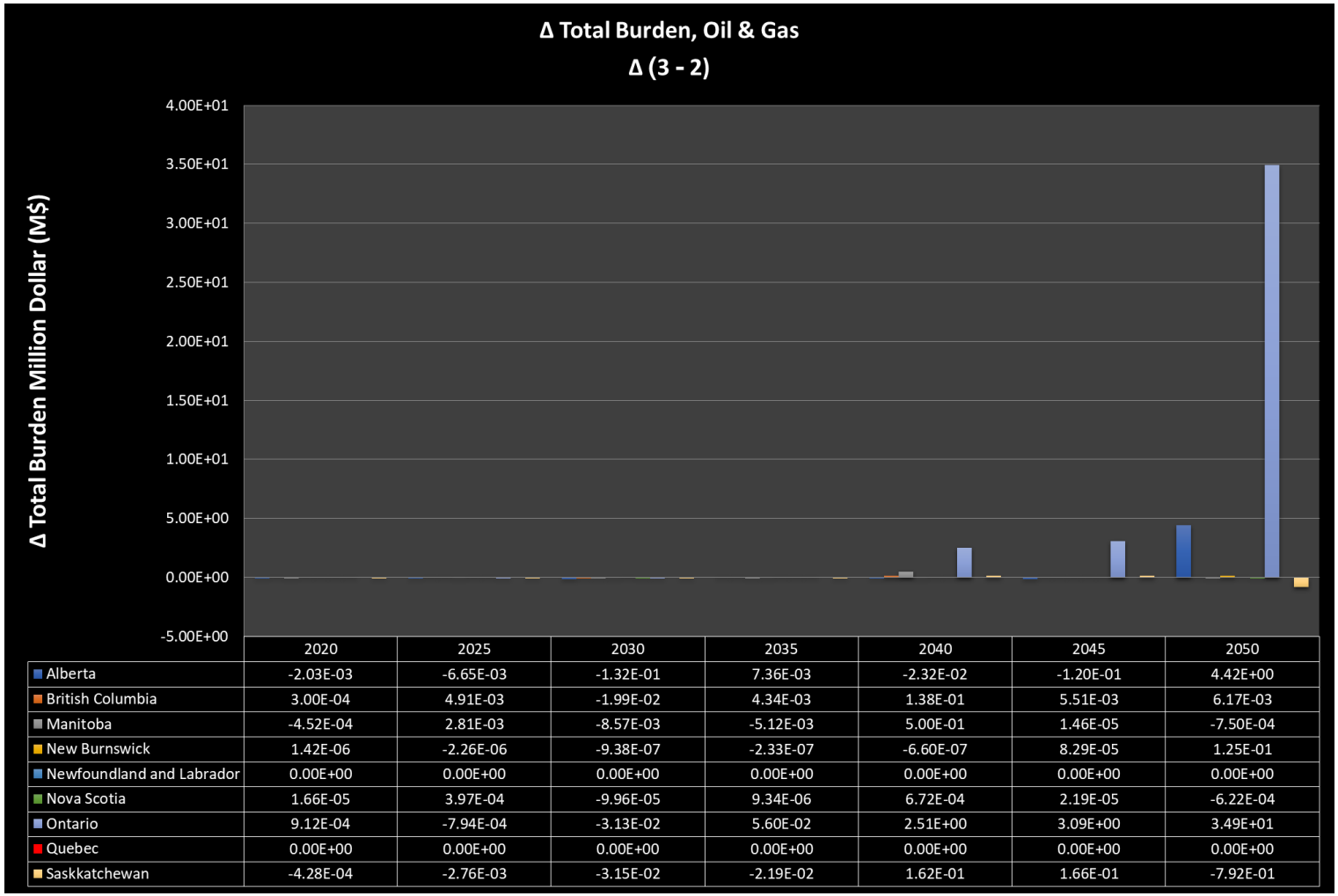
Oil & Gas (OGs)

Provincial Total Burden (M$) Difference Between 3 & 1 (2015-2050)



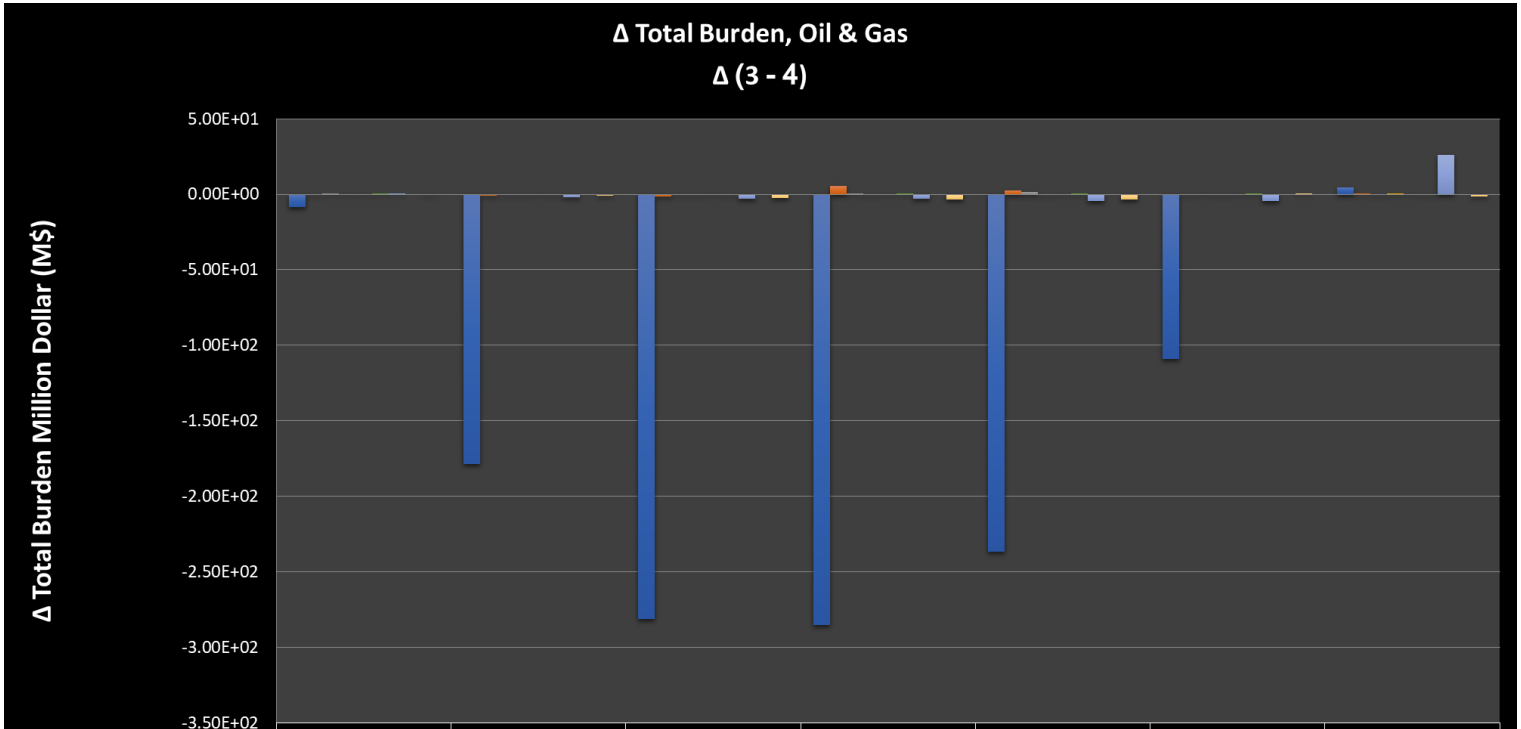
	2020	2025	2030	2035	2040	2045	2050
Alberta	-8.23E+00	-1.81E+02	-2.60E+02	-1.28E+02	-7.71E+01	-1.70E+02	-2.27E+02
British Columbia	-8.98E-02	-3.58E-01	3.30E-01	-2.50E+00	-7.44E+00	-8.48E+00	-9.12E+00
Manitoba	-9.03E-01	-5.68E-01	-3.18E-01	-3.25E-01	4.27E-02	-1.97E+00	-2.91E+00
New Burnswick	2.95E-05	1.15E-04	-6.35E-05	-6.61E-05	-8.14E-05	-4.67E-04	1.24E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.21E-04	5.27E-03	1.04E-02	1.32E-02	7.72E-03	-7.49E-02	-1.27E-01
Ontario	1.48E-01	5.21E-01	5.37E-01	3.52E-01	-6.50E-01	-3.22E+00	2.40E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-2.89E-02	-1.07E+00	-1.45E+00	-2.56E+00	-2.22E+00	-3.25E+00	-7.41E+00

