EXPERIENCES PER MILE:

Are Experiences Per Mile Different for Electric Vehicle Owners?



Experiences Per Mile Advisory Council



Introduction

Experiences Per Mile can be defined as hyper-individualized experiences that solve for real consumer needs to help people maximize the time they spend in the car. This report addresses how the shift towards vehicle electrification that is currently underway may impact the consumer experience and subsequently the user's Experiences Per Mile. The paper also explores how collaborative, consumer-centric innovation can promote better experiences. It also describes the role of the Experience Per Mile Advisory Council in driving change, enabling a consumer-centric vision, and developing the foundation for positive and successful experiences moving forward.

The data and insight presented in this report is structured to answer one central question:

Are Experiences Per Mile different for electric vehicle owners?

Base Assumptions

To focus on how the ownership experience differs between electric vehicles (EVs) and traditional internal combustion engine (ICE) vehicles, this report uses a baseline of two fundamental assumptions:

- 1. Adoption of EVs will proliferate
- 2. The charging infrastructure will catch up and meet the level of demand

Setting the Stage for EVs: An Overview of the Global EV Market

The automotive industry is already transforming and evolving towards an electric future. Global EV sales are exhibiting strong growth, OEMs are setting aggressive product and investment targets, and the voice of the consumer is becoming a sounding board for innovation and environmentally conscious design. Let's explore whether this change is occurring consistently across the globe, or differently in three major geographies: China, EU and USA.





Year-over-Year BEV Sales Growth & Key Market Drivers



Source: SBD Automotive, EV Volumes, LMC Automotive



For quite some time, the Chinese market has been the global leader in EV sales, yet the European market recently surpassed China in terms of sales growth. Europe will likely continue to lead in growth for the near term, driven in large part by increased incentives during the COVID-19 pandemic to boost sales, as well as many new models coming to the market while OEMs work to meet impending and stringent CO2 emission targets.

The North American market, on the other hand, has seen a recent decline but is expected to rebound due to new incentives progressing through the legislative process, as well as the introduction of new models, including several trucks which have strong appeal in the US market.

Globally, there has been fast growth in the premium sectors as OEMs have focused on customers that are less price sensitive. As EVs are traditionally more expensive than ICE vehicles, this focus helps mitigate some cost pressures as OEMs and suppliers continue to work towards achieving the cost parity with ICE vehicles that is expected mid-decade.









OEM EV Commitments

There is a rare opportunity to conquest customers from less-progressive OEMs during this global electrification race. This table details all traditional global OEMs that have announced electrification targets, with automakers Mercedes-Benz, GM, JLR and Volvo having committed to offering EVs only in the near future.

While other carmakers have not committed to complete electrification of their fleets, investment strategies are still very significant with nearly \$330 billion being committed to offering electric vehicles from traditional brands.

It should be noted that Japanese carmakers have either not made public commitments or are just now starting to focus on electrification, primarily due to the Japanese government's prior lack of support for fully electric vehicles and the focus on fuel-cell technology.

The	All-	In'ers

Spending big and have committed to specific and ambitious dates for transitioning vehicle sales to EVs

The Big-Spenders

Have announced big investment plans and a large number of models but holding back from specific sales % targets

The Steady-Movers

Moderate market penetration, yet gradual inceases in the future instead of rapid transition

The Cautious Idealists

Have been moving more slowly but show ambitious goals for electrification in the future

Auto	EV Today		% of Total Unit Sales			Announced	New Models		
Makers	total unit sales	2025	2030	2035	2040	2045	2050	Investment	Committed
Volvo	16%	50%	100%						
JLR	7%	100% (Jaguar)	60% (Land Rover)		Carbon Neutral (2039)			\$67B (through 2039)	6 (Land Rover)
GM	4%	40% (US)		100%	Carbon Neutral			\$47B	30
Daimler Group	7%	25%	100%					\$85B	10
Hyundai Group	3%		25%					\$87B	34
BMW Group	8%	15-25% 33% (EU)	50% (EU)					\$35B	25
VW Group	5%	20-25%	40%					\$35B	70
Stellantis	2%	31% (US) 35% (EU)	35% (US) 70% (EU)					\$35.5B	40
Nissan	2%	60% (JP) 50% (EU) 23% (CN)					Carbon Neutral		20
Ford	1%		67% 100% (EU)				Carbon Neutral	\$22B	40
Honda	<1%		40%	80%	100%		Carbon Neutral		

Source: SBD Automotive Electric Vehicle Guide



EV Commitments



Traditional Global OEMs Are Feeling the Squeeze

This all comes in response to the pressure that traditional carmakers are feeling (detailed above). Early movers such as Tesla, other EV pure-play startups like Rivian and Lucid, as well as Chinese domestics and spinoffs have received massive investments and have capilitized on strong growth in global financial markets through reverse mergers (known as SPACs) and public offerings.

Traditional carmakers are also looking to increase control over the EV value chain through 'nearshoring,' increasing production capacity of critical components (such as batteries) and exploring new partnerships to address end of automotive life applications.



<2% 2021 global market share (forecast) of non-traditional OEMs, expected to rise to 4% by 2030 (Source: LMC Automotive)

"The sheer amount of committed EV investment from automotive OEMs and the entire ecosystem is staggering, and nothing like we have seen to date. The level of investment will further accelerate the electrification of many brand line-ups, support an infrastructure and support network (still nascent in many markets), develop new commercial models before and after EVs are sold, as well as create a re-imagined consumer experience more reliant on software and services than ever before."

