



ENERGY AND NATURAL RESOURCES POLICY

Time to Reboot: The Federal ZEV Mandate Requires Flexibility

By Brian Livingston

The federal government has proposed regulations requiring the sale of a minimum numbers of Zero Emission Vehicles (ZEVs) in Canada (20 percent of all light vehicles in 2026, ramping up to 60 percent in 2030 and 100 percent in 2035). The flip side of this requirement is that the sale of internal combustion engine (ICE) light vehicles will be reduced and eventually prohibited in 2035.

- This ZEV mandate will require an increase in ZEV sales from about 100,000 ZEV light vehicles in 2022 to 300,000 in 2026, 900,000 in 2030 and 1.5 million in 2035.
- This paper examines whether or not Canadians will be able to buy enough ZEVs (either domestically produced or imported) to meet this ZEV mandate requirement. The findings show that Canada should be able to meet the 2035 100 percent ZEV mandate for about 270,000 passenger cars (only 18 percent of the market) but will be unlikely to meet the 2035 ZEV mandate for the 1,240,000 remaining light vehicles (pickup trucks, vans and SUVs/crossovers) comprising 82 percent of the market.
- Canada cannot wait until 2035 to realize that the federal ZEV mandate will not be met. The gap between light-vehicle demand and forecasted ZEV light-vehicle supply will cause severe market disruptions. A better approach would be to reject a hardline ZEV mandate and instead to substitute a more flexible Plan B. Plan B should focus more on emissions rather than ZEV targets. For example, permitting some ICE light vehicles to be sold, particularly ones that can use renewable fuels. In addition, permitting plug-in hybrids (PHEVs) and hybrids to be included as ZEVs.
- Finally, the federal government may have to accept that the 100 percent ZEV target is not feasible by 2035, and therefore must include flexibility in the federal ZEV mandate to back away from the 100 percent ZEV target.

THE FEDERAL GOVERNMENT ZEV MANDATE

The topic of emissions targets has once again been in the news recently. Since transportation represents about 25 percent of Canada's emissions, discussion has focussed on emissions reductions in that sector, particularly on initiatives in the near future that might be able to reduce emissions from light vehicles.

One of the tools advanced for such purpose is called a Zero Emissions Vehicle (ZEV) mandate. As will be seen, the ZEV mandate will soon have a direct effect on Canadians as they try to purchase their next light vehicle, particularly pickup trucks and SUVs/crossovers (Canada a).

THE THEORY OF ZEV MANDATES

A ZEV mandate is government legislation that imposes a requirement on the sellers of light vehicles to sell a certain minimum of ZEVs in a year. (ZEV is used interchangeably with BEV for battery electric vehicle in this paper. PHEVs can also qualify as ZEVs to a limited extent). The theory is that this minimum requirement will give certainty to vehicle sellers that there will be a market for ZEVs, and will therefore give an incentive to companies to construct ZEV manufacturing facilities. In essence, the ZEV mandate assumes that the demand for ZEVs will be there and will displace the demand for ICE light vehicles, and therefore the increase in supply of ZEVs will occur.

The federal government has introduced a ZEV mandate for all of Canada. In December 2022, the federal government issued proposed regulations under the *Canadian Environmental Protection Act* (CEPA). Section 30.3 of these proposed regulations state that all sales of light vehicles (passenger cars, pickup trucks, vans and SUVs/crossovers) must meet the thresholds for ZEV sales in a year shown in the table to the right.

The flip side to a ZEV mandate is that it imposes a prohibition on the sale of ICE vehicles, plus a penalty for contravening this prohibition. A company selling light vehicles in effect has an ever-shrinking quota for the maximum number of ICE light vehicles that it can sell in a year (none in 2035).

A company creates one credit for each battery electric vehicle (BEV) it sells. A sale of a PHEV with a range of more than 80 kilometres can also create a credit, but this ability is capped at 20

Year	Federal Mandate: Minimum % of ZEV Sales
2026	20
2027	23
2028	34
2029	43
2030	60
2031	74
2032	83
2033	94
2034	97
2035	100

Source: Canada b. <https://canadagazette.gc.ca/rp-pr/p1/2022/2022-12-31/html/reg1-eng.html>

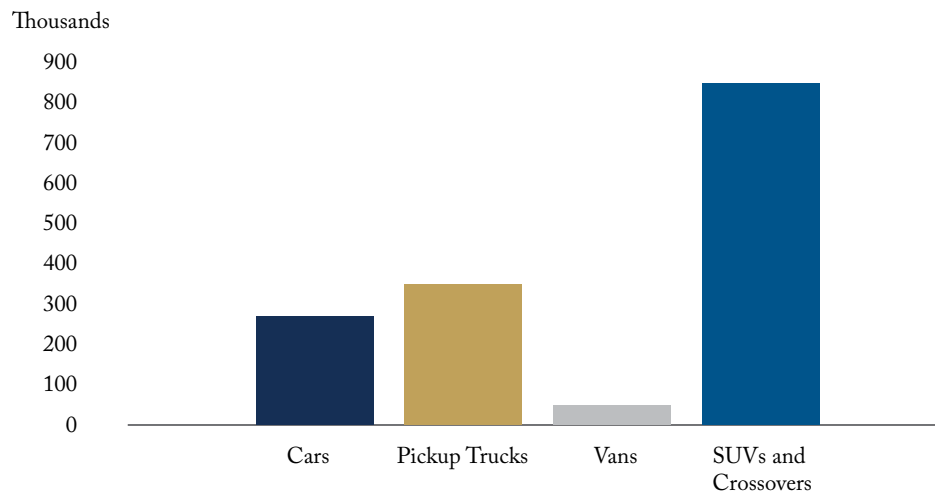
percent from 2028 onward. For example, a company selling 100 percent PHEVs in 2028 would only get credits for 20 percent.

If a company's sales create fewer credits than required by the ZEV mandate, it can still remain in compliance by using two mechanisms. First, it can buy credits from another ZEV company that has exceeded its ZEV mandate. This mechanism will likely provide hundreds of millions of dollars of extra revenue to companies such as Tesla. An alternative second mechanism would allow the company to create a credit by contributing about \$20,000 to specified ZEV activities such as supporting charging infrastructure. This second mechanism is capped at 10 percent of the ZEV mandate for the particular year, and is only available for the years prior to 2031.

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Figure 1: 2022 Light Vehicle Sales by Type of Vehicle



Source: Statistics Canada. “New motor vehicle registrations, quarterly.” Table: 20-10-0024-01 2023-12-11.

THE CANADIAN MARKET FOR LIGHT VEHICLES

2022 Sales by Type of Vehicle: Sales of light vehicles in Canada have been relatively stable in the last 4 years at about 1.5 million light vehicles.¹ The breakdown by type of vehicle is shown in Figure 1.

As can be seen, the first conclusion is that Canadians have made their vehicle preference very clear – less than 20 percent of sales are passenger cars and more than 80 percent of sales are other light vehicles. A second conclusion is that the ZEV mandate must focus on increasing the sales of ZEV pickup trucks, SUVs and crossover vehicles in order to be successful.

