Modeling VES policy in Canada (2020-2030)

Submitted to: Clean Energy Canada

Completed by: Jonn Axsen and Chandan Bhardwaj

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Background

Method

- We use the AUtomaker-consumer Model (AUM) to simulate the impacts of various VES designs on Canada's light-duty vehicle sector. Relative to:
  - **ZEV sales target**: of 50% by 2030
  - **Our assumed GHG reduction target**: 51 Mt by 2030, which is 40% below 2005 levels for LDVs (85 Mt) – though the federal government has not set a specific goal for LDVs.
- AUM is unique in that it simulates interactions between:
  - **Behaviorally-realistic consumers**: three car buyer segments, based on empirical data collected from representative samples of Canadian new car buyers. Consumer preferences evolve with increasing ZEV penetration.
  - **Automakers**: represented as an aggregate profit-maximizing automaker. The automaker has multi-year foresight for the automaker, including decisions about: (i) increasing ZEV model variety, (ii) intra-firm cross-price subsidies, and (iii) investing in R&D to reduce future ZEV costs.
- AUM is currently set up for a 2020-2030 time horizon. Outputs include:
  - Canada's ZEV new market share for light-duty vehicles, 2020-2030
  - Canada's stock of ZEVs, 2020-2030
  - GHG emissions from Canada's light-duty vehicles, 2020-2030
  - Total consumer fuel savings (total net present value, $CDN, 3% and 8% discount rate)

Policy scenarios

This project simulates a "baseline" policy scenario, along with several vehicle emissions standard (VES) scenarios added to this baseline.

1. **Baseline**, includes
   - **Carbon pricing:** increasing from $50/tonne in 2020 to $170 in 2030
   - **Clean Fuel Standard (CFS):** reducing the carbon intensity (g/MJ) of liquid fuels by 13% by 2030 (relative to 2016), moving from 90.4 g/MJ to 81.0 g/MJ
   - **Low-carbon fuel standard (LCFS):** the carbon intensity of liquid fuels is further reduced by British Columbia's LCFS, working with the CFS to reach 80.5 g/MJ by 2030
   - **ZEV mandate**: accounting for mandates in British Columbia and Quebec
   - **Purchase incentives:** Accounting for all national and provincial ZEV subsidies, with announced magnitude and estimated duration
   - **ZEV Charger deployment:** reaching 70% of car buyers by 2030
   - **VES:** held constant at 2021 level through 2030

2. **Baseline + "Trump-era" VES:** 1.5% efficiency improvements, 2023-26, hold 2026 level to 2030

3. **Baseline + "Obama-era" VES:** 5% efficiency improvements, 2023-26, hold 2026 level to 2030

4. **Baseline + "California-framework" VES:** 3.7% improvements, 2023-26, hold 2026 level to 2030

5. **Baseline + "Biden" VES:** 9.8% improvement in 2023, ~5% for 2024-26, hold 2026 level to 2030

Note : We do not include the effect of multipliers. The Biden VES have added more multipliers in addition to those that existed for existing VES. Thus, our scenarios may overestimate ZEV sales and GHG mitigation impacts. This overestimation is most pronounced for Biden VES, which includes the most EV multipliers.

Assumed "baseline" ZEV purchase subsidies

|	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Source
Canada	$3,750	$3,750	$3,750									Link
BC	$2,750	$2,750	$2,750	$2,750	$2,750							Link
QC	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000					Link
Nova Scotia	$2,500	$2,500	$2,500	$2,500	$2,500							Link
PEI	$3,750	$3,750	$3,750									Link
NFL	$2,500	$2,500	$2,500									Link
Yukon	$4,000	$4,000	$4,000	$4,000								Link
Sales-Weighted total	$ 5,662	$ 5,662	$ 5,663	$ 1,851	$ 1,834	$ 1,453	$ 1,453	$0	$0	$0	$0	

Sensitivity analysis

To account for uncertainty, we performed a sensitivity analysis for each policy scenario. For nine parameters in AUM, we included "optimistic", "pessimistic" and "median" values.

