Toyota's Bet on Hybrids

In 2024 Toyota, traditionally a leader in environmentally friendly vehicles, only had one electric vehicle (EV) in its US offerings. The bZ4X had modest sales in 2022 and 2023 but showed signs of improvement in 2024[i]. It was, however, significantly below the sales of Tesla, the largest supplier of EVs in the US[ii]. In many ways, Toyota, despite pioneering the electrification of cars, was behind in EV market. The company argued that this was deliberate, claiming hybrids as a more financially sensible and environmentally pragmatic stepping stone to a zero emissions future. In 2024 many observers agreed with Toyota as growth in the EV market cooled in the US. What was Toyota's bet on hybrids, and did it really make strategic or environmental sense?

Toyota As the Leader In Environmentally Responsible Cars

In 1997 Toyota launched the Prius in its home country of Japan. This featured an innovative electric/gas hybrid engine system and proved a strong competitor to ICE (internal combustion engine vehicles) which dominated the market. The Prius came to the US in 2000 gaining recognition from the Sierra Club (an environmental group), receiving their "Excellence in Environmental Engineering Award".[iii] The reliability and fuel economy of the Prius led to significant adoption, including the Prius V (a slightly larger version) becoming one of the most popular cars for taxi drivers[iv].

The Toyota Hybrid Range

Following the Prius, Toyota introduced a variety of hybrid vehicles to accommodate various lifestyles. Lexus cars, part of the Toyota group but a more luxury brand, also sold a significant number of hybrids. Within the main Toyota lineup, in addition to the Prius, there we hybrid versions of popular models such as the Corolla and the Camry. Larger vehicles included hybrid versions of the RAV4, Highlander, Grand Highlander, and Land Cruiser[v].

In 2012 a plug-in version of the Prius, also referred to as the Prius Prime, was released. This competed with the already popular plug-in Chevvy Volt.[vi] The difference between these PHEVs (Plug-in Hybrid Electric Vehicles) and traditional hybrids is while all have gasoline engines the plug-in's have a larger battery. This is often in the 30 to 50 mile range and can be charged with an outside source, e.g., plugging into electric sockets in a garage. Toyota now has a plug-in RAV4 as well as the plug-in version of the Prius.

The company has other innovative vehicles. Toyota also offer the Mirai, a fuel cell vehicle that is powered by pumping in hydrogen. This car is only sold in California, which is also the only state with public hydrogen refilling stations. As of 2024, Toyota had been heavily discounting this car to encourage any consumers who might have been put off by Shell's announcement that it would close its hydrogen filling stations[vii].

The bZ4X

Toyota's EV offering, the bZ4X, was named after beyond zero (emissions) combined with a reference to the similar sized Toyota Rav4 and an 'X' for a crossover vehicle. (A crossover combines features of a sedan and a larger SUV, sport utility vehicle)[viii ix]. The bZ4X's range, between 222 and 259 miles depending upon version, was a bit less than many rivals and had a charging time that was longer than rivals.[x] Unlike the impact the innovative Prius made a generation before, the bZ4X failed to make a major splash.

The US EV Market

US EV Sales

US sales of the bZ4X had reached a respectable 11,607 by the second quarter of 2024. (For context Tesla sold 164,264 EVs in the same period)[xi]. Sentiment around the EV market had cooled somewhat in 2024 but growth in the market was still occurring. Sales of BEVs (battery electric vehicles – full EVs had grown from 5.6% in Q2 2022 to an all-time high of 8.1% in Q2 2024. All electrified vehicles, i.e., including BEVs, Plug-in Hybrid Electric Cars, and traditional hybrids, were at 16% of US sales in Q2 2024, up from 12.6% in two years but down from 17.7% in Q1 2024.[xii] Note that the term EV

generally means BEV unless noted, while BEVs, PHEVs, and traditional hybrids together are referred to as electrified vehicles because they all have batteries (of significantly varying sizes). In 2024, US consumers still seemed somewhat reluctant to embrace EVs. One challenge is that EVs are more expensive to purchase, even though there can be significant saving on fuel and maintenance when operating the vehicles.

Charging The Vehicles

Range anxiety, the concern that the EV will run out of power in a journey, is a major consideration in the minds of consumers. Charging an EV, while a relatively simple operation, relies on the availability of charging infrastructure. This can be done in people's homes, e.g., in a garage, but problems occur for those in shared dwellings and for anyone on road trips. Public charging infrastructure is a necessary part of the transition to EVs. This has been improving and in 2024 there were about 61,000 EV charging stations[xiii]. This is thought to be enough for current use, but installations will, according to USA Facts, need to triple per year to meet projected demand by 2030[xiv].