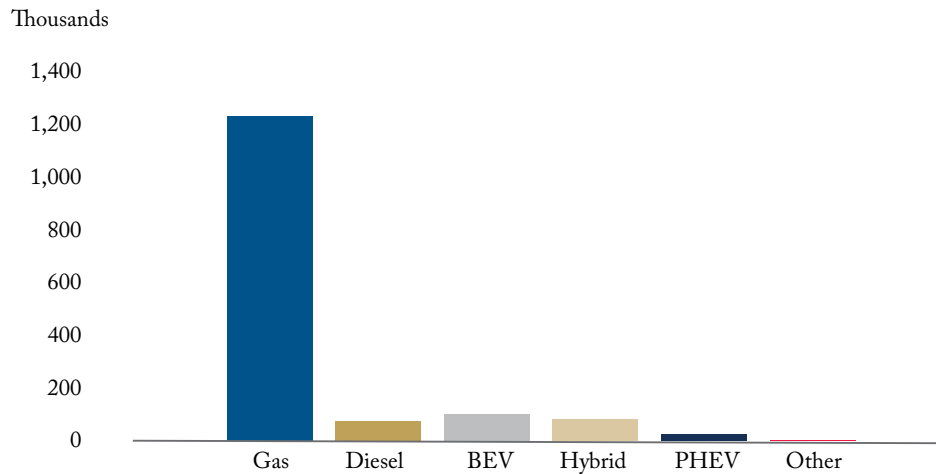
2022 Sales by Company: The light vehicle market as of 2022 is spread amongst many companies. The largest is Ford, with about 15 percent of sales. Toyota (12 percent), Hyundai (7 percent) and Honda (6 percent) are the next three. Tesla only has a 2.7 percent market share of light vehicle sales.²

2022 Sales by Source of Energy: The 1.5 million sales in 2022 can also be broken down by the vehicles’ source of energy. The largest percentage by far remains gasoline powered (82 percent). About 100,000 of light vehicle sales (6.5 percent of total sales) were full EVs, namely battery electric vehicles or BEVs. This number of BEVs is up from the 58,726 BEVs sold in 2021 (3.6 percent of sales).

1 Statistics Canada. “New motor vehicle registrations, quarterly.” <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010002401>

2 See https://www.chinamobil.ru/eng/sales/sales_canada/?year=22&mon=12

Figure 2: 2022 Light Vehicle Sales by Source of Energy



Source: Statistics Canada New Motor Vehicle Registrations, Quarterly.

In 2022, there were sales of approximately 25,000 PHEVs and 80,000 full hybrid vehicles. These vehicles are in essence ICE vehicles that get better mileage than conventional ICE vehicles. As noted above, there are transition provisions in the federal ZEV mandate that give some credit for such PHEVs (see Figure 2).

Assuming that total light vehicle sales remain at about 1.5 million per year, we can conclude that BEV sales will have to increase by 15 times (1.5 million divided by 100,000) from 2022 to 2035 in order to meet the ZEV mandate. This means a doubling every 3 years, or a 24 percent compound growth rate per year. These 1.5 million BEV sales will have to come from either domestic manufacturing capacity or imports.

BEV Sales in 2022 By Type of Vehicle: Figure 3 shows the breakdown of BEV sales in 2022 by

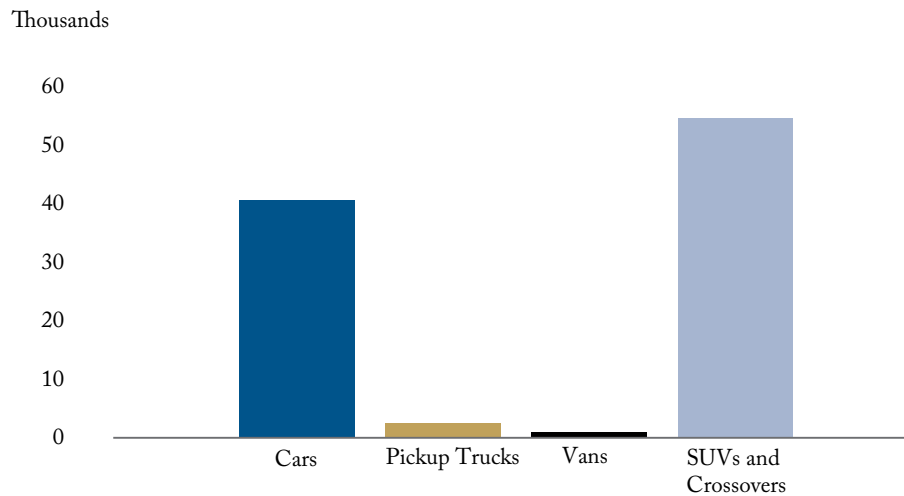
vehicle type. The chart shows that almost all BEV sales in 2022 were either passenger cars or SUVs/crossovers. Sales of pickup trucks and vans were almost nothing.

The gap between total sales and BEV sales in 2022 varies by type of vehicle. Passenger car BEV sales only need to increase from 40,000 in 2022 to about 270,000 in 2035. In contrast, pickup truck BEV sales need to increase from a minuscule 2,000 in 2022 to 350,000 in 2035. Van BEV sales need to increase from about 1,000 in 2022 to 50,000 in 2035. Most dramatically, SUV and crossover BEV sales need to increase from 55,000 in 2022 to 850,000 in 2035.³

BEV Sales by Company in 2022: For the approximately 100,000 BEVs sold in 2022, Tesla had a 41 percent market share, followed by Hyundai (11 percent), Ford (8 percent), Chevrolet

3 Statistics Canada website. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2010002401&pickMembers%5B0%5D=1.1&pickMembers%5B1%5D=3.1&cubeTimeFrame.startMonth=01&cubeTimeFrame.startYear=2022&cubeTimeFrame.endMonth=10&cubeTimeFrame.endYear=2022&referencePeriods=20220101%2C20221001>

Figure 3: 2022 BEV Sales by Type of Vehicle



Source: Statistics Canada New Motor Vehicle Registrations, Quarterly.

(7 percent), and Volvo (6 percent) with the balance of 27 percent from of smaller sales of many companies. The interesting point is that several large suppliers (Toyota, Honda, Nissan, Stellantis, Volkswagen) are not yet selling many BEVs in Canada.⁴

Provincial ZEV Mandates

British Columbia and Quebec have their own ZEV mandates, with targets for percentage of sales between now and 2035 that are slightly more aggressive than the federal ZEV mandate. Combined with provincial incentives to purchase BEVs, this has caused a channelling effect of BEV sales into the two provinces (13.6 percent for British Columbia, 9.1 percent for Quebec). These percentages are above the 6.5 percent Canada average for BEV sale as a percentage of total sales, with an offsetting reduction in BEV sales in the other 8 provinces below the 6.5 percent Canada average (see Figure 4).

The important point to note is that even with this channelling effect, there will likely still not be enough BEV passenger cars, pickup trucks, vans and SUVs/crossovers to satisfy demand in British Columbia and Quebec, let alone the other eight provinces.