Provincial Total Burden (M$) Difference Between 3 & 2 (2015-2050)



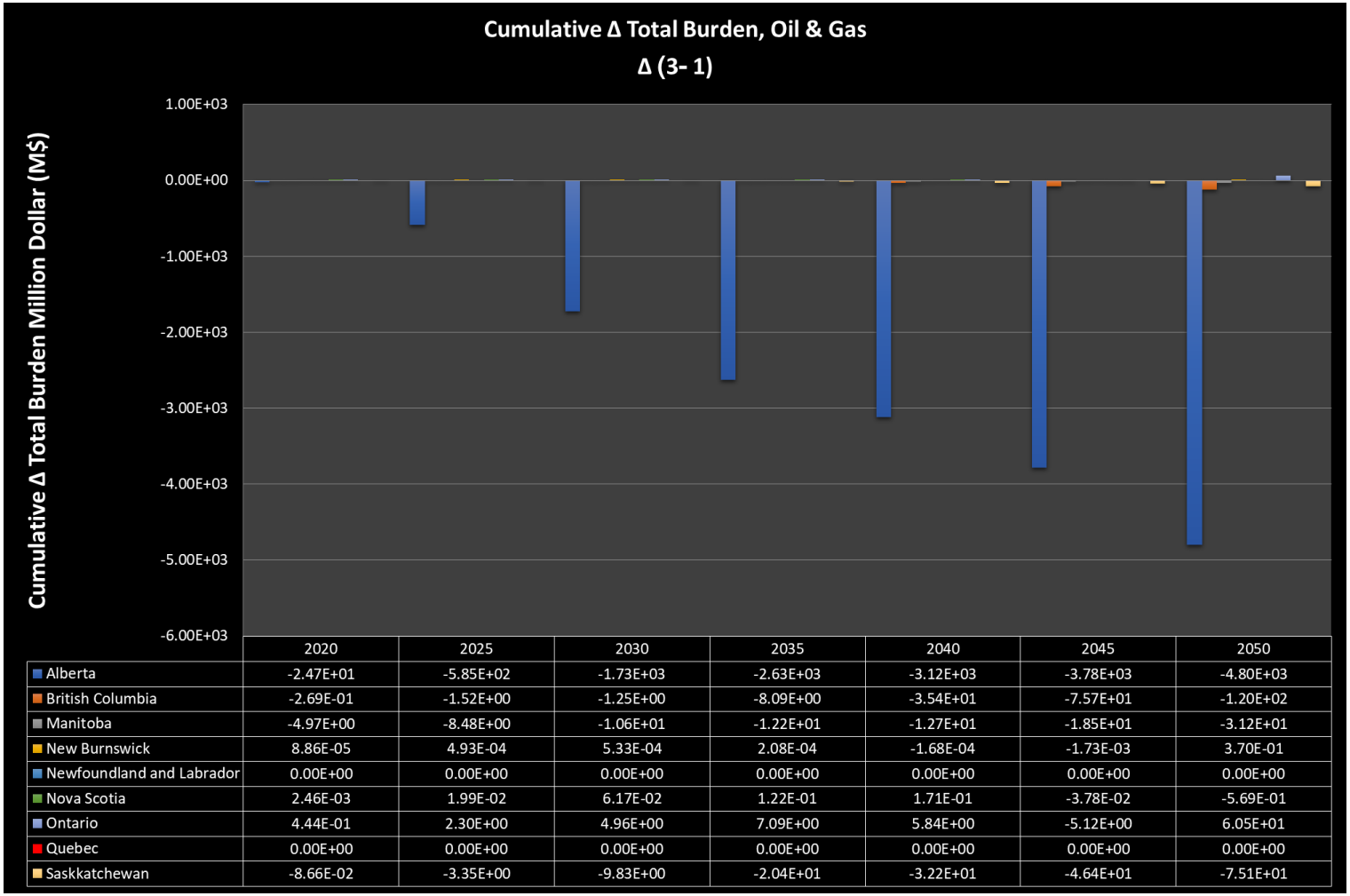
	2020	2025	2030	2035	2040	2045	2050
Alberta	-2.03E-03	-6.65E-03	-1.32E-01	7.36E-03	-2.32E-02	-1.20E-01	4.42E+00
British Columbia	3.00E-04	4.91E-03	-1.99E-02	4.34E-03	1.38E-01	5.51E-03	6.17E-03
Manitoba	-4.52E-04	2.81E-03	-8.57E-03	-5.12E-03	5.00E-01	1.46E-05	-7.50E-04
New Burnswick	1.42E-06	-2.26E-06	-9.38E-07	-2.33E-07	-6.60E-07	8.29E-05	1.25E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	1.66E-05	3.97E-04	-9.96E-05	9.34E-06	6.72E-04	2.19E-05	-6.22E-04
Ontario	9.12E-04	-7.94E-04	-3.13E-02	5.60E-02	2.51E+00	3.09E+00	3.49E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-4.28E-04	-2.76E-03	-3.15E-02	-2.19E-02	1.62E-01	1.66E-01	-7.92E-01

Provincial Total Burden (M$) Difference Between 3 & 4 (2015-2050)