There are three levels of charger[xv]. Level 1 charging is the slowest type of charger, which might charge 5 miles an hour. This is most appropriate for overnight charging, e.g., at a home or at a yard for delivery vehicles. This charging runs off normal electrical sockets so all it requires is the charging cable.

Level 2 charging reaches a speed of about 25 miles of charge per hour. This is suitable for charging many vehicles, e.g., workplace charging. These speeds can be delivered at home with the installation of special equipment.

Level 3 DC fast charging. Such fast charging has most potential for long distance driving. It requires special chargers (about 20% of US chargers are DC fast charging). It can deliver 100 to 200+ miles of charge in half an hour depending on the ability of the vehicle to receive the charge. The Hyundai Ioniq 6, which is available in the US, can charge from 10% to 80% of its 342 mile battery in 18 minutes[xvi].The more expensive Lucid Air Grand Touring has a range of 512 miles and can charge 200 miles in 12

minutes[xvii]. Newer car models are on the horizon that should be able to charge much quicker than this.

Toyota's Argument For Its Bet On Hybrids

Toyota in 2023 shared its strategy which was essentially a bet on hybrids in the short term. Underpinning the strategy was the idea that Toyota was "committed to reduce carbon emissions as much as possible, as soon as possible". The Lexus range would be fully electric by 2035, while Toyota factories would be carbon neutral by 2035, and all the products would be carbon neutral by 2050[xviii].

Critical Materials

There are a number of materials that are in relatively short supply used in EVs. For example, Lithium is a vital component and there is concern that this will provide a bottle neck. Currently China dominates refining of Lithium, presenting national security concerns. There are, however, large untapped deposits of Lithium in the US and countries near to, or friendly with, the US (Chile, Argentina, Bolivia, and Australia).[xix]

If Toyota's concern about material availability is correct, we might expect to see constraints on the critical materials needed for EVs. There was a spike in Lithium prices in 2022 and 2023 but in 2024 prices are down to 2020 levels[xx]. Still, Toyota argued that it could produce 90 traditional vehicles with the materials needed to produce one EV or 6 plug-ins. It argued that materials constraints were a vital consideration driving its all-of-the-above strategy (hybrids, PHEVs, and BEVs) to electrification[xxi].

Charging Infrastructure

Charging infrastructure is vital to successful EV adoption. Currently 64% of Americans live within 2 miles of a public charger[xxii]. Those living nearer chargers tend to be city dwellers, younger, and more Democratic leaning. They hold a more positive view of EVs. The concern about lack of charging infrastructure has some validity but there was a certain chicken and egg problem. Few consumers would adopt EVs without access to

charging, but it isn't financially viable for private companies to put in infrastructure without a large number of EVs on the road. These two-sided markets can be slow to ramp up sales, but they can tip and then deliver high sales. This means we might see modest progress for quite a while and then suddenly they get into self-reinforcing positive cycles, as consumers adopt and firms install chargers for the consumers to use.

Affordability

EVs are more expensive to purchase. The average EV cost $55,252 in April 2024 compared to $48,510 for non-EVs. The EV price has significantly dropped over the past year. Tesla was leading the reduction in EV prices, and the Ford 150 Lightning also showing big price reductions[xxiii]. While this makes owning an EV easier it has led to concerns about resale value for EVs[xxiv]. Some buyers might be reluctant to buy an EV due to concerns of lack of trade-in value at disposal. These concerns may also be somewhat heightened by expectations of significant improvements in EVs over the next few years (see below) which might leave current models obsolete.

There are federal incentives to purchasing an EV. This includes a $7,500 tax rebate[xxv]. This is restricted to people with incomes of less than $150k a year ($300k for married filers). The EV must also meet standards about being manufactured in the US. This process is somewhat complicated and the complexity and confusion around this may be a discouragement to consumers. There are states and power companies that also give incentives to EV ownership[xxvi]. While there are incentives, other US states add extra fees disincentivizing EV purchase. This can be as high as $200 for non-commercial vehicles in Georgia, and $235 in Michigan for heavy EVs (over 8,000 pounds)[xxvii].

Evolution In The Electric Car Space

There are a number of potential major changes coming in the electric car space.

Battery recycling is further increasing the environmental benefits of electric cars over other electrified cars and ICEs. The rare materials used in EVs could be reclaimed and reused. Batteries are an environmental hazard when thrown away but provide vital

materials for the next generation of cars when recycled, reducing the need for mining. The US Federal Government is investing to support this process. The US hopes to reclaim the materials from EVs partly to reduce concerns about relying on China for refining of critical materials[xxviii].

Sodium batteries hold out the hope of a new source of material to replace lithium. Unlike lithium, sodium is very widely available and easy to access[xxix]. Toyota is also working on a solid-state battery that could revolutionize the space.