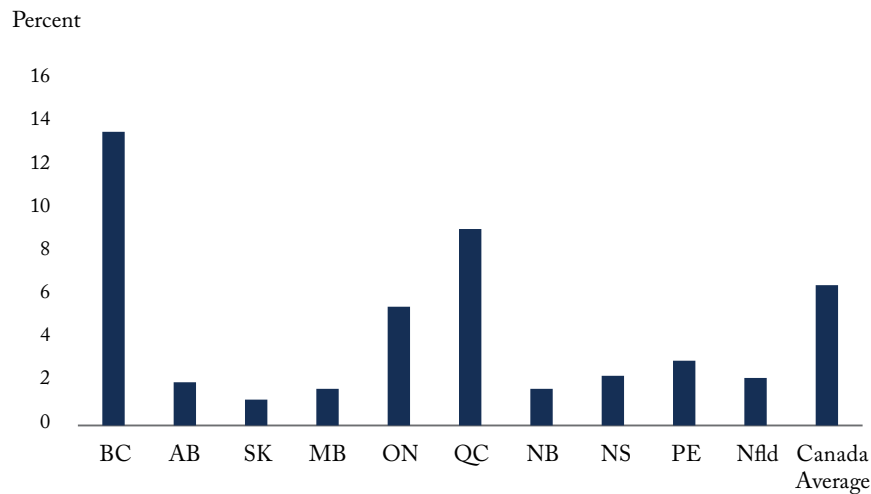
Possible Constitutional Challenge by Provinces to the Federal ZEV Mandate

The ZEV mandate is contained in regulations made under the federal *Canadian Environmental Protection Act* (CEPA). The Supreme Court in the 1998 Hydro Quebec case stated that CEPA is valid federal legislation under the criminal head of power in section 91(27) of the Canadian constitution. Federal legislation such as CEPA that is based on the criminal power requires that there be a prohibition plus a penalty.

Companies selling light vehicles are required to sell the mandated number of ZEVs, and are prohibited from selling any ICE light vehicles that

4 https://www.chinamobil.ru/eng/sales/sales_canada/?year=22&mon=12

Figure 4: Sales of ZEVs as % of all Vehicle Sales in 2022



Source: Statistics Canada New Motor Vehicle Registrations, Quarterly.

will cause the company to not meet this mandate.⁵ The simplest way for a company to comply is to sell the required number of ZEVs. As described above, the company can also comply by buying credits from another company such as Tesla, or by contributing \$20,000 to a fund used to build charging infrastructure.

If a company cannot meet its ZEV mandate requirement as described in the above paragraphs, it has two choices. First, it can stop selling ICE light vehicles, and thereby bring its sales back on side. If it does not restrict sales of ICE vehicles, and therefore contravenes the ZEV mandate, the company risks criminal prosecution under the criminal penalties in CEPA for non-compliance (fines of up to \$1 million per day and jail sentences of up to three years for individuals).

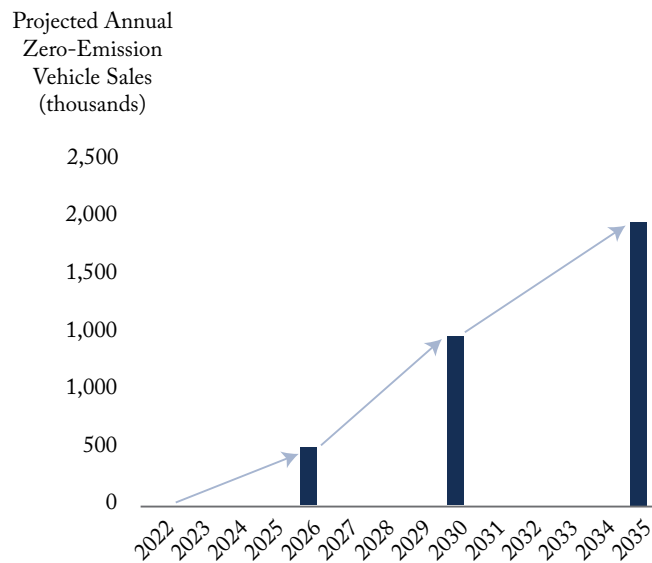
Some provincial politicians have observed that the ZEV mandate may be unconstitutional, and have noted the above observation that light vehicle companies will shut in sales of ICE vehicles, thereby causing a shortage of light vehicles for sale to consumers.⁶

The potential for shut-in sales and a shortfall of light vehicles for sale could give a large incentive to companies and provinces to challenge the constitutionality of the ZEV mandate in court. The argument would be that the federal government is doing more than just regulating GHG emissions, and is overstepping its authority by trying to regulate the light vehicle industry. The existing ZEV mandates in British Columbia and Quebec would strengthen the provincial argument.

5 Canada b. Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations: SOR/2023-275. Canada Gazette, Part II, Volume 157, Number 26.

6 *Calgary Herald*. "Braid: Smith says 'bananas' federal electric vehicle decree will cause shortages, rationing." Dec. 13, 2023.

Figure 5: Transport Canada Forecast of Future ZEV Sales in Canada



Source: Transport Canada. <https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/projected-annual-zero-emission-vehicle-sales-stock>

FORECAST FOR ZEV LIGHT VEHICLES SALES IN THE 2022 TO 2035 PERIOD

It goes without saying that forecasting the future is an uncertain business. Transport Canada has published a forecast for ZEV sales by 2035⁷ (Figure 5). (This table was on the Transport Canada website in the fall of 2023, but it appears that it has been deleted. The Transport Canada website states that they are updating their ZEV projections.)

The commentary on the Transport Canada website gave a strong impression that this forecast was made simply to fit the target in the Emissions Reduction Plan released by the federal government in March of 2022. There is no backup from Transport Canada to show the sources or assumptions of these

forecasts. The Transport Canada forecast in essence looks at the exponential growth of BEV sales in the past few years and assumes that this exponential growth will continue into the future. This assumption of future exponential growth ignores the fact that BEV sales can only come from new BEV factories. New BEV factories are not like a nuclear chain reaction where one neutron releases two neutrons, which then release four and so on. Rather, new BEV factories are built one at a time (arithmetic growth).

A Bottom-up Forecast

In contrast, this paper tries to build a forecast from the bottom up, by looking at specific manufacturers and suppliers of BEV passenger cars and light trucks.

⁷ Transport Canada. Canada's Zero-Emission Vehicle (ZEV) sales targets. <https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/canada-s-zero-emission-vehicle-zev-sales-targets>

As noted, the bottom-up forecast in this paper assumes an arithmetic growth based on production capacity. Furthermore, virtually all BEVs (regardless of brand) currently for sale in Canada have significant waiting times, often a year or more. There are three reasons for this: (1) supply chain issues; (2) delays in building and ramping up factories to build the BEVs; and (3) BEV sales being channeled into the United States and globally. The incentives to encourage the sale of BEVs in the US *Inflation Reduction Act*, along with ZEV mandates in states such as California, will take away much of the supply of BEV vehicles for Canada.

Breakdown by Company

Total Global ZEV Sales: EV sales in 2022 were about 11 million vehicles (14 percent of sales), with about 7 million BEVs (10 percent of sales) and the rest mostly PHEVs. China had about 60 percent, Europe about 25 percent and North America about 10 percent.⁸

Table 1 contains a quick summary of the light vehicle manufacturers that are supplying the BEVs to the world (and therefore possibly to Canada). Again, it is interesting to note that Ford, GM, Toyota, Honda and Nissan are not on the list.