> Jeffrey Hannah SBD Automotive

>50%

of total OEM Market Cap currently controlled by non-traditional OEMs, representing over \$1 Trillion in value

Source: SBD Automotive





The EV Value Chain Is Complex, Requiring New Collaboration

The EV value chain is quite complex and adds several more layers compared to the traditional automotive value chain. Specifically, the integration with electrical energy infrastructure and end-of-life component considerations adds significant challenges for OEMs, suppliers and the government entities. Coordination across industries is required to create an environment that is conducive to the present and future EV owner and to achieve reduction in emissions. With complexity and gaps inmarket comes the opportunity for new entrants and innovation, both of which are prevalent in the EV industry today.



Traditional value chain components

New & emerging value chain components

Mix of traditional and emerging



Overview of Global Legislation

Governments are stepping in around the globe to support regional emission targets through an array of legislative approaches (as shown in the graphic). For example, New York, similar to California, is close to passing an ICE sales ban that requires all new passenger vehicle sales to be zero emissions by 2035. This is in-line with the UK's ban that was moved up from 2040 to 2035, and the European Commision's recently announced EU-wide ICE ban in 2035 with the aim for "almost 100%" of cars on the roads in 2050 to be free from tailpipe emissions. The array of global legislative efforts generally fall into the following categories:

- 1. Powertrain bans and EV sales targets
- 2. Fuel economy and emissions standards
- 3. Point-of-sale and tax incentives
- 4. City access restrictions



Source: SBD Automotive



Consumers Are Ready to Adopt Electric Vehicles

EV Purchase Consideration by Region

Alongside government action, EV adoption is supported by key drivers including environmental impact, consumer perception and total cost of ownership. These motivations can differ considerably by region, with the US and European consumer exhibiting similar profiles for reasoning, while Chinese consumers show a greater focus on in-vehicle technology and environmental impact (illustrated in the chart to the right).

Consumers across the globe were asked to list their motivation for buying their electric vehicle and "vehicle brand" was relatively low on the list. This suggests that there is still a gap in model and vehicle availability that needs to be addressed to further motivate consumers to go electric. OEMs are working to address this, as more models are rolled out and additional segments are getting electrified options.



Source: SBD Automotive Global Consumer Survey



Motivations for Buying an EV Differ Considerably by Region

Motivations for EV Owners to Buy Their EV (Global)

EV Owners have different motivations for buying their vehicle by the various regions across the world. As you can see, the greatest motivation for buyers in all three regions is the EV's environmental impact. The consumers in China placed the highest value in the range of new tech provided in an electric vehicle. See the chart to better understands motivations in all three markets.

Petrol/diesel cars are in decline, electric cars are the future
Lower maintenance costs
Lower running costs
Range of new tech that electric cars have in the cabin
Tax benefits/advantages of buying/owning an electric car
Electric cars are better value for money
Quietness/noise of an electric car compared to petrol/diesel
Interior design and styling of electric cars
Performance is better than petrol/diesel cars
Exterior design and styling of electric cars
The brands that make electric cars
Parking benefits
l very rarely drive long distances
Friend/colleague talked through what it was like to own one
High resale value of electric cars
Controlled emission zones where I live
My children/family felt it was very important
It is easier to get a number plate

	Avg Number Benefits Mentioned
Global	4.3
USA	4.0
China	4.9
Europe	4.0



Source: SBD Automotive Global Consumer Survey



2019 Share of Greenhouse Gas Emissions

The environmental impact from direct and indirect emissions has become a focal point in the fight against climate change and the transportation industry is working to address its 29% share of greenhouse gas emissions (shown in this pie chart).

"Electrification is becoming a fact of life, with more cities and countries planning to go all-electric in the next few years. The environmental impact from the EV revolution is expected to be significant, as it will lower CO2 emissions and reduce dependency on fossil fuels. Furthermore, many autonomous vehicles and shared mobility solutions are expected to be electric, multiplying the environmental benefits of electrification. Automotive data from connected vehicles will be vital to enabling the ecosystem around electric vehicles."

Asaf Weisbrot, Otonomo





Electricity 25%

Source: US EPA

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The Environment and Costs Are Foundations for EV Adoption

The 'Pyramid of Reasons' provides a very high-level view of the importance of each driving factor when considering the purchase of an EV (see chart to the right). This data is based on the global average and gives a good first impression of the priorities of the average buyer.

The opinion of family and friends and the brand are just a minor reason for buying an EV.

Not a major reason but still a nice option when considering buying an EV

EVs offer good value for money and may provide good resale value as well

Design EVs look fresh and often come with new innovative styles

EVs are the future, offer good performance and automakers typically equip them with the newest technology

Lower maintenance and running cost are one of the main reasons for buying an EV

Environment The environment is by far the most important reason when buying an EV

Source: SBD Automotive Global Consumer Survey



Prestige

Convenience

Value

Technology

Running Costs

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The Impact US State Energy Generation Has on BEV & PHEV Emissions

While electric vehicles do not have tailpipe emissions, they can still have significant carbon footprints if the electricity consumed to charge them or produce the batteries and components are coalbased rather than from renewable inputs such as solar or wind. 'You are what you eat' is very applicable for electric vehicles and consumers are becoming increasingly conscious of this, highlighting the convergence of the automotive and energy industries under the umbrella of the 'EV industry. '

Looking at state-by-state energy generation, it's possible to plot the equivalent well-to-wheel emissions of EV driving across the United States (see chart to the right). These values, when compared to the emissions of ICE vehicles, illustrate the need to achieve and establish targets that span the industry and incorporate the carbon footprint from a holistic life-cycle perspective. For example, driving an electric vehicle in Vermont is much more beneficial with respect to life-cycle emissions when compared to one in West Virginia, given the dramatic differences in energy generation in the two States.