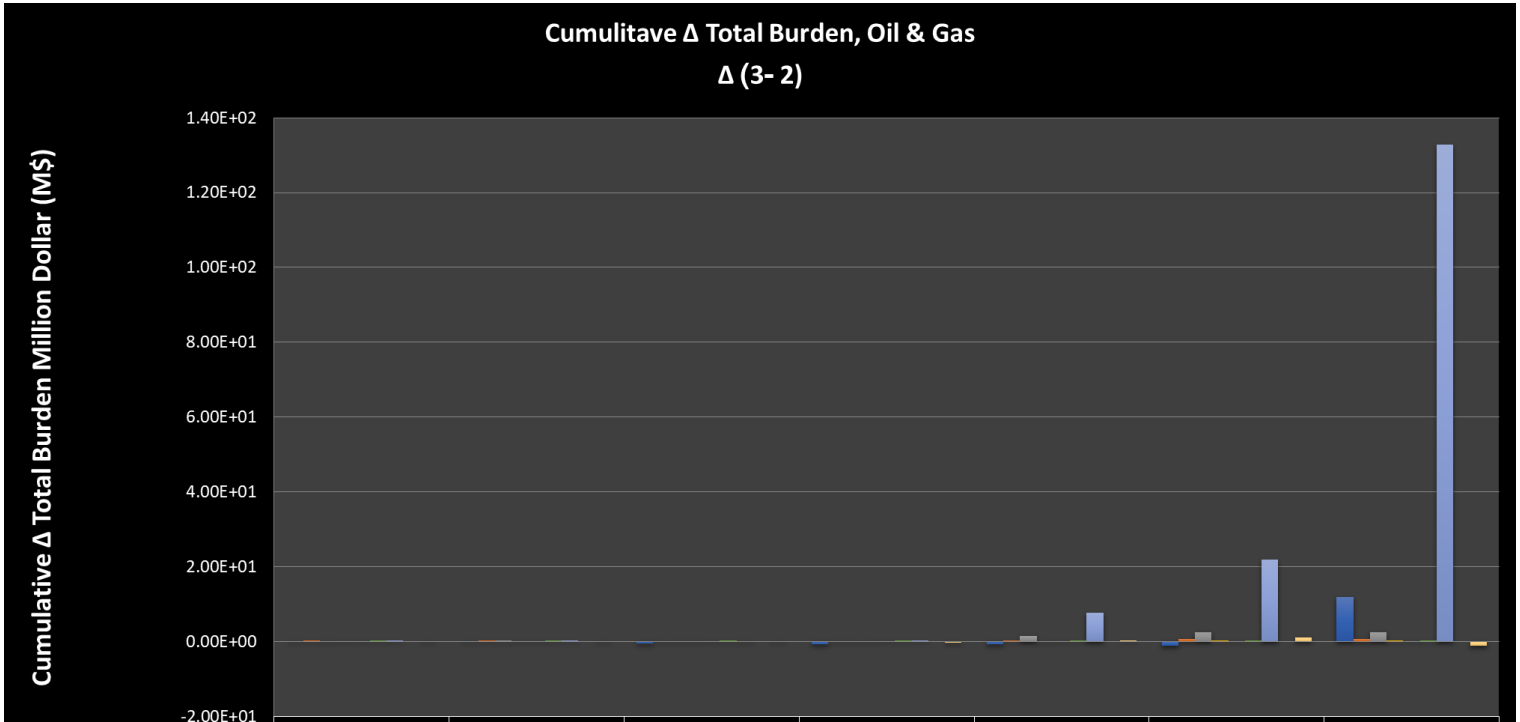
	2020	2025	2030	2035	2040	2045	2050
Alberta	-8.25E+00	-1.79E+02	-2.81E+02	-2.85E+02	-2.37E+02	-1.09E+02	4.43E+00
British Columbia	-9.01E-02	-1.19E+00	-1.28E+00	5.30E+00	2.41E+00	-2.39E-01	6.27E-03
Manitoba	2.28E-02	-2.92E-01	-1.95E-01	1.94E-01	1.28E+00	6.22E-06	-7.29E-04
New Burnswick	3.04E-05	-6.46E-04	-1.14E-03	-1.39E-03	-1.35E-03	-1.00E-03	1.24E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.30E-04	-9.86E-03	-1.20E-02	4.88E-02	4.66E-03	4.99E-04	-2.33E-05
Ontario	1.52E-01	-2.11E+00	-3.04E+00	-2.88E+00	-4.55E+00	-4.56E+00	2.61E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-3.63E-02	-1.22E+00	-2.56E+00	-3.58E+00	-3.58E+00	1.39E-01	-1.27E+00

Provincial Cumulative Total Burden (M$) Difference Between 3 & 1 (2015-2050)



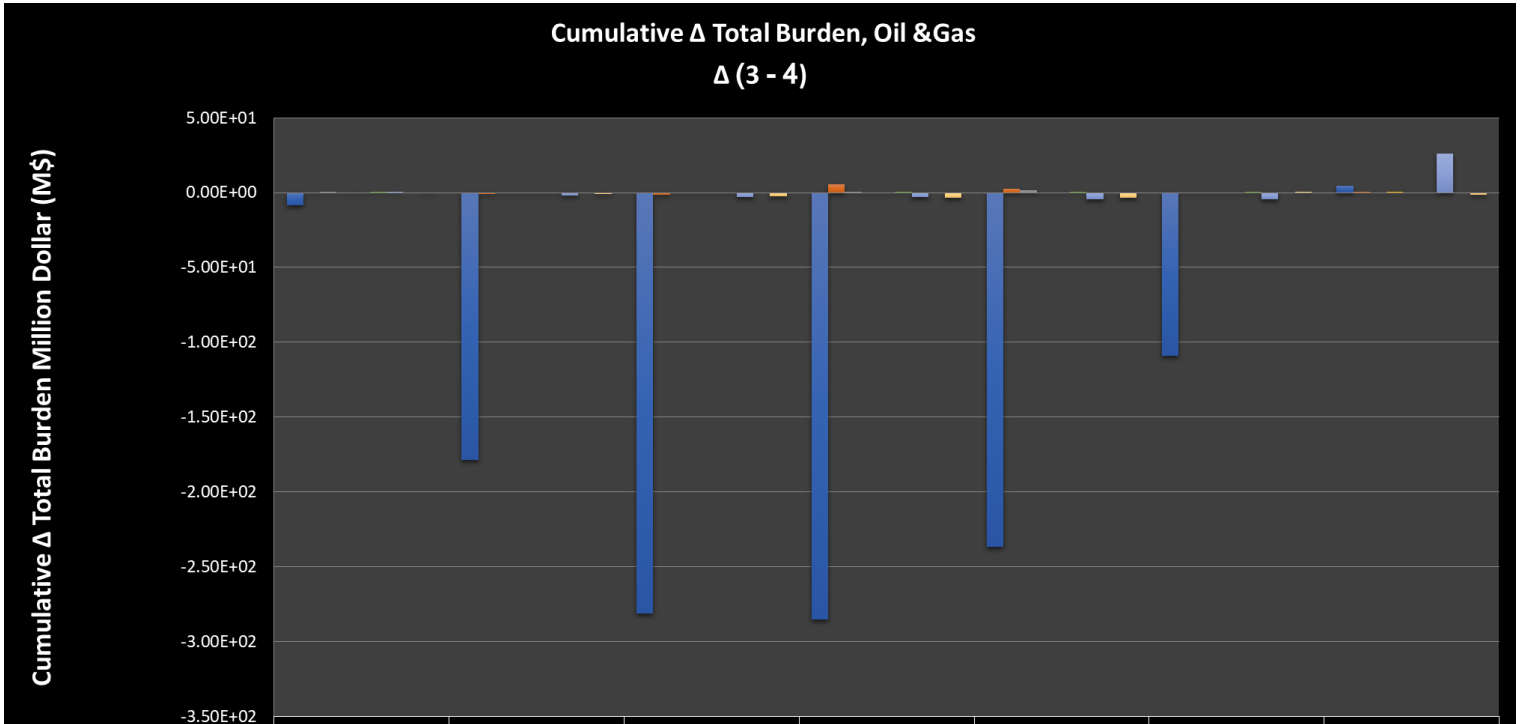
	2020	2025	2030	2035	2040	2045	2050
Alberta	-2.47E+01	-5.85E+02	-1.73E+03	-2.63E+03	-3.12E+03	-3.78E+03	-4.80E+03
British Columbia	-2.69E-01	-1.52E+00	-1.25E+00	-8.09E+00	-3.54E+01	-7.57E+01	-1.20E+02
Manitoba	-4.97E+00	-8.48E+00	-1.06E+01	-1.22E+01	-1.27E+01	-1.85E+01	-3.12E+01
New Burnswick	8.86E-05	4.93E-04	5.33E-04	2.08E-04	-1.68E-04	-1.73E-03	3.70E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	2.46E-03	1.99E-02	6.17E-02	1.22E-01	1.71E-01	-3.78E-02	-5.69E-01
Ontario	4.44E-01	2.30E+00	4.96E+00	7.09E+00	5.84E+00	-5.12E+00	6.05E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-8.66E-02	-3.35E+00	-9.83E+00	-2.04E+01	-3.22E+01	-4.64E+01	-7.51E+01