| Parameters	2020 values	Optimistic (in 2030)	Median (in 2030)	Pessimistic (in 2030)	Source
Model variety (relative to CVs)	10%	90%	70%	40%	Authors' judgement,
Recharging access (%, relative to gas stations)	10%	90%	70%	50%	Authors' judgement
Gasoline price (CDN$/bbl in 2020)	75	121.9	92.3	64.1	National Energy Board (2019), US EIA (2020) , IEA (2020)
Battery costs (CDN$/kWh in 2020)	230	70	100	130	Lutsey et al. (2021)
Consumer own-price elasticity for vehicle purchase (2020-2030)	-0.6	-0.3	-0.6	-1	Fouquet (2012); Holmgren, (2007)
Consumer elasticity for travel demand (2020-2030)	-0.2	-0.15	-0.2	-0.25	Small and van Dender (2007)
Automaker rate of learning (%) (2020-2030)	8	10	8	6	Weiss et al. (2012), Barreto and Kypreos (2004)
Automaker discount rate (%) (2020-2030)	10	8	10	15	Jagannathan et al. (2016)
Vehicle stock turnover rate (%) (2020-2030)	7	10	7	5	National Energy Board (2019), Author's judgement

Key results

None of the VES scenarios will achieve 2030 ZEV sales goals. The most stringent VES (Biden) only reaches 22% ZEV sales by 2030
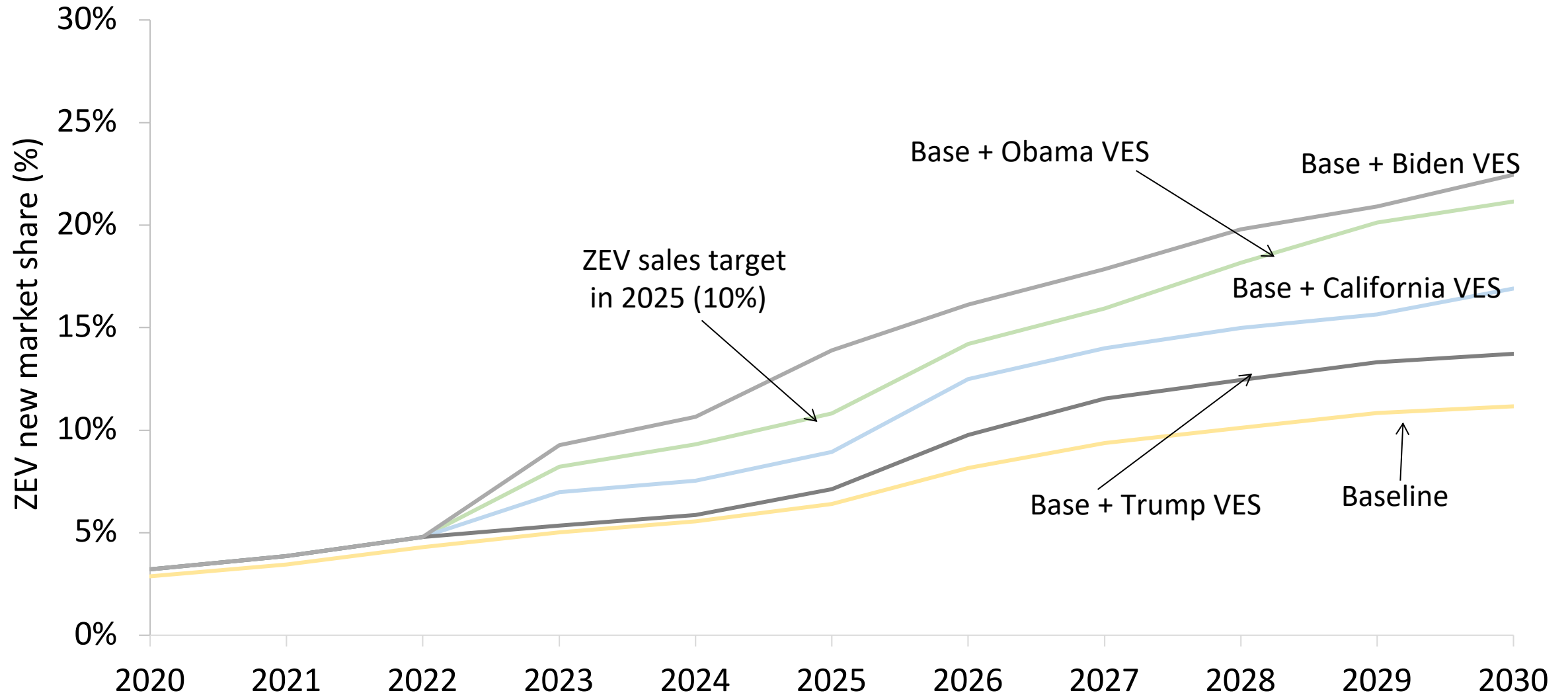