	C0 ₂ Emissions BEVs	C0 ₂ Emissions PHEVs	CO ₂ Emissions ICE
State	Kilograms of C0 ₂ equivalent	Kilograms of C0 ₂ equivalent	Kilograms of C0 ₂ equivale
Vermont	0	1,499	
Maine	386	1,740	
Idaho	432	1,769	
Washington	454	1,783	
New Hampshire	491	1,806	
South Dakota	575	1,859	
Oregon	708	1,943	
New York	837	2,025	
California	990	2,121	
South Carolina	1,078	2,176	
			5,187
Illinois	1,084	2,180	
New Jersey	1,103	2,192	
Connecticut	1,172	2,236	
Maryland	1,225	2,269	
Tennessee	1,241	2,280	
Delaware	2,061	2,796	
New Mexico	2,412	3,018	
Kentucky	3,548	3,735	
Wyoming	3,678	3,817	
West Virginia	4,057	4,056	

Source: SBD Automotive Electric Vehicle Guide



The Impact US State Energy Generation Has on BEV & PHEV Emissions

The carbon footprint can increase more when considering the component materials, previous metal sourcing and the energy required to extract, transport, manufacture, use and dispose of them. Many OEMs and suppliers are beginning to establish targets for carbon neutral manufacturing and mitigate organizational impact through downward pressure and process innovation. Public reporting and accountability will continue to impact consumer perception and many companies are beginning to publish lifecycle analyses and carbon footprint assessments on an annual basis.

Long gone are the days where the Toyota Prius was one of the only options to pair environmental consciousness with vehicle ownership. Early hybrids and pure battery electric vehicles used

to be somewhat quirky status symbols, but now have evolved into more stylish and normalized designs. Tesla played a leading role in deviating from that narrative, working to capitalize on the 'cool factor' and established a status symbol of its own. As traditional OEMs have added to their portfolios and started rolling out EVs, they are now becoming more about a tech-forward image rather than obvious displays of a customer opting for alternative powertrains. It will soon be possible for 'soccer moms,' 'truck guys,' and 'sport car enthusiasts' to all have an EV that fits their lifestyle, performance requirements and budgets.

As EV owners experience a new powertrain and progress through the ownership lifecycle, they tend to become aware of additional benefits that were not evident prior to adoption. For example, public charging and the time it takes to charge are certainly perceived barriers or detractors upfront, however EV owners may realize that they rarely need to charge their vehicle away from home given their daily usage habits and ability to charge in their garage or on the street near their apartment. Each day these consumers have a full charge when leaving the house with no time spent beyond plugging in the vehicle and no longer making regular trips to the gas station. However, to fully understand this benefit, the consumer must experience it firsthand.



Benefits of Ownership (ICE vs. EV Owners)

This need to discover the benefit firsthand is consistent with the psychology of behavioral bias and selective perception, which when summarized results in consumers focusing on barriers they've heard of rather that the benefits they haven't. Consumers are quick to spot barriers while forgetting the benefits because changing opinion is difficult.

As shown in the chart to the right, an ICE owner's perception of an EV trends towards 'eco-friendly' and 'quiet' as key benefits, while consumers who have already made the switch to an EV are more likely to identify in-vehicle technology, performance, and running costs as top benefits. How environmentally friendly it is How quiet it would be to drive Running costs The tech inside the cabin Driving performance (acceleration/handling) Service/maintenance costs How the car is connected to my smartphone The styling/design Feeling when driving it The range it would have Resale value higher than ICE car



Source: SBD Automotive Global Consumer Survey



The Journey to EV Ownership Varies across Regions

What type of car had EV owners owned before this EV

It is important to note that the journey to EV ownership varies globally, with 47% of current EV owners in Europe having owned a hybrid prior to their electric vehicle, compared to only 30% in the US and 16% in China. This data shows that where hybrids are a 'gateway product' for European consumers, Chinese incentivization schemes are helping ICE consumers make the transition straight to EVs. The average US EV consumer closely mirrors the global average in evolution of powertrain ownership, as shown in this data.



Source: SBD Automotive Global Consumer Survey



4.1

Reasons for buying EV, by powertrain types owned previously (Global)

Environmental impact Lower running costs ICE cars are in decline, EVs are the future Tax benefits/advantages of buying/owning an EV It is easier to get a number plate Parking benefits Quietness/noise of an EV compared to ICE Electric cars are better value for money The brands that make electric cars Performance better than ICE cars



efore	- Owned Hybrid Before	- Only Owned ICE Before		
ons	Avg Number of Reasons	Avg Number of Reasons 4.8		

Barriers to EV Purchasing See Few Changes Over Time

Current Barriers for EV Adoption

Although strong support is evident for the EV transition, there are still several barriers to adoption and ownership pain points that remain. Charging infrastructure requires continued development in both physical availability and the overall user experience, while range continues to be a leading concern voiced by consumers considering EVs.