Provincial Cumulative Total Burden (M$) Difference Between 3 & 2 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	-6.09E-03	-3.01E-02	-4.40E-01	-6.82E-01	-7.37E-01	-1.14E+00	1.19E+01
British Columbia	9.01E-04	1.62E-02	-3.36E-02	-6.04E-02	3.63E-01	6.56E-01	6.86E-01
Manitoba	-1.36E-03	6.17E-03	-1.39E-02	-4.64E-02	1.44E+00	2.44E+00	2.44E+00
New Burnswick	4.27E-06	3.54E-07	-6.97E-06	-9.54E-06	-1.20E-05	2.35E-04	3.76E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	4.97E-05	1.27E-03	1.77E-03	1.60E-03	3.63E-03	5.04E-03	3.22E-03
Ontario	2.74E-03	2.18E-03	-9.32E-02	1.23E-02	7.64E+00	2.19E+01	1.33E+02
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-1.28E-03	-1.04E-02	-1.11E-01	-2.39E-01	2.03E-01	1.02E+00	-1.02E+00

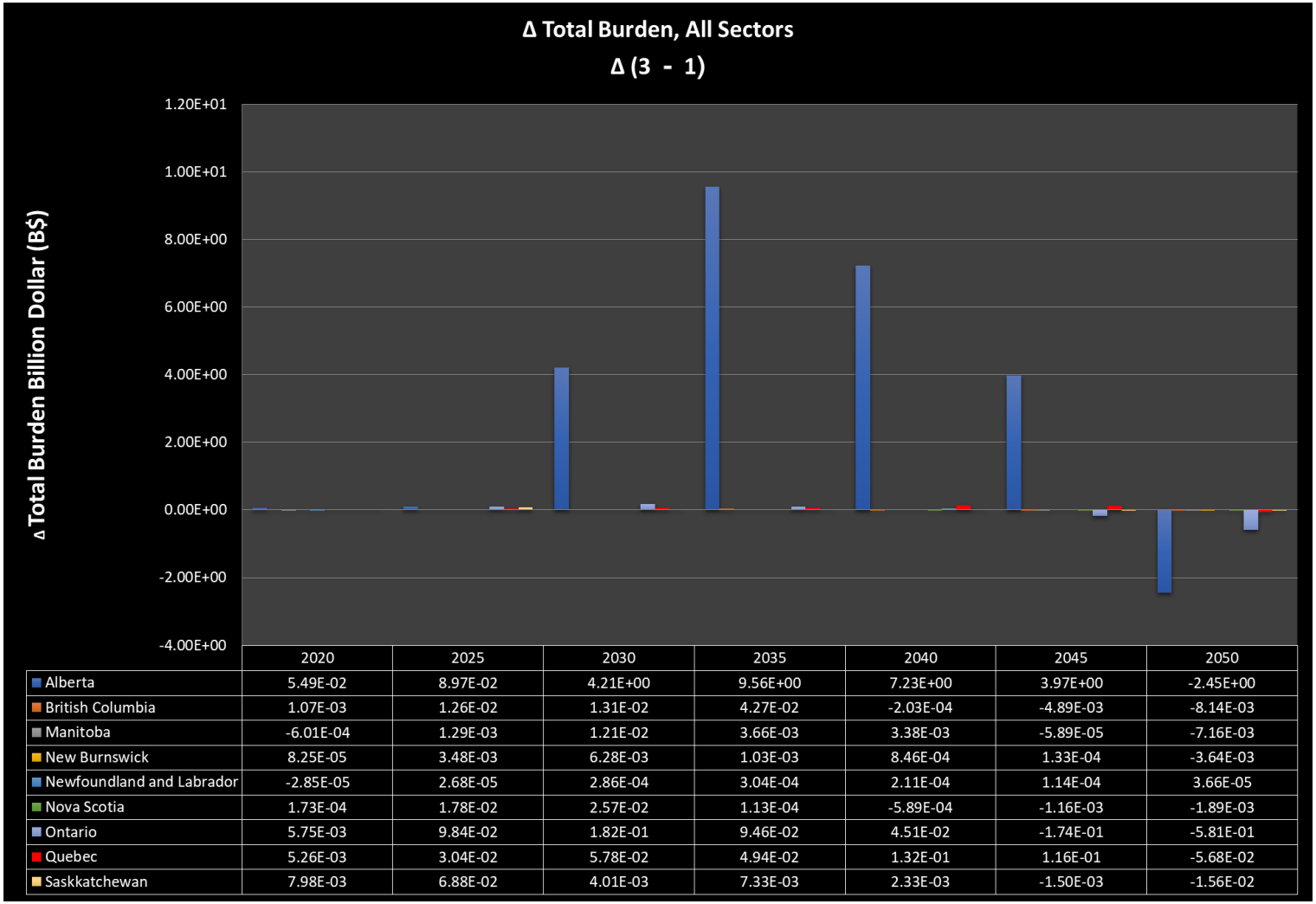
Provincial Cumulative Total Burden (M$) Difference Between 3 & 4 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	-8.25E+00	-1.79E+02	-2.81E+02	-2.85E+02	-2.37E+02	-1.09E+02	4.43E+00
British Columbia	-9.01E-02	-1.19E+00	-1.28E+00	5.30E+00	2.41E+00	-2.39E-01	6.27E-03
Manitoba	2.28E-02	-2.92E-01	-1.95E-01	1.94E-01	1.28E+00	6.22E-06	-7.29E-04
New Burnswick	3.04E-05	-6.46E-04	-1.14E-03	-1.39E-03	-1.35E-03	-1.00E-03	1.24E-01
Newfoundland and Labrador	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nova Scotia	8.30E-04	-9.86E-03	-1.20E-02	4.88E-02	4.66E-03	4.99E-04	-2.33E-05
Ontario	1.52E-01	-2.11E+00	-3.04E+00	-2.88E+00	-4.55E+00	-4.56E+00	2.61E+01
Quebec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Saskkatchewan	-3.63E-02	-1.22E+00	-2.56E+00	-3.58E+00	-3.58E+00	1.39E-01	-1.27E+00