Tesla Sales

Tesla is the classic case of believing in the exponential growth of production in the next few years. Global Tesla production was 1.3 million vehicles in 2022 and 1.8 million in 2023. Using their publicly stated goal of a Compound Annual Growth Rate (CAGR) of 50 percent, Tesla forecasts production of 28 million vehicles in 2030. This ignores the fact that even when their four current facilities (Fremont, Shanghai, Austin, Berlin) reach

their maximum capacity, Tesla will only be able to produce 3 million vehicles in 2025. The only new light vehicle production factory (an example of what Tesla calls a Gigafactory) announced by Tesla is in Mexico for completion in 2026.

Tesla's experience has shown that:

- (1) it can start one new Gigafactory per year;
- (2) nameplate capacity of a Gigafactory is between 500,000 and 750,000 vehicles per year;
- (3) it takes 3 years from the date of announcement until the date of full nameplate production; and
- (4) the ongoing delay in the release of the Cybertruck is a good example of Tesla promising more than it delivers.⁹

Given all this, my best forecast as to the capacity of Tesla in the next 12 years is shown in the Figure 6. It shows a production of 6 million in 2030 (well below the 28 million for 2030), and almost 9 million in 2035.

Tesla sold about 1.8 million BEVs in 2023 world-wide. About 50,000 Tesla BEVs were sold in Canada in 2023 (about 3 percent of 1.8 million). Canada has 2 percent of global sales of light vehicles (1.5 million out of 75 million). Assuming Canada gets 2 percent of these total Tesla sales in the future, this means Tesla sales of 120,000 in 2030 and 180,000 in 2035.

So do not expect Tesla to come to the rescue with sales in Canada of many hundreds of thousands of BEVs in 2035. The assumption is that Tesla will sell 196,000 BEVs in Canada in 2035 (versus 40,707 in 2022).¹⁰

Other Companies Supplying BEVs

Table 2 shows the BEV sales in 2022 and the forecasted sales of BEVs in 2035, along with a brief description of the rationale for the 2035 BEV number.

8 SNE Research: https://www.sneresearch.com/en/insight/release_view/70/page/0

9 Top Speed: <https://www.topspeed.com/why-tesla-is-currently-having-the-time-of-its-life/>

10 https://www.chinamobil.ru/eng/cars/tesla/sales_canada/

Table 1: Sales of ZEVs by Company in 2022 – Annual Cumulative Global EV Deliveries (BEV+PHEV, include Commercial)

Rank	Auto Group	2021	2022	Growth Rate	2021 M/S	2022 M/S
		<i>Thousands</i>			<i>Percent</i>	
1	BYD	614	1,870	204.6	9.1	17.3
2	TESLA	938	1,314	40.0	14.0	12.1
3	SAIC	683	978	43.1	10.2	9.0
4	Volkswagen	749	815	8.8	11.2	7.5
5	Geely	305	646	111.8	4.5	6.0
6	Hyundai and Kia	362	510	40.9	5.4	4.7
7	Stellantis	359	499	38.9	5.4	4.6
8	R-N-M	340	468	37.8	5.1	4.3
9	BMW	329	412	25.3	4.9	3.8
10	Daimler (Mercedes)	285	313	9.7	4.3	2.9
	Others	1,748	3,007	72.0	26.0	27.8
	Total	6,713	10,831	61.3	100.0	100.0

Note: The EV sales volume of some countries are not aggregated. The 2021 data do not include those countries.

Source: SNE Research: https://www.sneresearch.com/en/insight/release_view/70/page/0

Further rationales for forecasted 2035 BEV sales include the following:

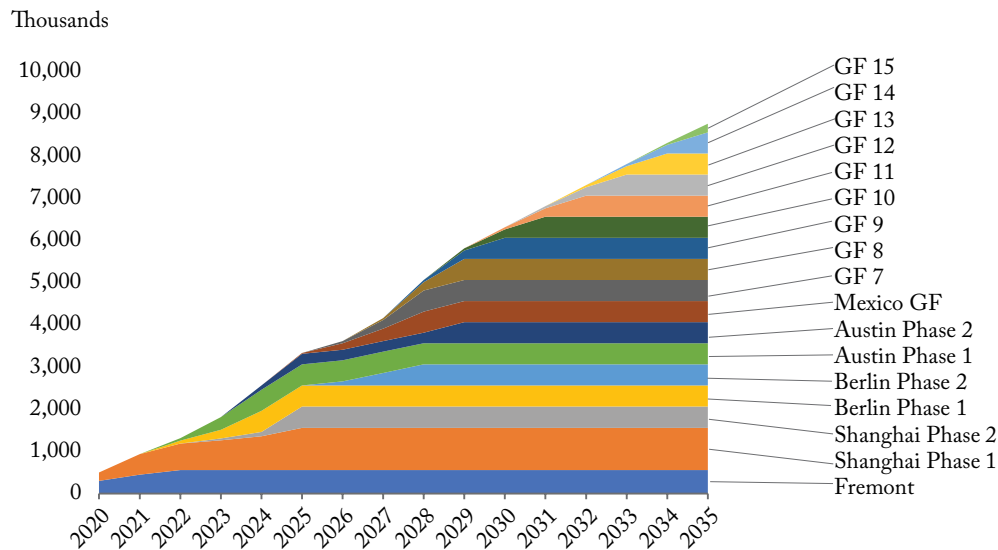
1. BEV sales in the United States have weakened in Q2 and Q3 of 2023.¹¹
2. Nissan only had sales of about 1,400 light vehicle BEVs in Canada in 2022. It has focused mostly on hybrids to date. Nissan has stated that it has a goal of aiming for about 50 percent electric light vehicle sales by 2030. Nissan sales were about

3 million in 2022, implying that 50 percent of electric vehicle sales will be 1.5 million electric light vehicles. Assuming a ramp up period starting in 2030, it is reasonable to assume that Nissan will produce and sell 1.5 million electric vehicles by 2035. Assuming Canada is 2 percent of the global light vehicle market, it is reasonable to assume this would mean about 30,000 BEV light vehicles from Nissan in Canada in 2035.¹²

11 Reuters. "More alarm bells sound on slowing demand for electric vehicles." Oct. 25, 2023.

12 Nissan Canada. https://www.google.com/search?q=sales+of+2023+NISSAN+ARIYA+in+Canada&rlz=1C5CHFA_enCA894CA894&coq=sales+of+2023+NISSAN+ARIYA+in+Canada&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRifBTIHCAIQIRifBTIHCAQQIRifBTIHCAUQIRifBdIBCTEzNTcxajBqN6gCALACAA&sourceid=chrome&ie=UTF8
<https://www.nissan-global.com/EN/COMPANY/PLAN/AMBITION2030/#focus01>
<https://www.nissan-global.com/EN/IR/FINANCE/GLOBALSALES/>

Figure 6: Build-up of Tesla Capacity



Source: Author's calculations.