Neither of these barriers should be addressed in a vacuum, as each contributes to the overall user experience. A longer range might reduce trips to public charging stations, while increased charging speeds and charge point availability can reduce the burden of making stops on long journeys. Over the past two

years, the top 10 reported barriers to adoption have remained relatively consistent (see graphic to right), though major differences include perceived performance issues with EVs in 2019 falling away, and the increasing concern of charging time, service and maintenance costs.

These barriers will have varying impacts across consumer personas and will subsequently impact the purchase decisions of different people.

Charging



Source: SBD Automotive Global Consumer Survey



Buyer Personas and EV Consideration

Consumer	Description	Story	Experience	Result
Rural 'Joe'	Owns a truck to work on the farm, towing often. Long distance travel is required to get to the city.	Joe has to tow equipment around town between farms and notices that his vehicle range can vary widely. Sometimes he is forced to stop to charge when he expected to be able to use his truck all day. This adds significant time to already very long days during harvest and effects his ability to spend quality time with his family in the evening.	Negative	Not willing to adopt an EV until range & range estimation improves
<section-header></section-header>	Commutes to the city in a sedan 3-5 days during the week for work. Takes trips on the weekends to a nearby lake.	Debbie often commutes into the city for work. Her company has a handful of charge points in its parking lot that she can use to top off her battery while in the office. However, she has found that she rarely needs to use them since she starts each day with a full battery after charging overnight in her garage. She enjoys having one less task, never going to gas stations and uses the extra time to catch the end of her child's soccer practice.	Positive	Willing to adopt and likely to purchase an EV
<section-header></section-header>	Does not own a vehicle and uses public transportation whenever possible. Parking is very inconvenient and there is no on-street charging.	Sandra lives in the heart of the city. She doesn't own a car because parking is scarce and public transit, including ride hailing, is prevalent. She feels strongly about conserving the environment and reducing the need for personal vehicle ownership in the city. When possible, she prefers to hire an EV rather than an ICE vehicle because of the quiet ride and reduction in emissions. She has also noticed a few electric garbage trucks that make their rounds on her block and likes that they are much quieter and don't smell of diesel exhaust.	Neutral	Unlikely to purchase an EV, but would prefer to use one for ride or carsharing services



Lack of Charging Points Is the Biggest Barrier for All Consumers

Top 10 barriers to purchase among those considering EVs

Not enough places to charge EVs

Range an EV will travel on single charge

Time added to trip to recharge

Don't know where to charge and how much it costs

Cost of charging EV at home

Cost of charging EV away from home

EVs cost more than ICE cars

Service/maintenance costs higher than ICE car

Tech not developed enough

Don't know if charging stations would work

Charging Infrastructure

Progress has been made developing infrastructure and only one-in-five EV owners claim charging infrastructure to be a barrier. However, lack of infrastructure, either actual or perceived, remains a key barrier to EV ownership as shown in this consumer survey data.

Top 10 concerns among current BEV owners



Source: SBD Automotive Global Consumer Survey





About 2/3 of American EVs Don't Meet American Expectations USA

The Issue of Range and Range Anxiety

Range can be argued as more of a perceived and regional barrier than a global challenge. Plotting the available range in-market vs. regional consumer expectations (show here) illustrates roughly two-thirds of American EVs don't meet consumer expectations. This holds generally constant across vehicle price points and correlates with stronger EV sales in Europe and China compared to the US. The following charts illustrate how expectations vary by the three major regions: US, EU and China.



Source: SBD Automotive Electric Vehicle Guide



About 2/3 of American EVs Don't Meet American Expectations





Source: SBD Automotive Electric Vehicle Guide





Nearly All Chinese EVs Exceed the Respondents' Expected Range



Experiences Per Mile

Source: SBD Automotive Electric Vehicle Guide



European EVs Exceed the Needs of Consumers





Long Distance Travel in an EV Requires More Planning and Time



2021 Mustang (ICE)

Tank size (gallons/liters) 16/60.6

Full Tank Range (miles) 370

> Efficiency (MPG, 80% Highway) 29.8

Cost to full usable tank \$40.18

> Fuel price (\$/gal) \$2.79

Energy cost-per-mile \$0.09



Trip Comparison

Mach-E

718

5

14-43

2:24

10:30

12:54

\$100.63

	Mustang (ICE)
Total Distance (miles)	714
# of required stops	2
Time per stop (min)	10
Stoppage Time	0:20
Drive Time	10.28
Total Time	10:50
Total Cost	\$85.78

Source: SBD Automotive





Battery size (kWh) 88

Full Tank Range (miles) 270

> Efficiency (MPG, 80% Highway) 94.4

Cost to full usable battery \$28.38

Electricity price, DC charging (\$/kWh) \$0.43

Energy cost-per-mile (DC fast charging) \$0.14



Recharging an EV while on a Journey

Charging time is another key barrier that cannot be resolved in isolation, creating the need for more planning and time when embarking on long distance travel, especially in the US.

An example cross-country trip from Ann Arbor, Michigan to Atlanta, Georgia in both an ICE Ford Mustang and electric Mach-e illustrates how trip lengths and cost considerations vary significantly by powertrain.

This trip comparison shows that it can be less costly to go on the journey with an ICE vehicle versus than an EV.



