Mind the EV Gap

The worldwide adoption of electric vehicles is a critical step in reducing energy consumption and carbon emissions, but there are myriad challenges for both consumers and automakers. This article examines the long road ahead for EV adoption.

The electric vehicle (EV) industry has garnered a lot of interest in recent years, and there has been growing competition across different geographies. This has been particularly the case in relation to the fight against climate change, which is continually gaining momentum. The Chinese EV market has had phenomenal growth sustained by state support in the past few years, but a recent slowdown has resulted from diminished state subsidies, stuttering infrastructure development, and intensive competition. On the other hand, the United States and Europe, seen as frontrunners in the EV race, have also experienced their share of challenges ranging from consumer demand to commercial aspects. Around the world, the adoption of EVs has not gone as smoothly as investors or consumers may have hoped.

The invention of EVs cannot be attributed to one specific person; innovators from across the globe toyed with the idea of building battery-operated cars for years. EVs became popular in the U.S. in the early 1900s, given their ease of use compared with gasoline cars. However, this was short-lived when Henry Ford successfully mass-produced the Model T in 1908 for $650. Despite the dark ages that the EV industry went through after the discovery of oil in Texas and the continued innovation of traditional car makers, gasoline shortages resulting from the 1973 Arab Oil Embargo revived curiosity around this industry.

Since the successful production in Japan in 1997 of the Toyota Prius — the world's first hybrid car — and the innovative breakthrough by a small startup called Tesla in 2006, the market for EVs has resurged. Today, it is flooded with options for consumers. According to an article from the U.S. Department of Energy, there are more than 200,000 fully chargeable cars on the road and 3.3 million hybrid cars in the U.S. alone. With climate change at the forefront of global politics and increased technological innovations, the future of EVs looks brighter than ever. However, many challenges remain despite vast investment and interest.

Policy Fuel for the Electric Revolution

Over the past decade, governments around the world have attempted to encourage the shift towards EVs, particularly in three of the biggest EV markets of China, the U.S., and Europe.

Take China first: Under the country's long-term national strategy to revitalize its auto industry, and urged by a growing domestic energy shortage, China has supported a shift towards new energy electric vehicles (NEVs) gradually substituting conventional car sales. The Xi administration, through the Ministry of Industry and Information Technology, has announced a national target of 20% of all car sales to be NEVs by 2025. In spite of manufacturing challenges in core technologies such as chips, sensors, assembly, and software, China's regulatory environment has been favorable to both the supply (manufacturers and original equipment manufacturers) and the demand sides (consumers) to realize the country's ambitious EV targets. On the supply side, regulations support cleaner manufacturing and the expansion of EV production, while subsidies on national and local levels incentivize OEMs. Regulations include emissions credits, which conventional carmakers must earn to remain environmentally compliant each year. China has also selected 11 pilot cities with percentage targets for annual EV sales.

On the demand side, Chinese consumers are also heavily incentivized to purchase EVs. EV owners enjoy parking and charging privileges and priority quotas for registration in major cities, on top of a lower transaction tax (at 5% – 10%) compared with internal combustion vehicle (ICV) buyers. Some provincial governments provide additional incentives to consumers to support the national EV push. And when it comes to policy implementation, the government shows no favoritism between domestic players, such as NIO Inc., Li Auto, and Xpeng, and foreign players. This can be seen in Tesla's significant success in the Chinese market; adaptability to the local policy environment is key to success for EV carmakers.

Favorable regulations have allowed China's EV industry to grow in the past years. But faced with other investment priorities such as in Africa or Latin America, the Chinese Communist Party has channeled much of its resources away from EV. Demand incentives such as reduced sales tax were halted, while subsidies on the supply side were also slashed. Other unfavorable regulatory trends in China include declining incentives for OEMs in light of growing subsidy fraud. Some players' attempts to cheat the subsidy system, resulting in overcapacity and potential closures.

By comparison, although the U.S. has seen significant growth in EVs, mostly attributable to the private sector, government support has been limited. The Obama administration rolled out loans to support the initial growth of EV manufacturers. More recently, the Biden administration made further commitments by announcing a target of 50% of all new vehicles sold by 2030 to be electric, and allocating billions of dollars toward EV adoption in the Infrastructure Investment and Jobs Act, which was signed into law in November 2021. However, more could be done from a policy perspective for the U.S. to stay ahead in the global EV race. Despite some consumer subsidies — such as the federal tax credit of $7,500, the California state-level clear-air credit of $1,500, and other benefits for charging and energy consumption on the federal and local levels — the incentive structure has been fragmented. More coordination among states, the federal government, counties, and cities would certainly help standardize the incentive structures and push the country's EV commitment more efficiently.

