EVCO EV Adoption Curve Model RTF[30]

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We bought our first electric vehicle in 2017. We're a typical family of four living in a central Ottawa car-dependent suburb and we quickly became hooked on the cost-effectiveness and lifestyle improvements driving an electric vehicle offers compared to our previous gas and diesel cars. The built-in features, lack of oil changes and other ongoing maintenance requirements, and smooth more comfortable ride made it clear to us that electric vehicles are definitely the future of private vehicle transportation. But how far away is that electric future? How long will it be until every driver experiences the joy and superior performance of an electric car?

Predicting the future is hard, some would even say impossible. I don't own a crystal ball and if I did my kids probably would have broken it ages ago but I do have access to the internet, so I decided to see if anyone else had tried to make such a prediction before.

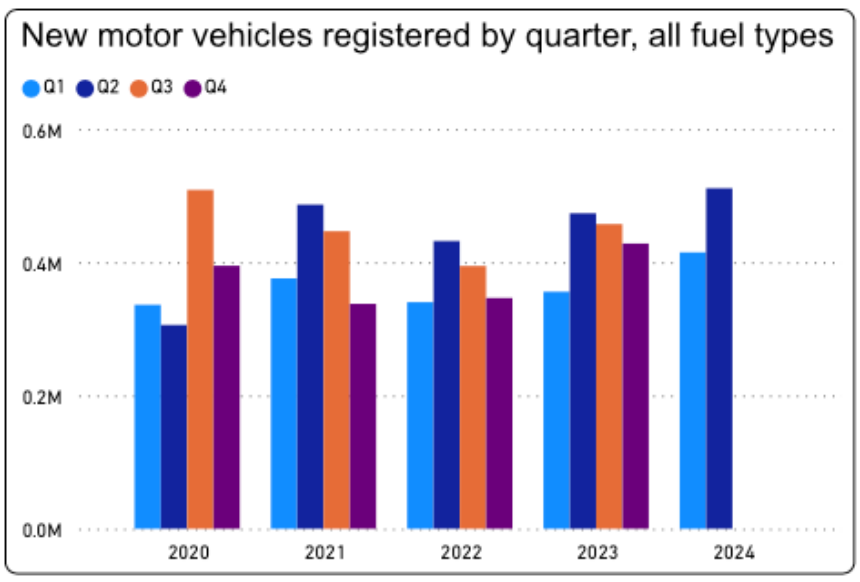
Not surprisingly someone had! I quickly came across a video on YouTube (https://youtu.be/2b3ttqYDwF0?si=i3D6Ubd2JpfMZEvV), (https://youtu.be/GbQBNOKds8o?si=BRYxPXuHKJo5CQyy) with Tony Seba from ReThinkX arguing that a major disruption was indeed coming to the automotive landscape thanks to electric vehicles. He argued that EVs were simply more efficient, cheaper to 'fuel', less complex and cheaper to maintain. What really caught my attention was what he called the "Technology Adoption S-Curve", a swoopy graph plotting the increase in EV sales over the course of about a decade or so. He made the points that "no successful technology in history has ever been adopted on a linear basis"; they all followed an "S"-curve like the swoopy one on the screen. Cell phones, digital cameras, colour TVs, computers, and virtually every other disruptive technology followed the exact same kind of adoption curve.

"Where are we on that S-curve with EVs?" I wondered.

Looking for more information about this "Technology Adoption S-Curve" thing, I learned that it was actually based on something called the "Law of Diffusion of Innovation". The law of diffusion of innovation was popularized in the 1960's by Professor Everett Rogers at Ohio State University in his book *Diffusion of Innovations* first published in 1962. The function at its core is a normal distribution curve - more commonly known as a "bell curve" - something I'm pretty familiar with thanks to the work I do for a living. Being a sociologist though, Rogers added some additional variables to the normal distribution curve in order to account for sociological factors he felt could influence the curve. Rogers broke these factors down into five key elements; the innovation itself, adopters, communication channels, time, and the social system.

His concepts were developed further into a mathematical model by Frank Bass in 1969 with the creation of the Bass diffusion model consisting of a differential equation that describes the process by which a new product or technology is adopted by a population. The model factors in the probably of a given actor adopting a new technology based on how likely they are to be exposed to that technology at any given point in time by other actors. As a technology becomes more and more prevalent among a population the likelihood of any given actor adopting that technology increases.