Toyota has been teasing solid-state EV battery tech for several years now.[xxx]

As of 2024, it was hoped that solid-state battery cars would be available in a few years. These should provide a range of 750 miles and be much faster to charge (10 mins charging 10% to 80% full). This would effectively remove charging as a concern on even the longest road trips. Already available for pre-order in China is a semi-solid state battery that is available on the $45k L6 Max Lightyear Edition which boasts a 620 mile range and charging of 249 miles in 12 minutes[xxxi]. In addition to their superior performance, solid state batteries are likely to be much cheaper than the current batteries. Given battery cost is up to 40% of the vehicle price[xxxii] significant reductions in the cost of batteries could radically alter the economic competitiveness of EVs. It is quite possible in a few years ICEs may be more expensive to initially purchase as well as continuing to be more expensive to fuel and maintain after purchase.

Environmental critics have expressed concerns about Toyota's hybrid strategy. A hybrid is just a more efficient gas-powered vehicle. Plug-in hybrids have many benefits if charged daily and such charging is a convenience benefit for homeowners with garages as it reduces the need to go to the gas station. One challenge however is that people forget to plug them in or may not be able to plug in given where they live[xxxiii]. Not plugging in the battery destroys the environmental benefits and, hence, a key argument for plug-in hybrids. When never plugged in a plug-in hybrid is just a heavier (so slightly less fuel efficient) version of a hybrid car that needs extra materials to manufacture.

Toyota had placed a bet on hybrids, but did it make strategic or environmental sense?

Endnotes

[i] Patrick George, Inside EVs, “The Toyota bZ4x Is On A Hot Streak This Year”, June 10, 2024, https://insideevs.com/news/722783/toyota-bz4x-sales-may/, accessed September 27, 2024
[ii] Justin Fischer, Car Edge, “Electric Vehicle Sales and Market Share (US – Q2 2024 Updates)”, Aug 28, 2024, https://caredge.com/guides/electric-vehicle-market-share-and-sales, accessed September 27, 2024
[iii] Toyoland, “Toyota Prius Chronological History”, https://www.toyoland.com/prius/chronology.html, accessed September 27, 2024
[iv] Vitalli Movchan, Auto Bid Master, “What Car Models to Choose for Taxi Work?”, March 7, 2024, https://blog.autobidmaster.com/2024/03/what-car-models-to-choose-for-taxi-work/, accessed September 27, 2024
[v] Toyota, “Toyota Hybrid Cars”, https://www.toyota.com/hybrid-cars/, accessed September 27, 2024
[vi] John Voelcker, Green Car Reports, “Plug-In car sales soar in march led by Chevrolet Volt”, April 3, 2012 https://www.greencarreports.com/news/1074785_plug-in-car-sales-soar-in-march-led-by-chevrolet-volt, accessed September 27, 2024
[vii] Jonathon Ramsey, Autoblog, “2024 Toyota Mirai gets a huge July promotion, up to $33,000 off MSRP”.https://www.autoblog.com/features/2024-toyota-mirai-gets-a-huge-july-promotion-up-to-33000-off-msrp, accessed September 27, 2024
[viii] Gustavo Henrique Ruffo, Inside EVs, “Toyota BZ4X Is The Name For Automaker's New Electric Crossover”, April 13, 2021, https://insideevs.com/news/500744/toyota-bz4x-electric-crossover-rav4/, accessed September 27, 2024
[ix] Mitsubishi, Crossover Vs. SUV, https://www.mitsubishicars.com/crossover-vs-suv-difference, accessed September 27, 2024
[x] Patrick George, Inside EVs, “The Toyota bZ4x Is On A Hot Streak This Year”, June 10, 2024, https://insideevs.com/news/722783/toyota-bz4x-sales-may/, accessed September 27, 2024
[xi] Justin Fischer, Car Edge, “Electric Vehicle Sales and Market Share (US – Q2 2024 Updates)”, Aug 28, 2024, https://caredge.com/guides/electric-vehicle-market-share-and-sales, accessed September 27, 2024
[xii] Justin Fischer, Car Edge, “Electric Vehicle Sales and Market Share (US – Q2 2024 Updates)”, Aug 28, 2024, https://caredge.com/guides/electric-vehicle-market-share-and-sales, accessed September 27, 2024
[xiii] Samuel Bestvater and Sono Shah, Pew Research Center, “Electric Vehicle Charging Infrastructure in the U.S.”, May 23, 2024, https://www.pewresearch.org/data-labs/2024/05/23/electric-vehicle-charging-infrastructure-in-the-u-s/, accessed September 27, 2024
[xiv] USA Facts, “How many electric vehicle charging stations are there in the US?”, March 28, 2023, https://usafacts.org/articles/how-many-electric-vehicle-charging-stations-are-there-in-the-us/, accessed September 27, 2024
[xv] US Department of Energy, Alternative Fuels Data Center, “Electric Vehicle Charging Stations” https://afdc.energy.gov/fuels/electricity-stations, accessed September 27, 2024
[xvi] Hyundai, 2025 Ioniq 6, https://www.hyundaiusa.com/us/en/vehicles/ioniq-6, accessed September 27, 2024
[xvii] Lucid, “Lucid Air Grand Touring”, https://lucidmotors.com/air-grand-touring, accessed September 27, 2024