Long Distance Travel in an EV Requires More Planning and Time

Long distance travel is a significant barrier to adoption for some consumers, even if they don't take long road trips often. Families often purchase vehicles to support the exceptions, rather than the average use case, such as driving a group of kids to and from practice in a van or towing a boat with a truck in the summer. Range will impact consumer decision as well, especially if the decision maker does not feel a vehicle can support all the needs of the family.

Traveling long distances in an EV can require 20%+ more time to incorporate charging and can also be more expensive if only using high-

powered charging stations along the route. This can be enough time to turn a feasible and fun family road trip into an unsustainable journey with tired and cranky children. A trip that was possible over the weekend in an ICE vehicle may not be achievable in an EV today.

Although the added time required for charging can certainly be negative in some respects, it also provides an opportunity for carmakers and other industry players to provide value through goods, services, or entertainment, whether inside the vehicle or out. A family may be able to embrace the added time requirement

to charge if there are fun activities associated with each stop. Whether it be local attractions, cafeterias, shopping or interactive games, the location and planning of charging stations and in-vehicle technologies can have a significant impact on the overall consumer experience and the perception of it being a driver or barrier to adoption.



There Is More to Electrification than Just Batteries

Defining the EV Ownership Experience Cycle

When purchasing a vehicle, the overall consumer lifecycle is not structurally different across powertrain offerings. However, the level of education and support a prospective EV owner may need requires online assets and dealership training that goes beyond the traditional buying experience. The lifecycle of ownership has several added aspects to consider, including charging, non-traditional service requirements, and residual value concerns, to name a few.

Private and public charging experiences are completely new to most consumers, while high-voltage system and battery maintenance is not supported by all repair shops. This creates many points where education and support are critical to the preownership, ownership, and postownership phases.

Infotainment Average display size on EV, 10.2" versus 8.7" for ICE vehicles **Charging Downtime** Maximum time required to 1 Day recharge a 98kWh battery at a slow public charger **Supply Chain** 150+ Battery production expected to triple over 4 years GWh







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The Overall Importance of EV-X (EV Experience)





Experience

Charging Infrastructure

Throughout the ownership period, what was my experience with the charging infrastructure? How did my vehicle support me in reaching charge points, understanding range and accounting for environmental variables?

Revert to ICE or Retain EV

An EV was/was not appropriate for me.

"Continuous education on the EV shopping and ownership experience is key to driving widespread acceptance and adoption. This report captures the significant progress we're making across the industry, as well as the opportunities to drive additional consumer confidence,"

> Lea Malloy Cox Automotive Mobility

Reflect

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Lifecycle Costs

At the end of my ownership period, did the total cost savings make up for any charging inconveniences or initial price premium? Did my vehicle perform well enough to buy one again?

Source: SBD Automotive Global Consumer Survey



The Overall Importance of EV-X (EV Experience)

Each ownership phase will be approached differently depending on an individual's personality or persona. The SBD Automotive Consumer Survey shows that even 50% of laggard consumers are already considering an EV, increasing steadily across the segmentation to 98% of early adopters. This clearly points to adoption as a question of when, rather than if someone will buy an EV.

HARMAN recently conducted consumer research to identify buyer personas for new car buyers. This work provides more context with respect to attitude, principles, and technology perspectives for individual consumer groups.



The 'Maximizers' persona represents a younger-middle aged consumer that views technology as an enabler and believes innovation is key to a better lifestyle.



The 'Projectors' persona illustrates the middle-aged consumer that is willing to pay more for the latest technology as they feel it is an enabler and connector.

When considering the late majority and laggard consumers who will continue to encompass more of the target market over the next decade, understanding their perceptions, needs and hesitations is critical to support adoption and positive Experiences Per Mile. These consumer groups can view technology as 'intrusive' or 'something to break away from,' while some find it 'overwhelming and complicated,' but also a 'statement of success.' The context of consumer personas can help in developing products and services that meet the needs of diverse consumer groups, while also supporting stakeholders who engage in educating and promoting technology.¹

Pre-ownership

Dealers play an important role in pushing consumers towards or away from electric vehicles, with varying motivations for each approach.

Both personas can be used to broadly illustrate the early adopters and early majority of electric vehicle owners, who aim to 'be the best' and 'stay ahead of the curve' when it comes to product choices.

¹ Source: HARMAN Consumer Research, 2020



Typically, dealers are self-motivated to sell higher-priced models and since most EVs are priced higher than their ICE counterparts, it would seem natural for dealers to push EVs. However, many automakers are struggling to meet EV demand, due in part to OEMs lack of marketing (until recently), incentivization, profit margins, and available EV stock. SBD's research suggests a clear association of willingness to adopt an EV with dealer knowledge. "Framing" is a behavioral bias that presents choices, or options in a positive way for the consumer. A savvy, knowledgeable dealer will "frame" a barrier properly. An example of this is highlighting the lack of charging points early but positioning the problem as one surmountable by public infrastructure development efforts and/or private charge point ownership. This upfront acknowledgment can help reduce the barriers perceived during ownership.

"For the transition to EVs to be successful, EVs will need to be connected and provide a range of key features, including smart remote maintenance services and smart traffic. Future EVs will need to be connected mobility hubs that provide security and data management for all elements of the connected vehicle."

> Manish Mehrotra Hyundai Motor North America

Additionally, lack of onsite dealership stock impacts a customer's ability to test drive a new EV, which can have a greater impact on the purchasing experience than it would for a traditional vehicle that can be compared to past experience or more closely simulated with alternate models or trims that are available onsite.