Table 2: BEV Sales in Canada, by Company

Company	2022 Sales		Forecast 2035 Sales		Comments
	Total	BEVs	Total	BEVs	
Ford	232,709	8,548	209,429	109,000	F150 Supply
GM	200,918	6,373	194,349	116,000	Pickups/SUVs Supply
Toyota	200,205	702	176,123	56,000	Focused on hybrids
Stellantis	166,731	0	166,362	87,000	50% BEVs by 2030
Hyundai	112,333	14,800	115,238	69,000	60% BEVs
Honda	90,044	0	98,317	45,000	Focused on hybrids
Volkswagen	79,146	4,632	73,336	37,000	50% BEVs
Nissan	70,552	1,387	73,394	31,000	Focused on hybrids
Kia	66,893	1,470	52,781	28,000	50% BEVs
Volvo	8,286	6,113	14,000	12,000	85% BEVs
Tesla	40,707	40,707	196,000	196,000	2% of global sales
Rivian	687	687	6,000	6,000	2% of global sales
Other	243,188	13,170	138,069	72,415	50% BEVs
Total	1,512,399	98,589	1,512,399	864,415	647,984 shortfall

Source: Author's calculations.

3. Toyota only had sales of about 700 light vehicle BEVs in Canada in 2022. It has focussed mostly on hybrids to date. Toyota has stated “We will expand our current lineup of BEVs, aiming to release ten new models by 2026 and set a pace to sell 1.5 million units annually by then.” Assuming a ramp up period starting in 2026, it is realistic to assume that Toyota could reach this BEV production target by 2030. Assuming Canada is 2 percent of the global light vehicle market, it is reasonable to assume that would mean 30,000 BEV light vehicles from Toyota in 2030, and close to double that (56,000) by 2035.¹³
4. Honda is currently focussing on hybrids and is only planning its first significant BEV light vehicle starting in 2024. Honda has stated that it is planning to launch 30 EV models globally with an annual production volume of 2 million EV light vehicles by 2030. It is realistic to assume that there will be a ramp up period to achieve such production, meaning that it will likely take until 2035 to achieve this volume. Assuming Canada is 2 percent of the global light vehicle market, that would mean 40,000 Honda EV light vehicles sold in Canada in 2035.¹⁴
5. GM, Ford and Volkswagen have postponed plans to build BEVs in the next few years. It is reasonable to assume that they will only reach sales of 50 percent BEVs by 2035.¹⁵
6. It is reasonable to assume that the other major light vehicle suppliers (Kia, Stellantis, Hyundai) will reach sales of 50 percent BEVs by 2035.
7. Rivian is forecast to improve sales in Canada from 687 in 2022 to 6,000 in 2035. Assuming Canada gets 2 percent of Rivian’s global sales, this implies Rivian global sales of 300,000 in 2035.

All these factors indicate that the sales of BEVs in the next 12 years will be less than earlier forecasts, which will likely turn out to be too optimistic.

Sensitivities to the Forecast

Upside That Would Increase Forecasted Sales

1. Imports of BEV light vehicles from China may increase from manufacturers such as BYD (Build Your Dreams). This might displace capacity to manufacture BEV light vehicles in Canada, and would hurt Canada’s balance of trade with China. A realistic volume would be in the order of 100,000 to 200,000 BEV light vehicles per year.
2. The federal and provincial governments might give further financial support to encourage additional capacity to make and sell BEV light vehicles in Canada.

Downside That Would Decrease Forecasted Sales

The forecast assumes that the sales volume will be determined by supply, and that demand will soak up whatever BEV light vehicles are supplied. However, sales may be decreased by reduced demand for the following reasons.

1. High prices for BEV light vehicles may cause Canadians to hold on to their ICE light vehicles for a longer time, and therefore not buy a BEV light vehicle.
2. As demand moves from the early adopters to mass adoption, it may be more difficult to convince Canadians to buy BEV light vehicles. A recent story indicates that inventories of EVs on

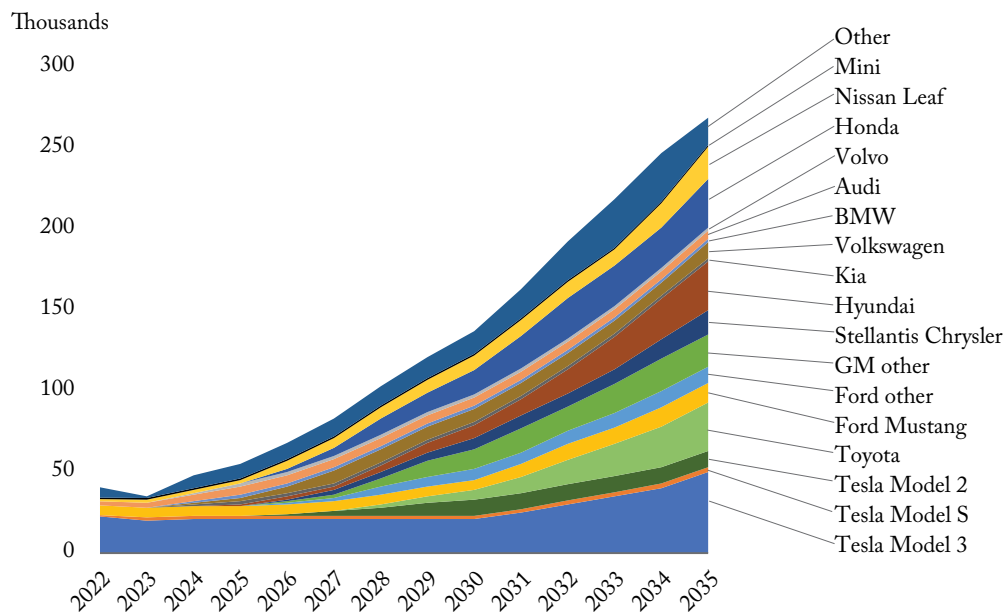
13 *Globe and Mail*. “At Toyota, activist investors’ ESG, electric-vehicle agenda put the company at risk.” Gus Carlson. June 18, 2023.

SEC.gov. Form 20-F Toyota filed with the SEC on Edgar June 30 2023, page 12

14 Honda News. <https://hondanews.ca/en-CA/releases/release-3db80816ae3d093c5b3d3122fc07fbca-summary-of-honda-briefing-on-automobile-electrification-business>; Motor Trend. <https://www.motortrend.com/news/2024-honda-civic-hybrid-confirmed-acura-evs-online/#:~:text=The%20Civic%20will%20be%20offered,the%20current%2011th%2Dgeneration%20Civic>.

15 See for example, *Financial Post*. “GM scraps guidance amid strike, delays EV truck plant” Oct. 24, 2023; *The Verge*. “GM delays production of Chevy Equinox, Silverado, ...” Oct. 24, 2023
CNBC <https://www.cnbc.com/2023/10/26/ford-will-postpone-about-12-billion-in-ev-investment.html#:~:text=Autos-Ford%20will%20postpone%20about%20%2412%20billion%20in,as%20buyers%20become%20more>

Figure 7: Forecast for BEV Passenger Car Sales in Canada



Source: Author's calculations.

dealer lots in the United States are increasing.¹⁶

3. If charging infrastructure is not expanded sufficiently, Canadians may not be inclined to purchase BEV light vehicles.