The European market has a similar dynamic to the U.S., where regulation has not had a significant impact. Instead, demand is driving the change. OEMs have incentives to reduce their CO2 emission by 15% by 2025 and by 37.5% by 2030, under COP 21 agreements. However, companies are free to choose compliance strategies, so they can select different pathways for the mix of their new car sales and overall vehicle fleets. An example of this flexibility is the increase in the number of new hybrid vehicles launched to comply with European standards of less than 95 grams of CO2/km.

On the other hand, the European Union is increasing its investments to boost research on batteries. In 2019, it approved a payment by member states of €3.2 billion to help establish battery production plants. A new public fund of €2.9 billion will be added to support research on batteries, additional to regulation securing supplies of raw materials, recycling, and training. With this project, called European Battery Innovation, the European Commission wants to federate companies and block Chinese and Korean giants currently dominating the market. A total of 42 companies, including BMW, Fiat, Tesla, and Swedish battery specialist Northvolt, have already joined the project. According to the European Automobile Manufacturers' Association (ACEA), EV sales doubled in Europe in 2020 and those of plug-in hybrids tripled, exceeding a total of 1 million vehicles sold despite the COVID-19 pandemic. Ultimately, the EU's goal is to be able to power at least 7 million electric cars by 2025. In a joint article published on March 12, 2021, in the French newspaper *Les Echos* and the German newspaper *Handelsblatt*, Bruno Le Maire, the French minister of the economy, Peter Altmaier, his German counterpart, and Maroš Šefčovič, vice president of the European Commission wrote: "By 2025, the European Union should be manufacturing enough batteries to equip at least 7 million electric cars every year."

To stimulate demand, EU governments have taken steps to provide price incentives, though at varying degrees. According to ACEA, 26 out of the 27 EU member countries offer incentives for chargeable cars. Out of these, 20 members offer direct discounts such as bonus payments or premiums to EV buyers, while the remaining six (Belgium, Bulgaria, Cyprus, Denmark, Latvia, and Malta) grant tax deductions or exemptions for EVs. Lithuania is the only member to not provide any tax benefits or incentives. This relative fragmentation of regulatory incentives could be improved by standardizing incentives throughout the EU. Yet even when subsidized, the price of an EV remains high.

In comparison to the EU, the best-in-class country in Europe in the field of EVs is Norway, which has a steadily growing field of electric vehicles. In 2020, more than 50% of vehicle sales there are EVs. While 97% of EV owners charge their vehicles at home, relative to 11% who say they charge in public stations, Norway is also moving towards equipping collective housing with charging stations. Norway's stellar performance is primarily due to the power of its incentives, including single and cumulative

tax incentives and exemptions, value-added tax (VAT), and free parking. These elements have allowed the network to be deployed in such a way that it has reached a new level of profitability, including for private operators.

Roadblocks on the Way to Electrification

Regional regulations are designed to promote the transition from gas-powered vehicles to EVs, ultimately reducing carbon emissions. Transportation accounts for approximately 24% of worldwide CO2 emissions. In addition to the shifting regulatory landscape, challenges exist in consumer behavior, the business model for car manufacturers, and the environmental track record of the vehicle and its production.

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Take consumer behavior first. In the U.S., one of the biggest barriers is charging. EVs require a charging behavior that is fundamentally different from what consumers are generally accustomed to. Drivers are used to traveling to gas stations in order to refuel their car, so the tendency when considering an EV purchase is to apply the same framework to the idea of charging. This leads to anxieties concerning the availability of charging stations, and the perception that the charging infrastructure is insufficient to support large-scale adoption of EVs in the U.S. In fact, charging is generally done at home. In a study by the Idaho National Laboratory, it was found that the majority of charging was done at home or at work. This reduces the infrastructure hurdle — the need for an extensive network of charging ports around the country — significantly. The general driving behavior of most EV owners does not require a charge greater than what can be provided overnight at home through the power outlet, though for longer road trips, a visit to the charging station is needed. This particular challenge for long-distance road trips is exacerbated by the fragmented infrastructure in the U.S. Although Tesla, for instance, has its Supercharger network throughout the country, its proprietary charging ports means that other EV models cannot use this network, posing a legitimate barrier to non-Tesla owners. The EU, conversely, does not have this problem due to its standardized charging ports.