Dealers Have Various Motivations for Selling BEV or ICE Vehicles Dealers Encouraging Customers to Change Their Decision

The Ownership Period

The fundamental difference between the ownership experience of an ICE vehicle and an EV is the traction battery and the need to charge it. This requirement effects a vast majority of the ownership experience from private infrastructure purchase & management, public infrastructure awareness & navigation, to life-cycle performance and degradation implications. OEMs and suppliers are working to support the ownership experience as it intersects other industries and creates new experiences that can affect their brands.

A poor experience at a gas station is highly unlikely to impact a consumer's brand perception of their vehicle, while a poor charging experience is more likely to play a role in forming brand perception, especially given the white labelled and proprietary charging networks being provided or suggested to consumers.



The Ev-X (EV Experience) Not Ready for Mass Adoption



Hidden Charging Points

"There's supposed to be one around here somewhere, but where is it?"



Complex Charging Pricing

"Why do I need a PhD to work out how much it's going to cost me to charge up my EV?"



Incomplete Information

"It's showing me my destination but how do I know if I have enough battery?"

Source: SBD Automotive



Innacurate Range Calculations

"How could it possibly take almost 2hrs to travel 6.7km, and how do I do it on 9%?"



The automotive industry is experiencing accelerated innovation across vehicle technology, and electric vehicles are flagships for new, highly connected features. These can be directly related to the electric powertrain, or independent and geared towards internet of things (IoT) and the push to create in-cabin experiences that are consistent with high technology standards stemming from smartphones and consumer electronics.

With respect to powertrain differences, the ease of finding charging stations and efficiently completing the charging process is critical. OEMs and mapping providers are partnering directly with charge point operators (CPOs) and e-mobility service providers (eMSPs) to bring charge point data to the in-vehicle and companion app interfaces.

Opportunity: Improve real-time charge point data

Currently, real-time charge point data is marred by inaccuracies, and this has been a major issue flagged during vehicle testing, spanning last mile navigation and real-time status use cases. Given the minimum 20-minute charge times required at public charge points, availability information is a fundamental requirement for EV owners to avoid added time sinks, while efficiently reaching charge points places more burden on mapping providers to pinpoint station locations that are no longer well-lit and easily recognized fuel stations.



EV In-Vehicle Infotainment Features

Experiences While Charging

Though a barrier in some senses, this also presents an opportunity to curate and customize experiences in-vehicle and in the surrounding environment that can serve entertainment or productivity. Tesla has become famous for in-vehicle gaming and 'easter eggs,' coupled with a full internet browser and connectivity that is leveraged during charging events.

"Topics like range anxiety and charge point locations are important customer concerns that we, as an industry, need to address. HERE is planning for the future with a new HERE EV Routing feature optimized for private and commercial electric vehicles. EV Routing takes into account topography, road geometry, charging station data, real-time traffic information and traffic patterns to help minimize total travel time, including battery charging times, based on a vehicle's consumption model and battery charging characteristic. HERE has also launched HERE EV Charging Points, pinpointing local EV charge stations based on a vehicle connection type, required voltage, pricing, and other attributes, simplifying an important customer concern. Charging Points will also support a new parking experience by helping drivers find local parking where they can combine parking and EV charging at the same time. The transition to EV is creating an exciting moment for our industry, and we are just grazing the surface of what the new driving experience will look like."

Joel Brush, HERE Industries









Source: SBD Automotive Electric Vehicle Guide



In-Vehicle Infotainment (IVI) Feature Description Allows users to schedule their charging times and charge rates (kW) to optimize battery life and Charge energy cost. Advanced implementations are beginning to integrate electricity rate fluctuations, Planning grid demand management and energy buyback programs. Illustrates the output power and/or how energy is being distributed between vehicles systems. Advanced Energy implementations couple this feature with efficiency scoring and gamification to educate drivers on the Flow impact driving patterns and energy usage has on the overall efficiency and life-cycle costs of the vehicle. Allows users to monitor the battery state of charge (SoC), set charging parameters (limit, current), and **Battery** view charging status. This also includes range warnings and potential intervention with suggested Level charging stops automatically provided to the driver as SoC nears critical levels. Consumption history shows distance/kWh (efficiency) history and can be used to track and encourage Consumption efficient driving. Integration with energy flow, efficiency scoring, and gamification provides a value-added History feature to the consumer. Efficiency scoring is an extension of the consumption history feature, using gamification to push Efficiency improvements in driving efficiency through a reward system. OEMs have also trialed community-style Scoring & rankings and challenges, though social traction has been limited thus far. Scoring can be divided into Gamification multiple factors to help the driver understand what led to the final score. Integrates charging station POIs and route guidance to reduce range anxiety. Advanced integrations are **EV-Specific** beginning to incorporate eco routing that accounts for the topographical effect on vehicle efficiency, as Navigation well as trip planning support through suggested or automatic charging session planning. E-Pedal & Often referred to as one-pedal driving, the e-pedal leverages regenerative braking to charge the vehicle's Regenerative battery by converting kinetic energy from vehicle motion to stored energy while decelerating the vehicle. Braking



EV In-Vehicle Infotainment Features

Nissan Leaf: Eco Routing



Chevrolet Bolt: Instrument Cluster



Audi etron: Range Display Routing



Nissan Leaf: e-Pedal



Source: SBD Automotive Electric Vehicle Guide



Audi etron: Range Display



Tesla: Trip Planner (Beta)