These ZEV sales results hold even under "pessimistic" and "optimistic" conditions. In a best case scenario, the Biden VES does not surpass 24% ZEV market share by 2030
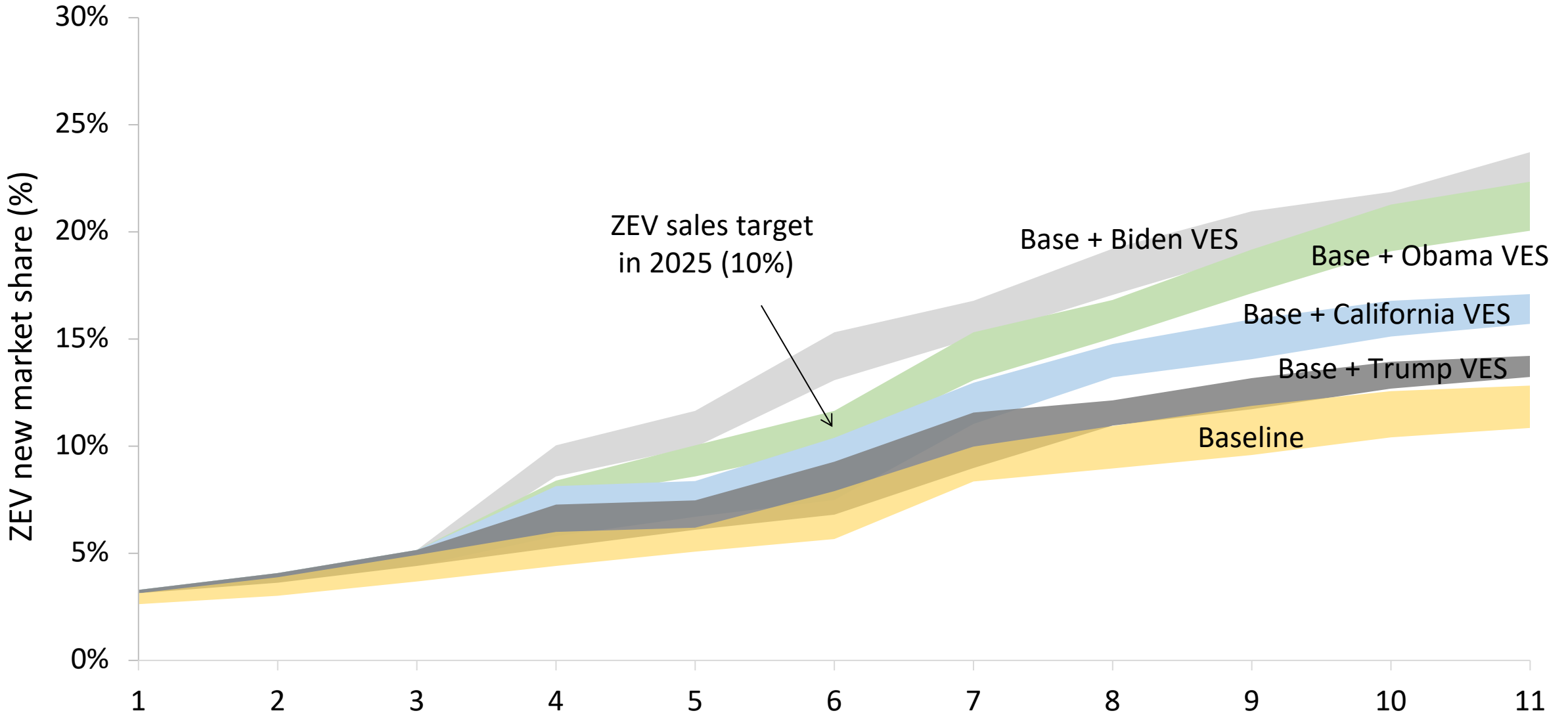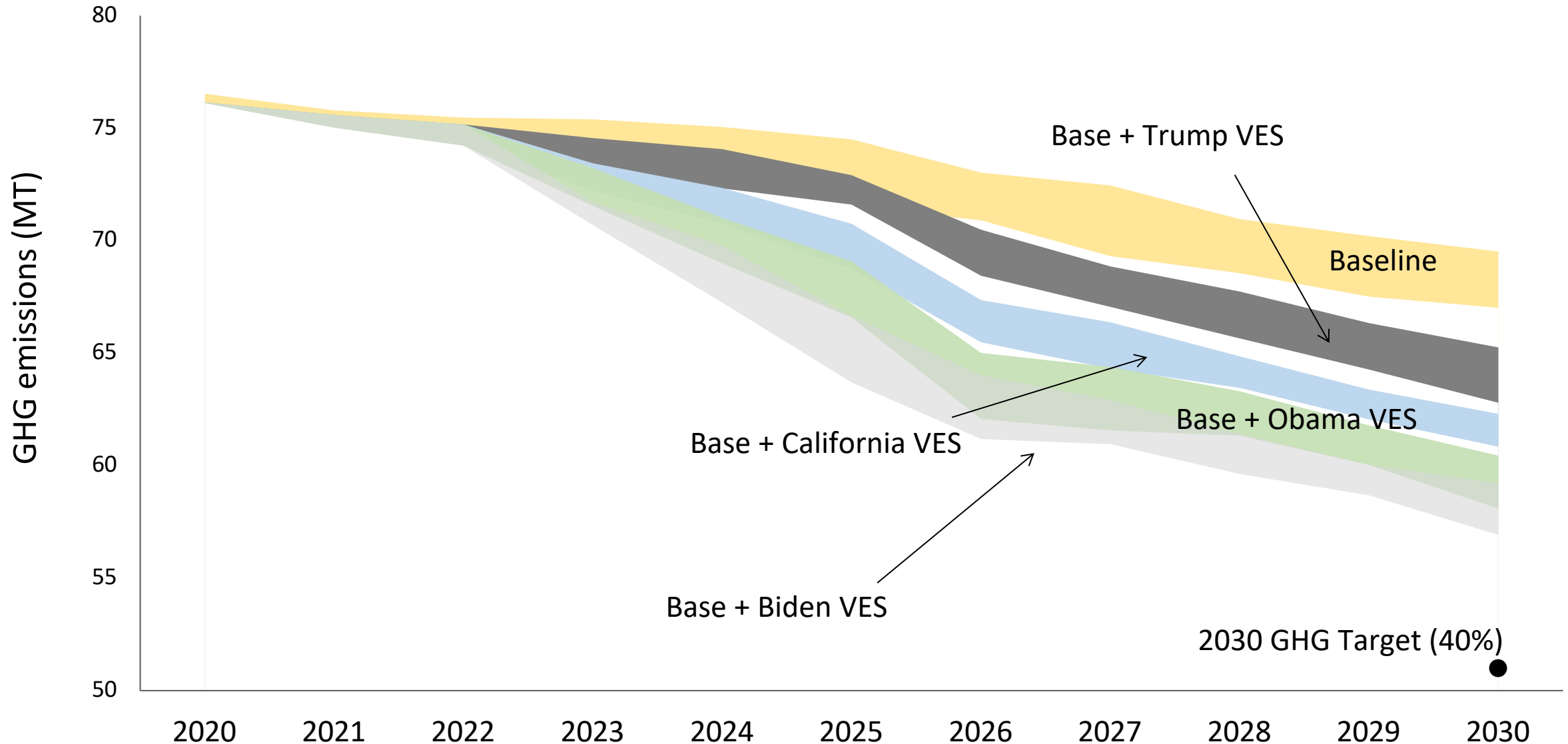
With no added policy, ZEV stock is simulated to increase from 175k to 1.6 million. The strongest VES can push 2030 stock to about 2.7 million.
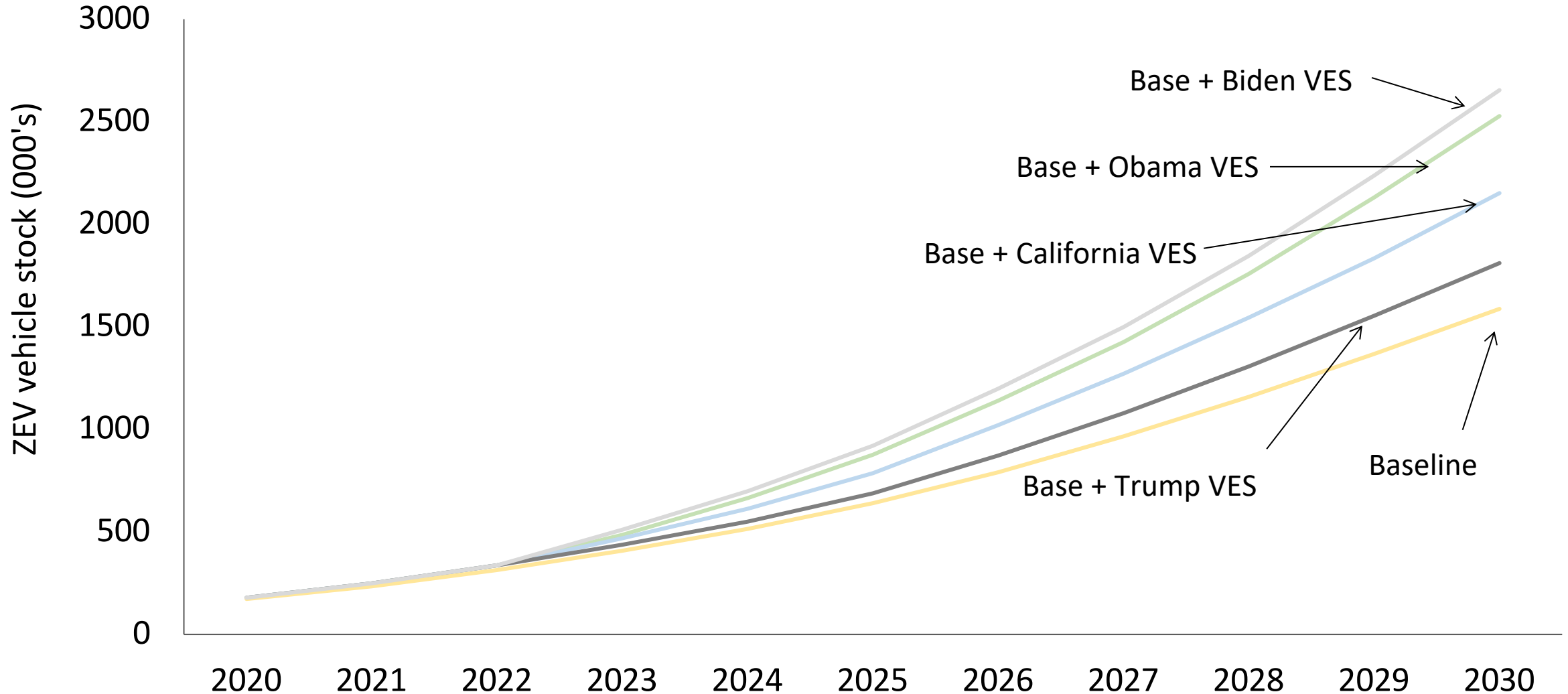
None of the VES scenarios will achieve 2030 GHG emissions goals. The most stringent VES (Biden) reduces light-duty vehicle emissions by 23% (2020-2030).
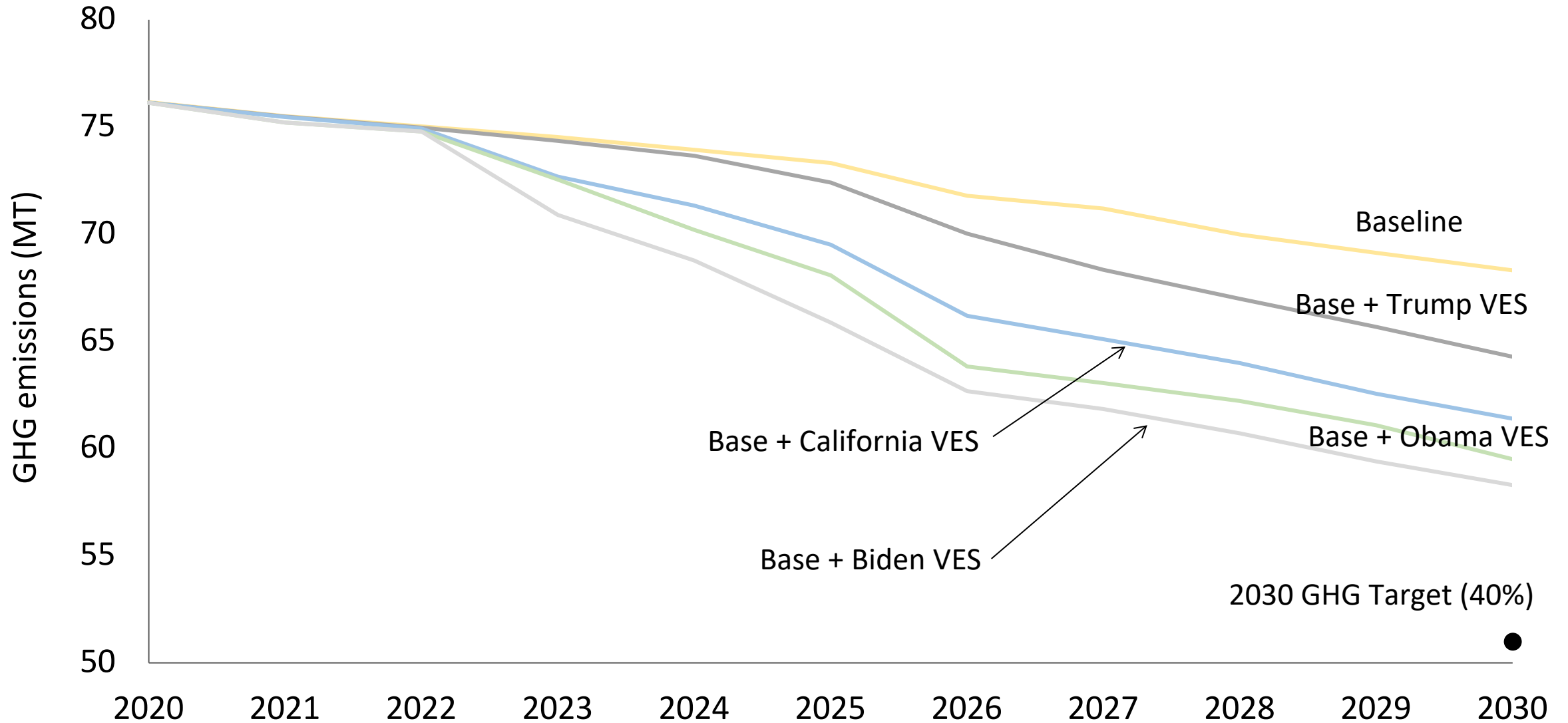
The GHG emissions results hold even with uncertainty. The most stringent VES (Biden) is about 6 MT higher than the 2030 goal.

- Base + Trump VES
- Baseline
- Base + California VES
- Base + Obama VES
- Base + Biden VES
- 2030 GHG Target (40%)

GHG emissions (MT)

Compared to the baseline policy scenario, a VES can save consumers $2.1 to $16.9 Billion (2020-2030). The Biden VES yields six times the savings as the Trump-era VES.

Policy Scenarios	Social discount rate 3%	Private discount rate 8%
Baseline + VES Biden	$16.9 B	$12.2 B
Baseline + VES Obama	$14.7 B	$10.5 B
Baseline + VES California	$ 7.1 B	$5.2 B
Baseline + VES Trump	$ 2.9 B	$2.1 B

Note: The Canadian government recommends using both a 3% and 8% discount rate for cost-benefit analyses. 3% is more in line with a "social" perspective, and will lead to higher valuation of future costs/benefits. 8% is in line with a private or company perspective on valuation. Consumers tend to undervalue future fuel savings at the time of vehicle purchase. These calculations consider the actual fuel savings as they will unfold over the lifetime of the new vehicle fleet.