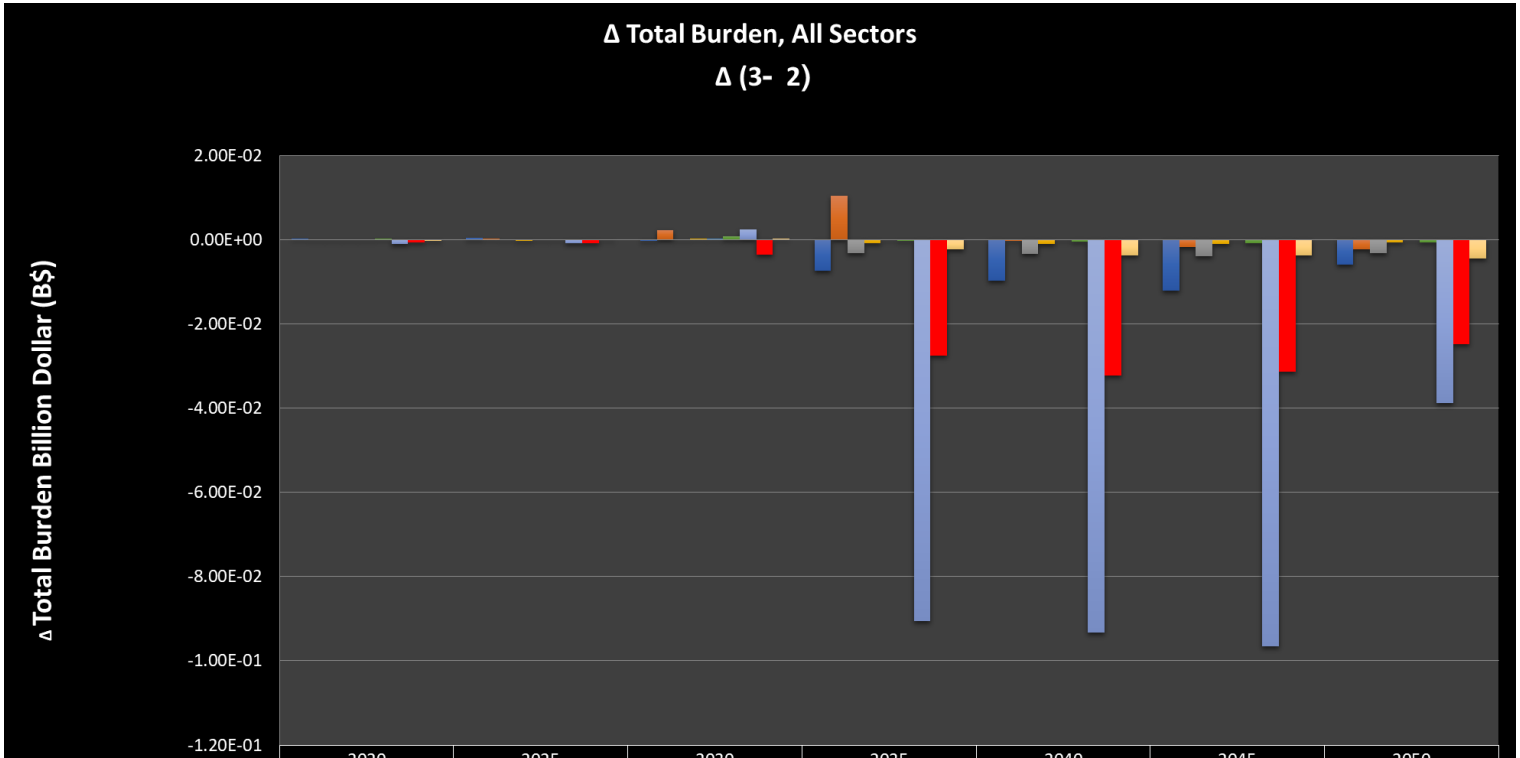
All Sectors

Provincial Total Burden (M$) Difference Between 3 & 1 (2015-2050)



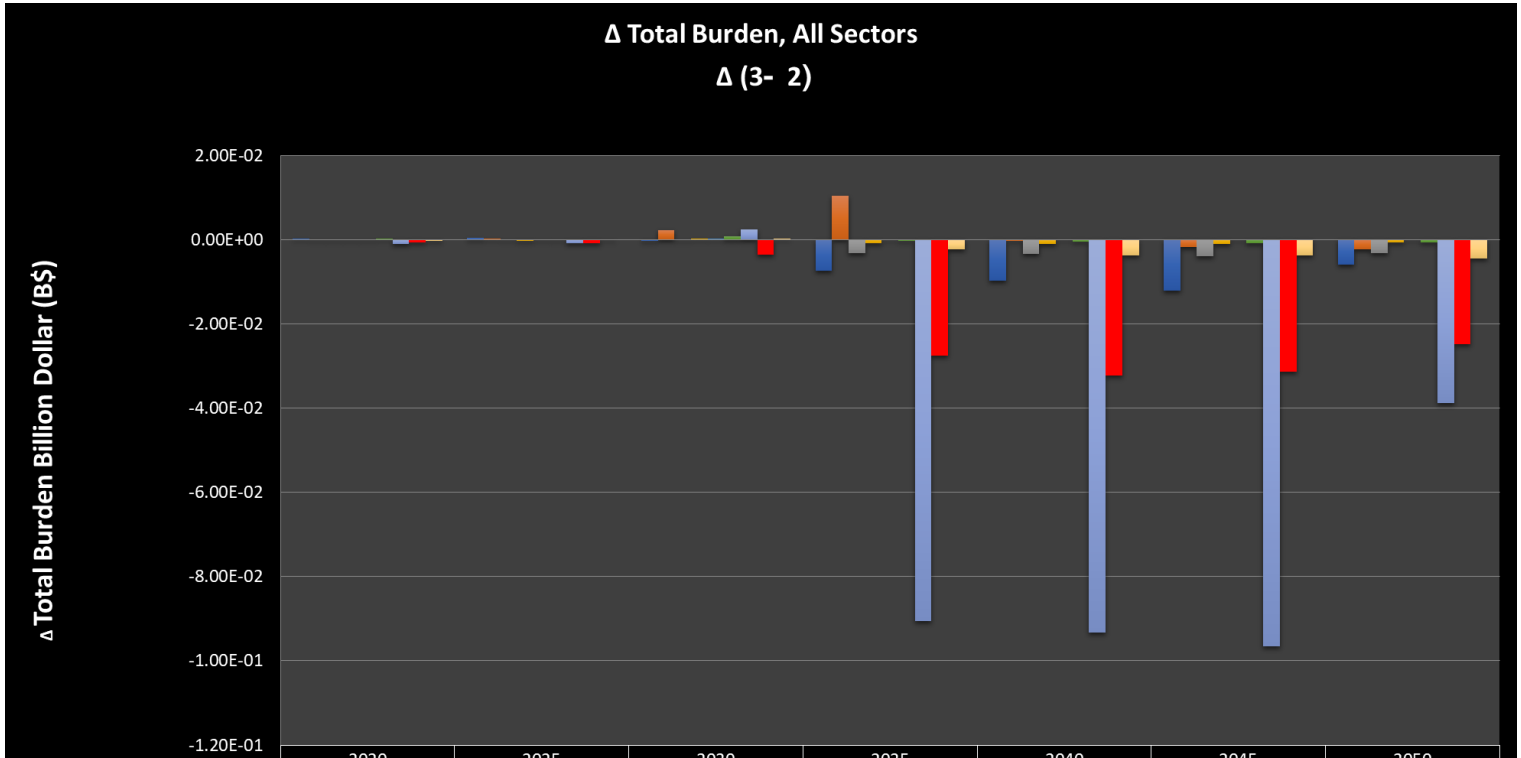
	2020	2025	2030	2035	2040	2045	2050
Alberta	5.49E-02	8.97E-02	4.21E+00	9.56E+00	7.23E+00	3.97E+00	-2.45E+00
British Columbia	1.07E-03	1.26E-02	1.31E-02	4.27E-02	-2.03E-04	-4.89E-03	-8.14E-03
Manitoba	-6.01E-04	1.29E-03	1.21E-02	3.66E-03	3.38E-03	-5.89E-05	-7.16E-03
New Burnswick	8.25E-05	3.48E-03	6.28E-03	1.03E-03	8.46E-04	1.33E-04	-3.64E-03
Newfoundland and Labrador	-2.85E-05	2.68E-05	2.86E-04	3.04E-04	2.11E-04	1.14E-04	3.66E-05
Nova Scotia	1.73E-04	1.78E-02	2.57E-02	1.13E-04	-5.89E-04	-1.16E-03	-1.89E-03
Ontario	5.75E-03	9.84E-02	1.82E-01	9.46E-02	4.51E-02	-1.74E-01	-5.81E-01
Quebec	5.26E-03	3.04E-02	5.78E-02	4.94E-02	1.32E-01	1.16E-01	-5.68E-02
Saskkatchewan	7.98E-03	6.88E-02	4.01E-03	7.33E-03	2.33E-03	-1.50E-03	-1.56E-02