EV Companion Apps

	Feature	Available Range	Remote Charging Control		
Mobile App	Description	Range anxiety is an important issue for EV owners and is often cited as a barrier to purchase. Viewing available range is especially beneficial when public charging is required. OEMs are implementing feedback through eco-coaching and/or trip logs to provide insights into how driving style effects range and how.	Remote control charging allows users to remotely start and/or stop charging their vehicles. More advanced implementations include the ability to set preferred charge times and integrate energy provider information. This is useful for minimizing cost by selecting a cheaper rate of electricity when available, managing time to departure, and ensuring there is enough charge for the next trip remotely.		
	Examples	<complex-block></complex-block>	Image: status modulated numberori modulated numberori Charge status Dhr Omin to full mod plugged in mod plugged in modulated numberori modulated numberori 		
		VW Smart Watch App	VW Smart Watch App		

Source: SBD Automotive Electric Vehicle Guide



Remote Climate Control

Though not specific to electric vehicles, EVs can use remote climate control when the engine is switched off. Users do need to be aware that having climate control switched on when unplugged from the grid will take power from the battery and so it will have implications on range. However, if connected to the grid, the vehicle uses grid power to condition the vehicle's interior, improving range.



Tesla



REMOTE CLIMATE CONTROL

Nissan



Public Charging Support

OEMs are integrating with charge point operators and eMSPs to provide location, availability and contextual information for charging station POIs within the traditional companion app experience. This is an important feature to support the EV ownership and charging experience. It will be interesting to see if/when charge point reservation support makes its way into OEM apps in the future.

Plug & Charge

Plug & Charge (built off the ISO 15118 standard) allows users to setup account and payment details for supported networks and seamlessly complete the charging process by simply plugging in the vehicle. Authentication and payment are completed automatically, and Ford provides the ability to setup and manage Plug & Charge through the FordPass mobile app.





Volkswagen





Volkswagen



EV Charging and Cybersecurity

"As the number of electric vehicles in use grows, so do the potential security risks posed by internet-connected charging portals. Hackers can attack these stations directly, shutting them down to impact mobility. Hackers can also attack charging portals indirectly, potentially accessing financial information and personal data when users connect their vehicles.

There are many layers to adequate security, making cooperation between all EV supply chain members essential for protecting consumers and the mobility platform effectively. To combat these growing threats, visibility into digital infrastructure is crucial.

Further connectivity in mobility increases potential threats, so cyber security needs to be a top priority."

Eloy Avila, Darktrace

Upon reaching an available charger, a driver should be met with a seamless and consistent charging experience. ISO 15118, the foundation for 'Plug & Charge,' lays the groundwork to accurately identify the vehicle and driver, fulfill the objectives of the charging session, complete payment transactions, and ensures the process is secure and automated.

Though not the primary focus of the latest revision, it also opens the door for high bandwidth functionality and several new value propositions supported by a wired communication channel to the vehicle. These could include a wide

variety of software updates, content services, and ADAS data transport to and from the vehicle. With new data connections to the vehicle also comes security risks that need to be mitigated.

While EV models and charging providers are beginning to support basic Plug & Charge features, the industry is still far from realizing the full potential born out of ISO 15118. The process to sign up is generally convoluted and provider specific, while customer support often echoes the woes common with some connected vehicle programs.



Thermal Management and EV HMI Implementation

Experiences with New Vehicle Technology

Related to charge management is the need for drivers to understand battery state of charge (SoC) and the impact driver and environmental variables have on performance. Thermal management systems continue to evolve to actively manage cold weather and high heat environments, while advanced algorithms are being developed to support accurate range calculation and battery management systems (BMS) to reduce preconditioning requirements and increase overall efficiency.

From the user's perspective, this happens largely behind the curtain but has a strong and direct effect on overall experience. How information based on these calculations is presented varies widely in-market, with some systems providing extensive efficiency data and active feedback, while others provide no context or support to the driver. Through extensive static and dynamic system evaluations, SBD Automotive has derived some key takeaways that apply across EV human machine interface (HMI) implementations, shown here.



ownership



Trip planning and predictive charge suggestions are progressing, but require improvement to support UX

Key Takeaways for EV HMI Implementation



EV-centric design is necessary to support EV-specific features and

Last mile navigation continues to be an issue across the industry



POI databases are missing the mark with respect to charging stations





OEMs are implementing feature descriptions and educational support in-vehicle



The depth of range prediction and consumption insights varies significantly across vehicles

Source: SBD Automotive



Updating EVs – Over-the-Air (OTA)

Updating the EV, a Software **Centric Vehicle through OTA**

As a key driving force, EV car consumers generally expect far more from their cars when it comes to overall driving experience; with features ranging from advanced connectivity, smart telematics, cutting edge digital cockpit, ADAS (and even AD) capabilities and more. All these features are enabled mainly by smart software. Therefore, Electric Vehicles are generally more Software centric than traditional ICE vehicles, hence much more dependent on software updates, and less on HW maintenance/replacements (by nature, EV cars tend to require less hardware maintenance). Also, this level of software in the vehicle allows for much more updating through OTA and trying out new features during the ownership period.