Challenges to EV adoption also exist in the business incentives for OEMs. EV sales are still relatively low, posing a problem for the capital-intensive automakers. One of the primary levers for EV players to use to achieve profitability is the emission credits trading system. These credits are generated for car manufacturers for their production of zero-emission vehicles (ZEVs) and can be traded between OEMs to fulfil regulatory emissions requirements. Players like Tesla are able to make significant profits through this, with revenues from credit trading of up to $2 billion in 2021, according to Bloomberg. As a result, in spite of relatively low sales, EV manufacturers are able to stay in business and, as Tesla has, become as much a household name as the OEMs only slowly transitioning their fleets. Meant to incentivize OEMs to produce more EVs, the credit trading system currently enables a small number of EV makers to stay in business, while allowing traditional OEMs to skirt the issue of fleet electrification.

Additionally, new innovations in production that would support the EV transition or reduce the carbon footprint of internal combustion vehicles (ICVs) are only slowly trickling through. Vehicle production is capital-intensive and lead times are long before innovations make it onto the production band. An example of such an innovation is the in-wheel drivetrain developed by Protean Electric, a U.K.-based company with operations in the U.S. and China. Protean Electric CEO Andrew Whitehead noted that the long lead time for adoption into production processes means that it will be years before the technology will be seen regularly on the road. Though Protean's technology has been in development since 2008, it is up to the traditional OEMs to integrate this technology into their production lines.

A third challenge exists in the emissions-intensive production of EVs, compared with the total emissions footprint of ICVs. Carbon emissions for vehicles come from two sources: the manufacturing process, and the refilling and maintenance process during the car's life-cycle. Several reports have found that hybrid electric vehicles, plug-in hybrids, and full-electric vehicles generate more carbon emissions during their production than current

ICVs. The consensus from some studies is that emissions from EV production are higher than for ICV production. This higher carbon footprint arises from the process of battery production for the EVs. Firstly, the battery production for EVs involves lithium batteries, the sourcing of which requires metal extraction, which is highly harmful to the environment with effects such as ground water and air contamination. Secondly, the battery's weight requires changes to the production processes of other car parts to make these lighter. Additional emissions are generated in order to achieve a lower weight for the non-battery parts of the EV and maintain a comparative fuel efficiency with ICVs. Finally, the production processes of ICVs are generally more streamlined and efficient, while the newer ones of EVs are early in the optimization process. Emissions are expected to go down with technological improvements and favorable regulations. The vast majority of the emissions associated with the production of EVs is associated with the production and supply chain steps before the car is ever delivered to the customer, with some estimates on emissions reaching as high as the emissions given off by ICVs throughout their entire life cycle.

Each of these challenges in the production process for EVs can result in the perception that the saved carbon emissions through owning an EV are not as high as often claimed. However, even though EV production emits more carbon dioxide than ICV production, throughout the car's lifetime (estimated at around 200,000 miles or the life cycle of one battery), EVs are significantly more carbon-efficient than ICVs, based on a study by the International Council on Clean Transportation. Emissions are heavily impacted by the energy mix used to generate the battery power and power the EV throughout its life-cycle. In regions with high renewable energy sources, like Europe and the Pacific Northwest in the U.S., the difference in emissions between EVs and ICVs can be more than 60% over the lifetime of the car. Even in China and India, where more than 80% of energy is nonrenewable, savings range from 10% to 30%. Overall, EVs are capable of reducing emissions substantially in the long run, though this is dependent in part on the surrounding energy generation conditions.

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Nevertheless, for the U.S. to meet its commitments to the Paris Climate Agreement to limit gas emission to 39 gigatons, EVs represent a critical lever. Even with EVs, the solution must be adopting California's model of 100% of new cars being EVs by 2030 or following a mix of EV promotion and other strategies to reduce emissions. These could include improving fuel efficiency, reducing the weight, and decreasing miles traveled per person. Regulations should go hand-in-hand with technological advancements and incentives to drive adoption. Over time, the electrification of vehicles must accelerate more than it has thus far. Governments have done much in the past years to incentivize customers to own EVs. However, recent rollbacks of incentives and other challenges have set up roadblocks. These must be removed through regulatory and infrastructure standardization in the U.S. and Europe, or other measures implemented to highlight the lifetime environmental benefits of EVs. Now is not the time to slow down the electrification of vehicles. In order to reach the climate goal, electric wheels have to continue spinning.

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