Provincial Total Burden (M$) Difference Between 3 & 2 (2015-2050)



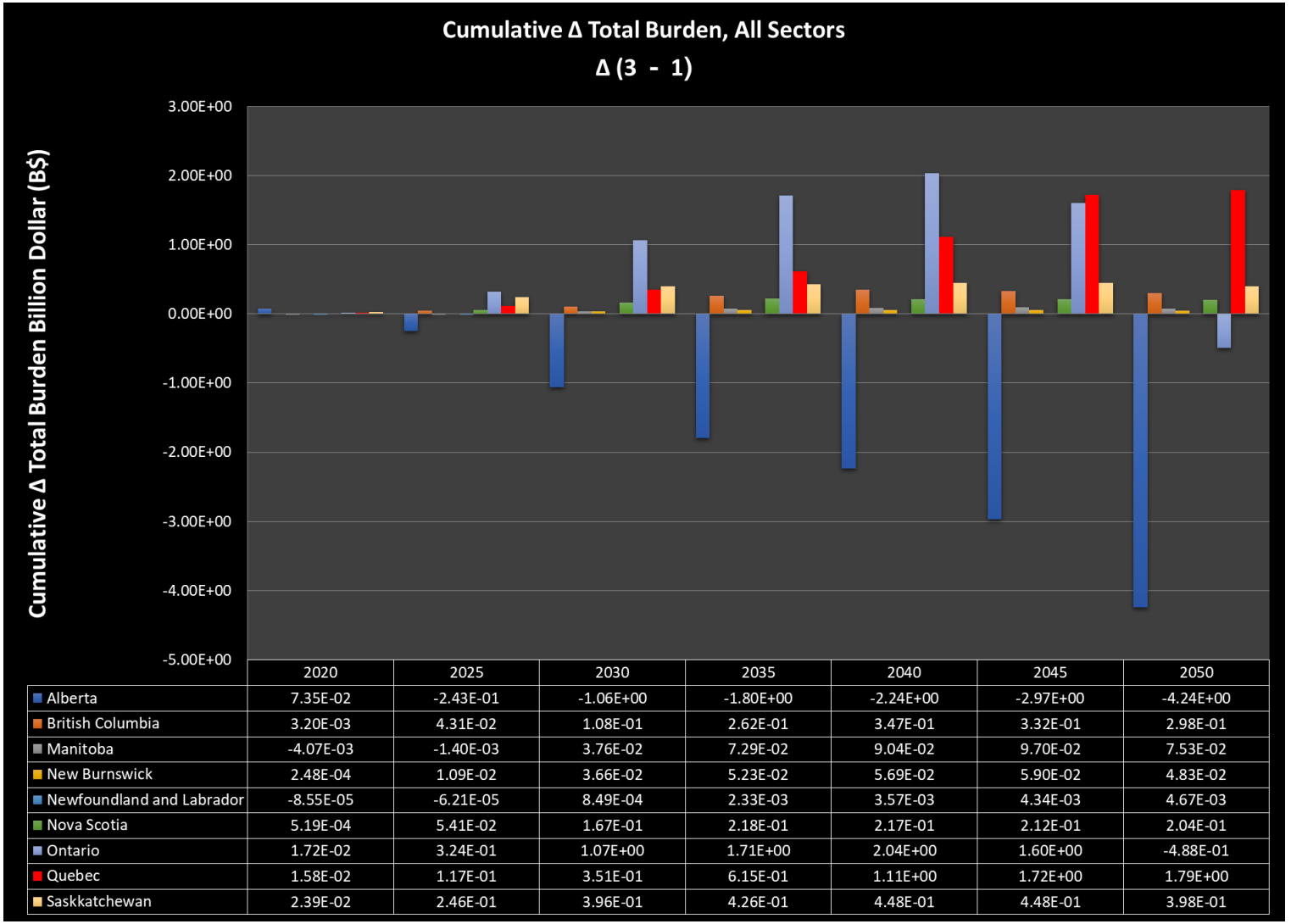
	2020	2025	2030	2035	2040	2045	2050
Alberta	5.75E-05	4.68E-04	-2.51E-04	-7.33E-03	-9.71E-03	-1.21E-02	-5.91E-03
British Columbia	-1.76E-04	9.58E-05	2.15E-03	1.04E-02	-3.31E-04	-1.69E-03	-2.30E-03
Manitoba	-1.86E-05	-1.69E-04	-8.90E-05	-3.17E-03	-3.32E-03	-3.86E-03	-3.13E-03
New Burnswick	-1.34E-05	-3.34E-04	1.12E-04	-7.70E-04	-9.82E-04	-9.94E-04	-6.25E-04
Newfoundland and Labrador	-6.54E-07	-4.45E-06	2.01E-05	-7.95E-05	-1.09E-04	-1.28E-04	-1.26E-04
Nova Scotia	2.57E-06	-1.07E-04	6.97E-04	-3.54E-04	-4.93E-04	-8.55E-04	-6.28E-04
Ontario	-9.95E-04	-9.37E-04	2.34E-03	-9.06E-02	-9.32E-02	-9.66E-02	-3.89E-02
Quebec	-7.20E-04	-7.70E-04	-3.55E-03	-2.75E-02	-3.23E-02	-3.13E-02	-2.47E-02
Saskkatchewan	-2.22E-04	-1.80E-04	2.73E-04	-2.24E-03	-3.78E-03	-3.75E-03	-4.46E-03