A Forecast for BEV Sales in Canada in the 2022 to 2035 Period

Based on the assumed BEV sales volumes in Table 2 for various companies, the following are the forecasts for the four vehicles types that make up all light vehicle sales.

Passenger Cars

Figure 7 shows the forecasted passenger car sales in each year from 2022 to 2035, with a more specific list of suppliers. It shows BEV passenger

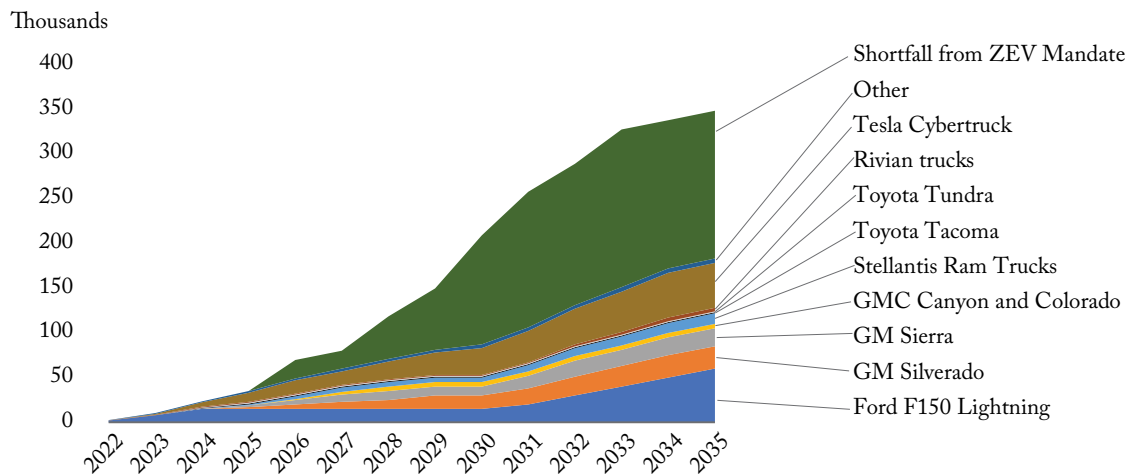
car sales rising from 40,000 in 2022 to 270,000 in 2035. Tesla models supply about 60,000, with the rest of sales coming from many other companies. Production of ICE passenger cars drops from 230,000 in 2022 to zero in 2035. The ZEV mandate for passenger cars should be met.

Pickup Trucks

Figure 8 shows the forecasted pickup truck sales in each year from 2022 to 2035, with a more specific list of suppliers. The top layer shows the forecasted shortfall from the ZEV mandate. BEV pickup truck sales in 2035 are forecast to increase to about 185,000, or 53 percent of demand. Sales come from the big four, as well as Tesla (Cybertruck), and Rivian. The remaining 47 percent of sales would be 165,000 of ICE pickup trucks, unless prohibited by the ZEV

¹⁶ *Financial Post*. "Top headlines: EVs pile up at U.S. dealers as inventories hit record high." Dec. 15, 2023.

Figure 8: Forecast for BEV Pickup Truck Sales in Canada



Source: Author's compilation.

mandate. If ICE pickup trucks sales are prohibited, the forecast shows that there will be a demand for 165,000 pickup trucks that will not be met.

Vans

Figure 9 shows the forecasted van sales in each year from 2022 to 2035, with a more specific list of suppliers. The top layer shows the forecasted shortfall from the ZEV mandate. It shows van sales in 2022 were about 50,000, with BEV sales of around 1,000.

BEV sales in 2035 are forecast to increase to about 27,000, or 54 percent of demand. Sales come from the current nine producers plus increased sales from Tesla. The remaining 46 percent of sales would be 23,000 ICE vans, unless prohibited by the ZEV mandate. Again, if ICE van sales are prohibited, the forecast shows that there will be a demand for 23,000 vans that will not be met.

SUVs and Crossover Vehicles

Figure 10 shows the anticipated SUV/crossover

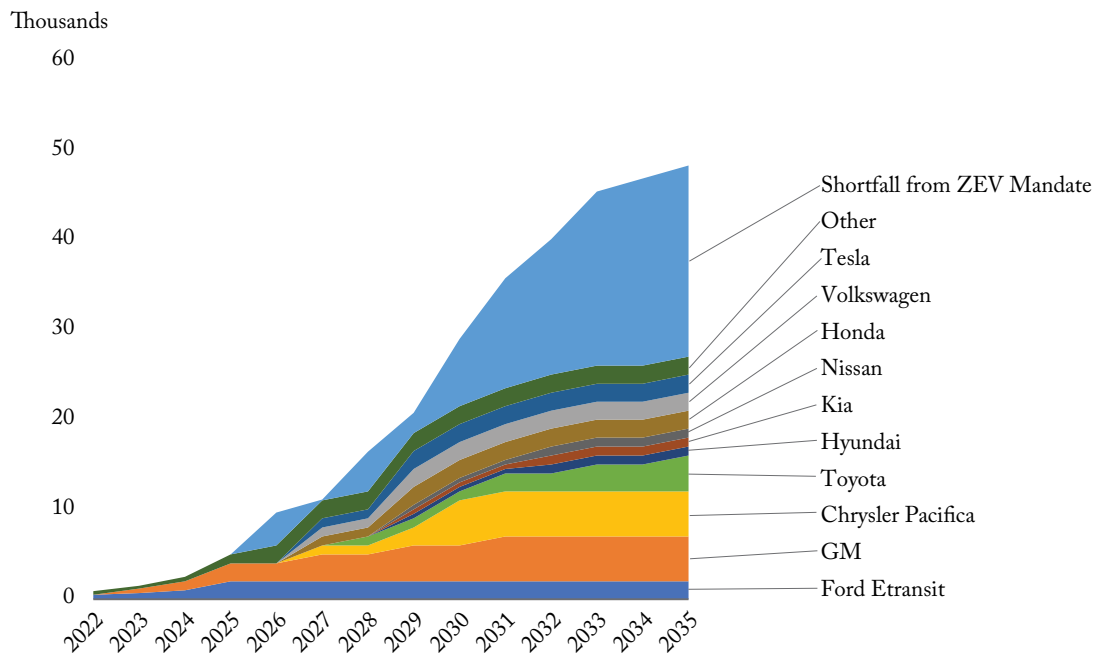
sales in each year from 2022 to 2035, with a more specific list of many suppliers. The top layer shows the forecasted shortfall from the ZEV mandate. It shows SUV/crossover sales in 2022 were about 850,000, with BEV sales of around 55,000 (17,000 from Tesla).

BEV sales in 2035 are forecast to increase to about 385,000, or 45 percent of demand. Sales come from many companies plus increased sales from Tesla. The remaining 55 percent of sales would be 465,000 of ICE SUV/crossovers, unless prohibited by the ZEV mandate. Again, if ICE SUV/crossover sales are prohibited, the forecast shows that there will be a demand for 465,000 SUV/crossovers that will not be met.