Fortunately for me I didn't need to figure out how to input these differential equations into a spreadsheet. I'm not a mathemagician and I'm only "okay" with *Excel*. Mathias Brandewinder at Clear Lines Consulting LLC was clearly much better at Excel than me as he had already done the work and published a spreadsheet online with all the necessary formulas already set up. Using that spreadsheet - and modifying it slightly for my own needs - I input the necessary known datapoints which I obtained from Statistic Canada's quarterly *New Motor Vehicle Registrations* data visualization tool (https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021019-eng.htm).



So armed with real-world data and the Bass equation spreadsheet Mathias made, I set to work creating my own EV adoption s-curve to see how close I could get to Tony Seba's predictions - but with Canadian data! The oldest data available to me was from 2012 so I input the plug-in market share data from that year along with the most up-to-date market share data available to me at the time from 2017. I estimated the market saturation point to be 99% (because there will always be some fossil car holdouts) and then I plotted the curve!

Curious to see how well the predictions of my adoption curve would hold up I added a new

column to the spreadsheet where I could input more current data without disrupting the original 2017 model. To date - six years later - the model has held up remarkably well to real-world market share numbers either accurately predicting or even under-predicting actual plug-in vehicle market share each year.

Alright, but why is this important to know?

Rogers' original model broke the adoption curve into five different segments. The first 2.5% of market share comes from what he called "Innovators", these are consumers willing to take risks and where the Canadian market was from 2011 to 2018. The next group representing the next 13.5% of consumers he called the "Early Adopters". He categorized this group as being similar to the "Innovators" but slightly-less risk-tolerant. Canada has been in this phase of the adoption curve since 2019. The next group, which begins around 15 to 18 percent market share and representing 34% of the population are what Rogers called the "Early Majority". This is arguably the most important group in the adoption curve as they are the critical mass that ensures wide adoption of a technology and they're the group that determines whether a technology will remain niche or reach mass adoption. The final two groups are "Late Majority" and the "Laggards" and represent another 34% and 16% of the market respectively.

What does this all mean for Canada?

Well as it turns out, my adoption curve model shows 2024 as being a critical year for EV adoption in Canada. Plug-ins are expected to reach 15.45% market share this year which means 2024 is a critical year in the transition from "Early Adopters" to the "Early Majority". Assuming the model continues to hold as it has been for the last six years, Canada is on the cusp of a major transition in how people drive around…and incumbent interests aren't taking it sitting on their hands.

Oil companies and legacy automakers alike are pretty smart too and have also already figured out the significance that reaching 15% market share will have for the EV transition and they are using their vast resources to protect their oil burning interests. Numerous reports and articles are being circulated trying to convince consumers that electric vehicles are in decline and that they are unsuitable for most regular drivers. These reports are obviously untrue but can be compelling enough to convince potential EV buyers that maybe going electric isn't for really them. They're designed to slow the transition to electric (and away from fossil fuels) by attempting to relegate EVs to a technological niche and preventing or at least delaying mainstream adoption. In other words, the "EVs are in decline/don't work" narrative is trying to convert early majority buyers into late majority or even laggards. If left unchallenged it could kneecap the transition at a crucial point on the adoption curve.

The data doesn't support the 'death of EVs' narrative of course, the rate of growth in sales of plug-ins is actually increasing year over year - from 43.62% growth in 2022 to 49.38% year over year growth in 2023 – the transition is in fact accelerating. More plug-in vehicles were sold in Canada than ever before with 184,578 new vehicles hitting Canada's roads in 2023, that's more than were sold in all the years from 2011 to 2019 combined. This year plug-in sales are expected to reach 272,622 according to my model, over a quarter million new EVs on the road representing 15.45% of all new vehicles. Assuming we clear the tipping point to the "Early Majority" this year, half of all new vehicles sold in Canada by 2028 will have a plug – that's just four years from now!

Only time will tell whether my model will continue to hold going forward. I for one am optimistic. It has now accurately predicted plug-in market share for six years in a row, through a global pandemic and chip shortages, with no signs of slowing down. I'm looking forward to a world ten years from now where all new cars run on electrons instead of chemicals and where emissions from the transportation sector – fully a third of all CO_2 emission in Canada - are finally in rapid decline.