Provincial Total Burden (M$) Difference Between 3 & 4 (2015-2050)



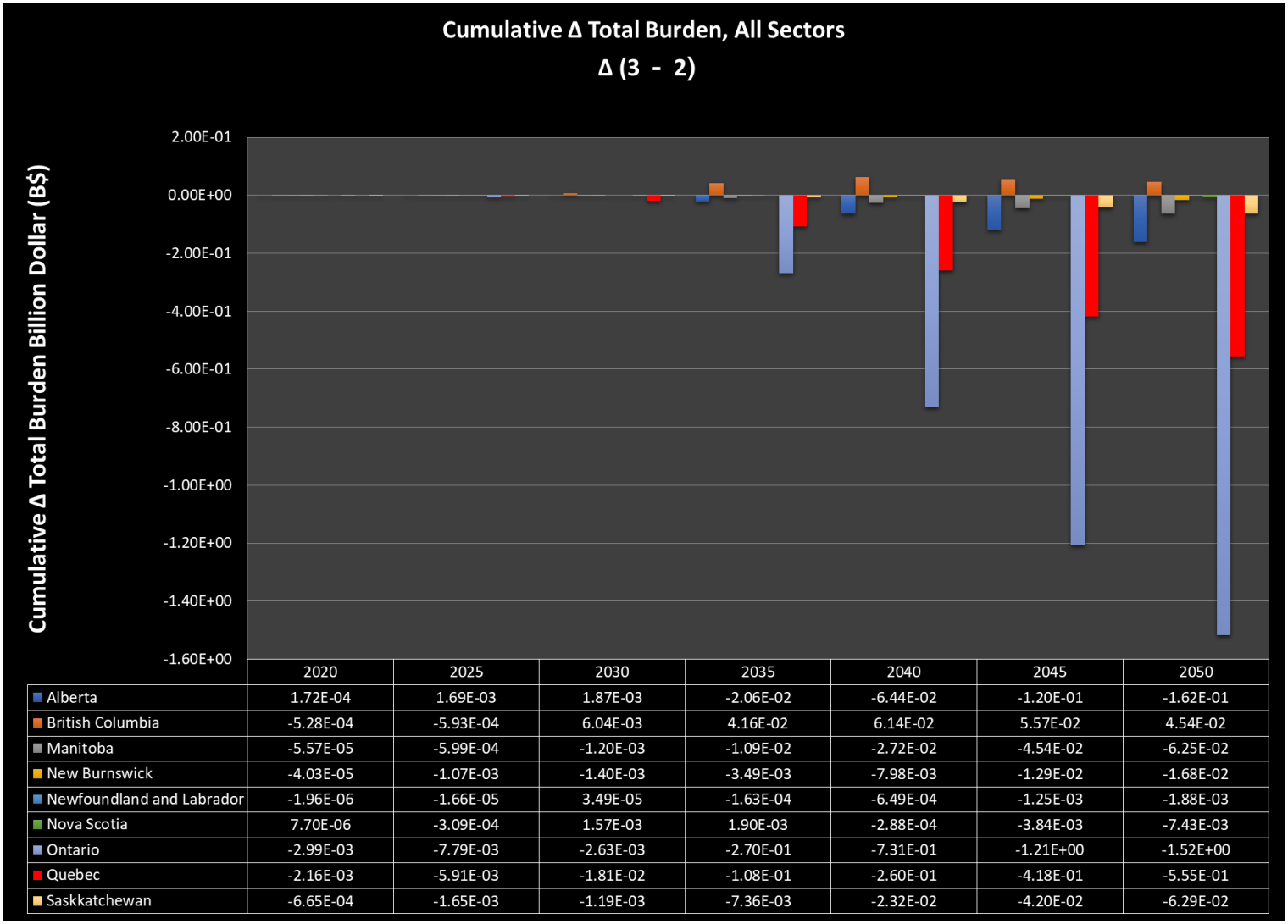
	2020	2025	2030	2035	2040	2045	2050
Alberta	5.75E-05	4.68E-04	-2.51E-04	-7.33E-03	-9.71E-03	-1.21E-02	-5.91E-03
British Columbia	-1.76E-04	9.58E-05	2.15E-03	1.04E-02	-3.31E-04	-1.69E-03	-2.30E-03
Manitoba	-1.86E-05	-1.69E-04	-8.90E-05	-3.17E-03	-3.32E-03	-3.86E-03	-3.13E-03
New Burnswick	-1.34E-05	-3.34E-04	1.12E-04	-7.70E-04	-9.82E-04	-9.94E-04	-6.25E-04
Newfoundland and Labrador	-6.54E-07	-4.45E-06	2.01E-05	-7.95E-05	-1.09E-04	-1.28E-04	-1.26E-04
Nova Scotia	2.57E-06	-1.07E-04	6.97E-04	-3.54E-04	-4.93E-04	-8.55E-04	-6.28E-04
Ontario	-9.95E-04	-9.37E-04	2.34E-03	-9.06E-02	-9.32E-02	-9.66E-02	-3.89E-02
Quebec	-7.20E-04	-7.70E-04	-3.55E-03	-2.75E-02	-3.23E-02	-3.13E-02	-2.47E-02
Saskkatchewan	-2.22E-04	-1.80E-04	2.73E-04	-2.24E-03	-3.78E-03	-3.75E-03	-4.46E-03

Provincial Cumulative Total Burden (M$) Difference Between 3 & 1 (2015-2050)