Summary of Vehicle Sales in Canada

Figure 11 summarizes the forecast for the sales of all light vehicle ZEVs in Canada for the period from 2022 to 2035. The first four layers represent the forecasted ZEV sales of the four types of light vehicles sold in Canada. The chart shows that these sales will total to about 860,000 in 2035. The top

Figure 9: Forecast for BEV Van Sales in Canada



Source: Author's compilation.

of the five layers represents the required sales of ZEVs in each year from 2026 to 2035. The top of the layers in the chart shows the increasing number for the ZEV mandate, starting at 20 percent in 2026, or approximately 300,000 vehicles, and rising to the full 100 percent requirement in 2035, or approximately 1,510,000 vehicles.

The top layer therefore represents the shortfall between the forecast of sales of ZEV light vehicles versus the required ZEV mandate. As can be seen, the top layer is small in 2026 and 2027, but rises dramatically after those dates. The shortfall in 2035 is approximately 650,000 light vehicles, being the difference between the overall forecasted demand in 2035 of 1,510,000 light vehicles and the forecasted supply of 860,000 ZEV light vehicles. The total cumulative shortfall in the 2026 to 2035 period is forecast to be 3.9 million light vehicles.

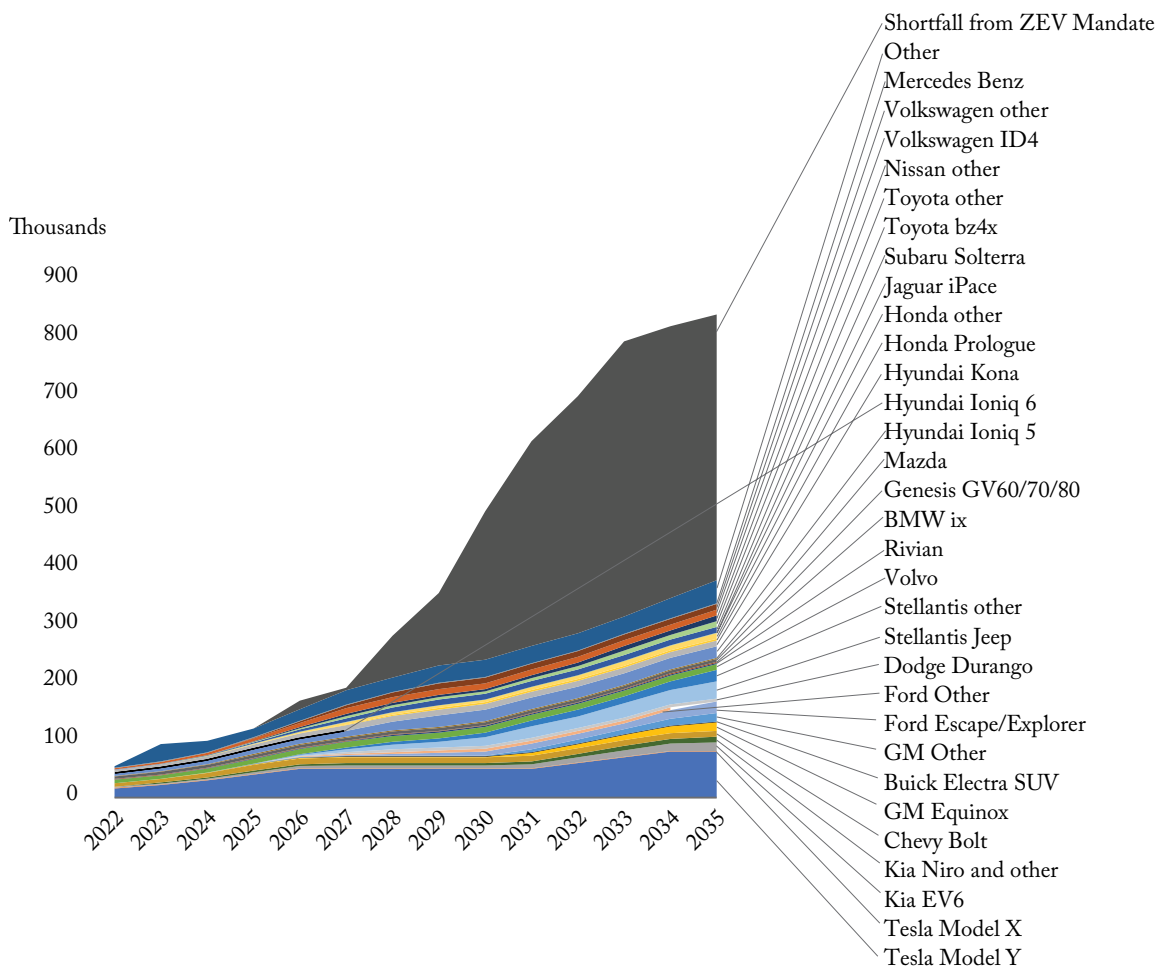
CONCLUSION

Make no mistake. BEV sales are increasing. The clear conclusion from the forecast is that the annual sales of BEVs will increase between 2022 and 2035 by a significant amount (100,000 to about 860,000). Notwithstanding this large increase, there will not be enough BEV light vehicles available to satisfy all demand in the period from about 2028 on, with the shortfall increasing in each year up to 2035. The prohibition of the sale of ICE light vehicles will mean that demand for light vehicles will not be filled.

When designing a policy, it is always useful to bear several things in mind:

1. Perfection is usually not possible. Therefore, never let the perfect be the enemy of the good.
2. It is difficult to get 100 percent of a group of people (such as Canadians) to do what they are asked to do. You could ask 100 percent of Canadians to tie their shoelaces, and explain

Figure 10: Forecast for BEV SUV/Crossover Sales in Canada



Source: Author's compilation.

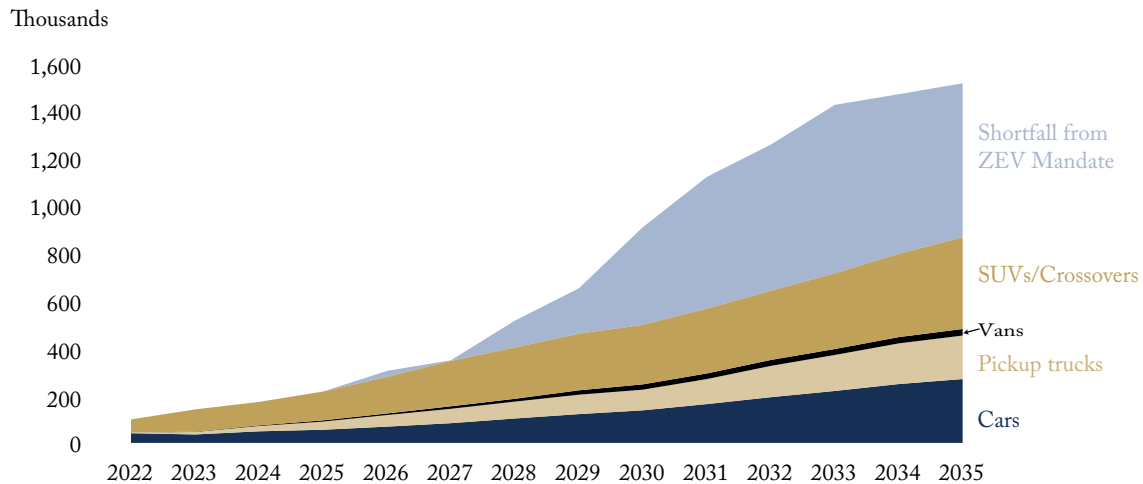
that it was in their best interests to do so, since it would prevent them from falling. The likely result would be that 80 percent would do so right away, 10 percent would do so with some encouragement, 5 percent would only do so with a lot of encouragement, and the last 5 percent would resist.