Since EV systems are flagships for new technology and in-vehicle experiences, it is much easier for automakers to innovate and try new things when they aren't tied to legacy systems or complex matrices of backward compatibility. 'Pure EV' OEMs have been more open to use over-the-air (OTA) the most aggressive OEM, Tesla, providing OTA updates to customers every few weeks. Traditional OEMs have explicitly expressed strategic intent to catch up with this impressive pace, leveraging the introduction of their EV car line-ups. For example, VW has recently launched OTA capabilities for its new ID Family of EVs, targeting four OTA updates per year.

EV-specific Development Improves Customer Experiences

Systems that are offshoots or minor evolutions from ICE vehicle platforms are often easily identifiable as such and miss the mark when it comes to EV ownership. Designing systems with the context of EV-X unlocks new experiences to benefit the consumer and revenue opportunities to benefit the business.

Gamification to educate and improve driving behavior is a great way to interact with consumers while also teaching them to get more out of their vehicles. New customizable driving profiles are being introduced that allow drivers to control vehicle sounds, suspension and the cabin environment

by leveraging EV-specific aspects such as regenerative braking, internal and external speakers, and the instant torque provided by an electric powertrain.

As over-the-air (OTA) updates and the software defined vehicle continue to advance in complexity and feature-centric design, new avenues are being forged to provide fresh and upgradable vehicle experiences. Whether it's unlocking battery capacity in the event of a natural disaster, like Tesla has in the past, or providing users the ability to purchase features like ADAS upgrades or trimlevel subscriptions through software, the real-time control and adaption of the ownership experience is just beginning. These new seamless and upgradeable experiences can engender brand loyalty and retain new EV owners.

"Over-the-air updates will approach 80% penetration in 2025 and In-vehicle Payment will exceed 20% penetration. With most new vehicles now able to connect to the cloud, it is time to view the cloud as one of connected mobility's foundational security technologies."

> Bill Foy Amazon Web Services



Dealer Knowledge Plays a Role in Repeat EV Purchasing

Likelihood of Replacing Current BEV with Another by Dealer Knowledge







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Dealer Knowledge Plays a Role in Repeat EV Purchasing

"HARMAN is committed to delivering EV innovations that benefit consumers and society in a lower-carbon world. We believe eco-friendly choices and superior automotive experiences are not mutually exclusive. When it comes to customizing audio for EVs, our solutions range from lighter and lower-power sound systems to HARMAN's eESS Safe and Sound, which projects electronic sound from external speakers at the front and rear of the vehicle to inform pedestrians of an EV's speed and location. These external speakers can also be linked to the externally coupled subwoofer to create a full-bandwidth external sound system to enjoy outdoors."

Chris Ludwig, HARMAN

Post-ownership

Given the world is moving towards an entirely Electric Vehicle future, the fact that around a quarter of current EV owners remain unsure whether they would remain in an EV highlights there is still work to be done even among the converted audience. Dealer knowledge and the ability to educate or support the consumer is also a concern for retention, as those less likely to buy another EV were more likely to claim their dealer had limited knowledge.

Given wider marketplace issues compared to traditional vehicle ownership, communication and support have a bigger impact on consumer sentiment. Managing the expectation of owners from the outset helps customers have a more positive experience and increases the likelihood they will remain in an EV.

Currently, the secondary market for EVs is nascent but this will change in step with EV park growth as primary sales



targets are achieved. Several concerns remain with respect to residual value and battery longevity, and this is a strong focus for many industry stakeholders.

Conclusion

In summary, Experiences Per Mile are different for EV owners compared to ICE owners, requiring new considerations, industry collaboration and EV-centric design to support consumers as they make the transition to electric vehicles. It is no longer a question of if, but when, will the mass adoption of EVs effect your business.

As consumer preference changes, so will their experiences. As vehicle powertrains are shifting, so is the connected world, colliding to create new opportunities and hyper-individualized experiences that solve for real consumer needs. Stakeholders across the automotive ecosystem are working to help people maximize the time they spend in and outside of the car.



Role of the EPM Advisory Council

This report was written by members of the EPM Advisory Council. This organization was formed to address key issues in the industry, driving innovation and supporting member initiatives to improve and capitalize on the EV-X.

Mobility is more than getting from one place to another. It's about shifting from one state of being to the next. The Experiences Per Mile vision gives people ownership of their experience in the car and transforms the value they place on the car and overall mobility experience.

HARMAN and SBD Automotive, together with industry partners and stakeholders, is transforming the industry and media dialogue through the recently formed Experiences Per Mile Advisory Council. The purpose of the council is to align automakers, Tierone suppliers, third-party providers, and other industry leaders, and to encourage collaboration regarding the changing value chains in the automotive industry that are being driven by the connected movement.

Active discussions focus on intelligent technology, evolving consumer trends and how they're both reshaping the experience inside the vehicle as well as what this means for automakers and consumers alike. There's an urgent demand for consumer-centric, invehicle and mobility experiences and the most forward-thinking industry members must get involved now to drive a significant change. The council is shaping the future of EPM with a mission to promote collaboration, establish processes and elevate the complete automotive ecosystem.

In early 2022, the EPM Advisory Council will release the results of an EPM Metric Exploratory Research Study which will reveal if Experiences Per Mile can be evaluated and measured by consumers through a unique vehicle segment test. The results of the study will be released publicly and will be announced on the www.experiencespermile.org website.



This Report Is Brought to You by the **Experiences Per Mile Advisory Council**

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