[xviii] Tom McParland, Jalopnik, This Is Why Toyota Isn't Rushing to Sell You an Electric Vehicle", May 17, 2023, https://jalopnik.com/toyota-focusing-on-hybrids-not-electric-vehicles-1850440908, accessed September 27, 2024
[xix] Andrew Fawthrop, NS Energy, Nov 19, 2020, "Top six countries with the largest lithium reserves in the world", https://www.nsenergybusiness.com/analysis/six-largest-lithium-reserves-world/, accessed September 27, 2024
[xx] Trading Economics, Lithium, https://tradingeconomics.com/commodity/lithium, accessed September 27, 2024
[xxi] Tom McParland, Jalopnik, This Is Why Toyota Isn't Rushing to Sell You an Electric Vehicle", May 17, 2023, https://jalopnik.com/toyota-focusing-on-hybrids-not-electric-vehicles-1850440908, accessed September 27, 2024
[xxii] Samuel Bestvater and Sono Shah, Pew Research Center, "Electric Vehicle Charging Infrastructure in the U.S.", May 23, 2024, https://www.pewresearch.org/data-labs/2024/05/23/electric-vehicle-charging-infrastructure-in-the-u-s/, accessed September 27, 2024
[xxiii] Cox Automotive, "After Three Months of Declines, New-Vehicle Prices Reversed Course in April, According to Latest Kelley Blue Book Estimates", May 14, 2024, https://www.coxautoinc.com/market-insights/april-2024-atp-report/, accessed September 27, 2024
[xxiv] Kevin Williams, Inside EVs, "Used Tesla Model 3 Prices Have Biggest One-Year Drop", September 24, 2024, https://insideevs.com/news/734989/tesla-model-3-used-price-drop/, accessed September 27, 2024
[xxv] IRS, "Credits for new clean vehicles purchased in 2023 or after, https://www.irs.gov/credits-deductions/credits-for-new-clean-vehicles-purchased-in-2023-or-after, accessed September 27, 2024
[xxvi] Chantel Wakefield, Kelley Blue Book, "Electric Car Rebates and Incentives: What to Know by State", 08/16/2024, https://www.kbb.com/car-advice/electric-vehicle-rebates-by-state/, accessed September 27, 2024
[xxvii] Jim Gorzelany, MyEv.com, "States That Charge Extra Fees To Own An Electric Vehicle", https://www.myev.com/research/interesting-finds/states-that-charge-extra-fees-to-own-an-electric-vehicle, accessed September 27, 2024
[xxviii] Camila Domonoske, NPR, "The race is on to build EV battery-recycling plants in the U.S", July 10, 2024 https://www.npr.org/2024/06/27/nx-s1-5019454/ev-battery-recycling-us, accessed September 27, 2024
[xxix] Casey Crownhart, MIT Technology Review, "How sodium could change the game for batteries", May 11,2023, https://www.technologyreview.com/2023/05/11/1072865/how-sodium-could-change-the-game-for-batteries/, accessed September 27, 2024
[xxx] Peter Johnson, Electrek, Jan 11, 2024 "Toyota confirms 750 mi range solid-state EV battery plans to catch up to Tesla, but when?", https://electrek.co/2024/01/11/toyota-solid-state-ev-battery-plans-750-mi-range/, accessed September 27, 2024
[xxxi] CC Weiss, New Atlas, "$45K EV smuggles a 620-mile solid-state battery out of the lab", April 11, 2024, https://newatlas.com/automotive/im-ls-lightyear-solid-state/, accessed September 27, 2024
[xxxii] Nick Carey and Paul Lienert, Reuters, "Focus: The battery test race to work out what used EVs are really worth", October 24, 2023, Theyhttps://www.reuters.com/business/autos-transportation/battery-test-race-work-out-what-used-evs-are-really-worth-2023-10-23/, accessed September 27, 2024
[xxxiii] Caroline Anschutz, US News & World Report, "Study Shows That Plug-In Hybrid Owners Aren't Plugging In", Jan 11,2023, https://cars.usnews.com/cars-trucks/features/phev-owners-not-plugging-in, accessed September 27, 2024