3. Things rarely work out as you expect them to do so. Be flexible. Always have a backup Plan B that describes what will happen if Plan A does not succeed.

Given this, my recommendations are as follows:

1. Recognize that there needs to be flexibility and a Plan B if sales of BEV light vehicles do not reach 100 percent by 2035.
2. Recognize that some ICE light vehicles will need to be sold in 2035. For example, Canadian policy could follow the recent decision of the EU to permit the sale of ICE vehicles in the 2035 period if they are supplied with renewable fuels. Another example of flexibility is the statement by the Prime Minister of Great Britain to delay

Figure 11: Forecast of All BEV Light Vehicle Sales in Canada



Author's compilation.

from 2030 to 2035 the ban on the sale of ICE light vehicles.¹⁷

3. The ZEV Mandate as currently drafted requires perfection, namely 100 percent ZEVs in 2035, of which at least 80 percent must be BEVs, and no more than 20 percent can be PHEVs with a range of at least 80 kilometres.
4. There is a view that some Canadians are not currently prepared to take the full plunge to BEVs due to range anxiety, longer times to recharge batteries in locations away from home and a lack of charging stations in some areas. This may especially be true in cases of rural Canadians buying pickup trucks that they use to tow things. These Canadians are voting with their feet by buying conventional hybrids and PHEVs (7 percent of total light vehicle sales in 2022, more than BEV sales of 6.5 percent).
5. A longer-term plan could be to recognize that a significant number of Canadians might want to have PHEVs as their main vehicle. PHEVs combine the benefit of electricity power for short

trips, the use of charging at home overnight and at work during the day, and gasoline power for longer trips where charging may be more difficult. Effective policy would be to encourage light vehicle manufacturers to install larger batteries in PHEVs to increase the electrical range from the current 80 kilometres to a higher range, say 200 kilometres. Such a range would mean that PHEVs use electricity for a majority of movement, thereby reducing emissions.

6. PHEVs can be looked upon as similar to the training wheels used to help young children when they are learning to ride a bicycle. Just as the training wheels give reassurance to children, so the backup gasoline engine give assurance to drivers transitioning to electric vehicles. This transition time will permit charging infrastructure to become widespread and convenient. And just as children eventually give up training wheels, so will drivers eventually move to fully electric battery electric vehicles.

17 *Globe and Mail*. "British PM Rishi Sunak rolls back key climate measures." Paul Waldie, Sept. 20, 2023. CNN Business "EU Changes Mind on Banning ICE Vehicles" <https://www.cnn.com/2023/03/24/cars/eu-combustion-engine-debate-climate-intl/index.html#:~:text=Then%20Germany%20changed%20its%20mind,they%20run%20on%20synthetic%20fuels.>

7. The recommendation is therefore that the 20 percent cap on PHEVs be eliminated, and that all conventional hybrid and PHEV light vehicles count as ZEVs along with BEVs. This view has been put forward by observers in Canada as well as in the United States.¹⁸
8. These recommendations show a pragmatic and realistic view as opposed to a rigid ideological view. They recognize that the perfect is the enemy of the good. Policymakers would be better advised to back off the perfect 100 percent ZEV requirement, and accept that a lesser number is more realistic and yet still yields a good result.

18 *Driving*. "Motor Mouth: Are hybrids primed to outshine full EVs?" David Booth. Oct. 20, 2023. Washington Post December 22 2023 https://www.washingtonpost.com/business/2023/12/22/biden-climate-green-hydrogen/?utm_campaign=wp_post_most&utm_medium=email&utm_source=newsletter&wpisrc=nl_most

APPENDIX: RECENT UPDATES

A. Announcement on December 20, 2023, of Final Regulations for ZEV Mandate

The federal government introduced the final version of the Regulations for the ZEV Mandate on December 20, 2023. The overall structure has not changed. The small changes were:

1. The program has been renamed as the Electric Vehicle Availability Standard, which is less draconian sounding than the name ZEV Mandate.
2. Companies can use electric vehicle sales above a certain threshold in 2024 (above 8 percent, to a maximum of 12 percent of sales) and 2025 (above 13 percent, to a maximum of 7 percent of sales) to create credits that can be carried into 2026. These early action credits must be used by 2027, and cannot be transferred.
3. The compliance mechanism of creating a credit by contributing \$20,000 for investing in charging infrastructure has been fleshed out to show the technical details for size, open availability to all vehicles, a requirement for completion by the end of 2027 and other details. These charging investment credits can only be used up to the year 2030, and are capped at 10 percent of ZEV targets for the years 2026 to 2030. The implication is that these charging investment credits cannot be created or used after 2030.
4. More PHEVs will be able to create credits up to 2035. Partial credits for the lowest range PHEVs have been eliminated, and credits for medium range PHEVs have been increased. The 20 percent cap on the use of PHEV credits after 2028 is unchanged.¹⁹

B. EV Light Vehicle Sales in 2023

1. The StatsCan data for the first 9 month of 2023 show sales of light vehicles of about 100,000 BEVs, with a forecast of 140,000 BEVs for the entire year of 2023. This updated 2023 forecast is exactly the same as the forecast used in Figure 12.²⁰
2. These 140,000 BEV light vehicle sales in 2023 represent 9 percent of sales in Canada, 18 percent in British Columbia and 14 percent in Quebec.
3. BEV sales in 2023 included sales of Tesla light vehicles made in Shanghai and imported into Canada.²¹
4. PHEV sales for the first 9 months are about 32,000, with a full year 2023 forecast of about 45,000.

C. Potential New EV Manufacturing Facilities and BEV Demand

1. Media stories have stated that Honda may be thinking of building an EV manufacturing facility in Canada. No decision is expected until the end of 2024, and no production would start until at least the end of 2028.²²
2. The rental company Hertz said it would cut its BEV adoption losses by offloading a third of its global fleet of Tesla vehicles to buy gasoline-powered cars.²³

19 Canada. Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations: SOR/2023-275. Canada Gazette, Part II, Volume 157, Number 26

20 Statistics Canada. "New motor vehicle registrations, quarterly."

21 *Driving*. "Motor Mouth: New year's predictions for electric vehicles." David Booth. Dec. 29, 2023.

22 *The Globe and Mail*. "Japanese automaker Honda considering multibillion-dollar EV plant in Canada, report says." Steven Chase. Jan. 7, 2024.

23 *Calgary Herald*. "Hertz to sell one-third of EV fleet in shift back to gas-powered cars." Bloomberg. Jan. 10, 2024.

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- Canada b. “Draft Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations: Canada Gazette Part I, Volume 156, Number 53.” Dec.31 2022. Website accessed at: <https://canadagazette.gc.ca/rp-pr/p1/2022/2022-12-31/html/reg1-eng.html>
- Transport Canada. “Canada’s Zero-Emission Vehicle (ZEV) sales targets.” Website. Accessed at: <https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/canada-s-zero-emission-vehicle-zev-sales-targets>