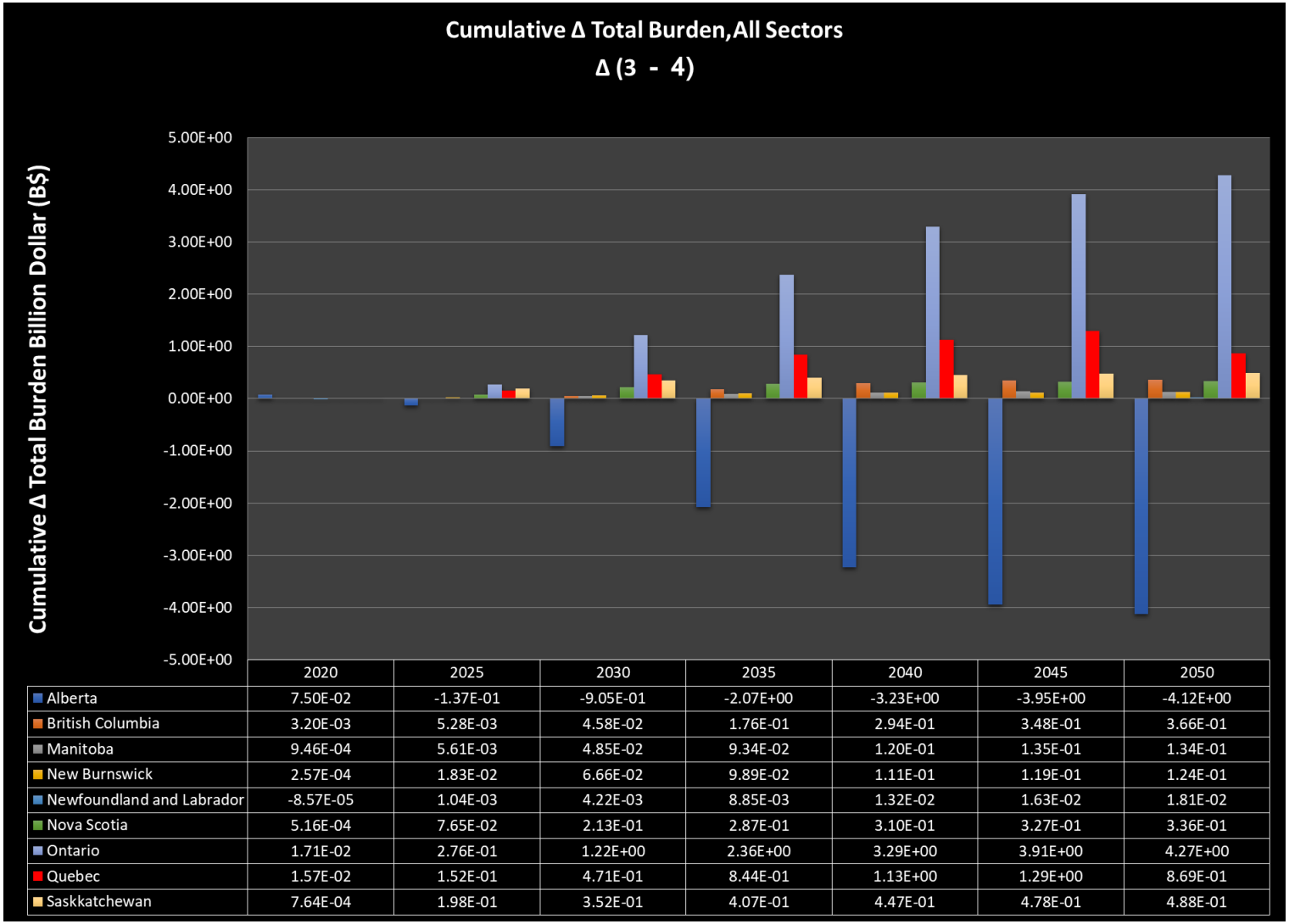
	2020	2025	2030	2035	2040	2045	2050
Alberta	7.35E-02	-2.43E-01	-1.06E+00	-1.80E+00	-2.24E+00	-2.97E+00	-4.24E+00
British Columbia	3.20E-03	4.31E-02	1.08E-01	2.62E-01	3.47E-01	3.32E-01	2.98E-01
Manitoba	-4.07E-03	-1.40E-03	3.76E-02	7.29E-02	9.04E-02	9.70E-02	7.53E-02
New Burnswick	2.48E-04	1.09E-02	3.66E-02	5.23E-02	5.69E-02	5.90E-02	4.83E-02
Newfoundland and Labrador	-8.55E-05	-6.21E-05	8.49E-04	2.33E-03	3.57E-03	4.34E-03	4.67E-03
Nova Scotia	5.19E-04	5.41E-02	1.67E-01	2.18E-01	2.17E-01	2.12E-01	2.04E-01
Ontario	1.72E-02	3.24E-01	1.07E+00	1.71E+00	2.04E+00	1.60E+00	-4.88E-01
Quebec	1.58E-02	1.17E-01	3.51E-01	6.15E-01	1.11E+00	1.72E+00	1.79E+00
Saskkatchewan	2.39E-02	2.46E-01	3.96E-01	4.26E-01	4.48E-01	4.48E-01	3.98E-01

Provincial Cumulative Total Burden (M$) Difference Between 3 & 2 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	1.72E-04	1.69E-03	1.87E-03	-2.06E-02	-6.44E-02	-1.20E-01	-1.62E-01
British Columbia	-5.28E-04	-5.93E-04	6.04E-03	4.16E-02	6.14E-02	5.57E-02	4.54E-02
Manitoba	-5.57E-05	-5.99E-04	-1.20E-03	-1.09E-02	-2.72E-02	-4.54E-02	-6.25E-02
New Burnswick	-4.03E-05	-1.07E-03	-1.40E-03	-3.49E-03	-7.98E-03	-1.29E-02	-1.68E-02
Newfoundland and Labrador	-1.96E-06	-1.66E-05	3.49E-05	-1.63E-04	-6.49E-04	-1.25E-03	-1.88E-03
Nova Scotia	7.70E-06	-3.09E-04	1.57E-03	1.90E-03	-2.88E-04	-3.84E-03	-7.43E-03
Ontario	-2.99E-03	-7.79E-03	-2.63E-03	-2.70E-01	-7.31E-01	-1.21E+00	-1.52E+00
Quebec	-2.16E-03	-5.91E-03	-1.81E-02	-1.08E-01	-2.60E-01	-4.18E-01	-5.55E-01
Saskkatchewan	-6.65E-04	-1.65E-03	-1.19E-03	-7.36E-03	-2.32E-02	-4.20E-02	-6.29E-02

Provincial Cumulative Total Burden (M$) Difference Between 3 & 4 (2015-2050)



	2020	2025	2030	2035	2040	2045	2050
Alberta	7.50E-02	-1.37E-01	-9.05E-01	-2.07E+00	-3.23E+00	-3.95E+00	-4.12E+00
British Columbia	3.20E-03	5.28E-03	4.58E-02	1.76E-01	2.94E-01	3.48E-01	3.66E-01
Manitoba	9.46E-04	5.61E-03	4.85E-02	9.34E-02	1.20E-01	1.35E-01	1.34E-01
New Burnswick	2.57E-04	1.83E-02	6.66E-02	9.89E-02	1.11E-01	1.19E-01	1.24E-01
Newfoundland and Labrador	-8.57E-05	1.04E-03	4.22E-03	8.85E-03	1.32E-02	1.63E-02	1.81E-02
Nova Scotia	5.16E-04	7.65E-02	2.13E-01	2.87E-01	3.10E-01	3.27E-01	3.36E-01
Ontario	1.71E-02	2.76E-01	1.22E+00	2.36E+00	3.29E+00	3.91E+00	4.27E+00
Quebec	1.57E-02	1.52E-01	4.71E-01	8.44E-01	1.13E+00	1.29E+00	8.69E-01
Saskkatchewan	7.64E-04	1.98E-01	3.52E-01	4.07E-01	4.47E-01	4.78E-01	4.88E-01