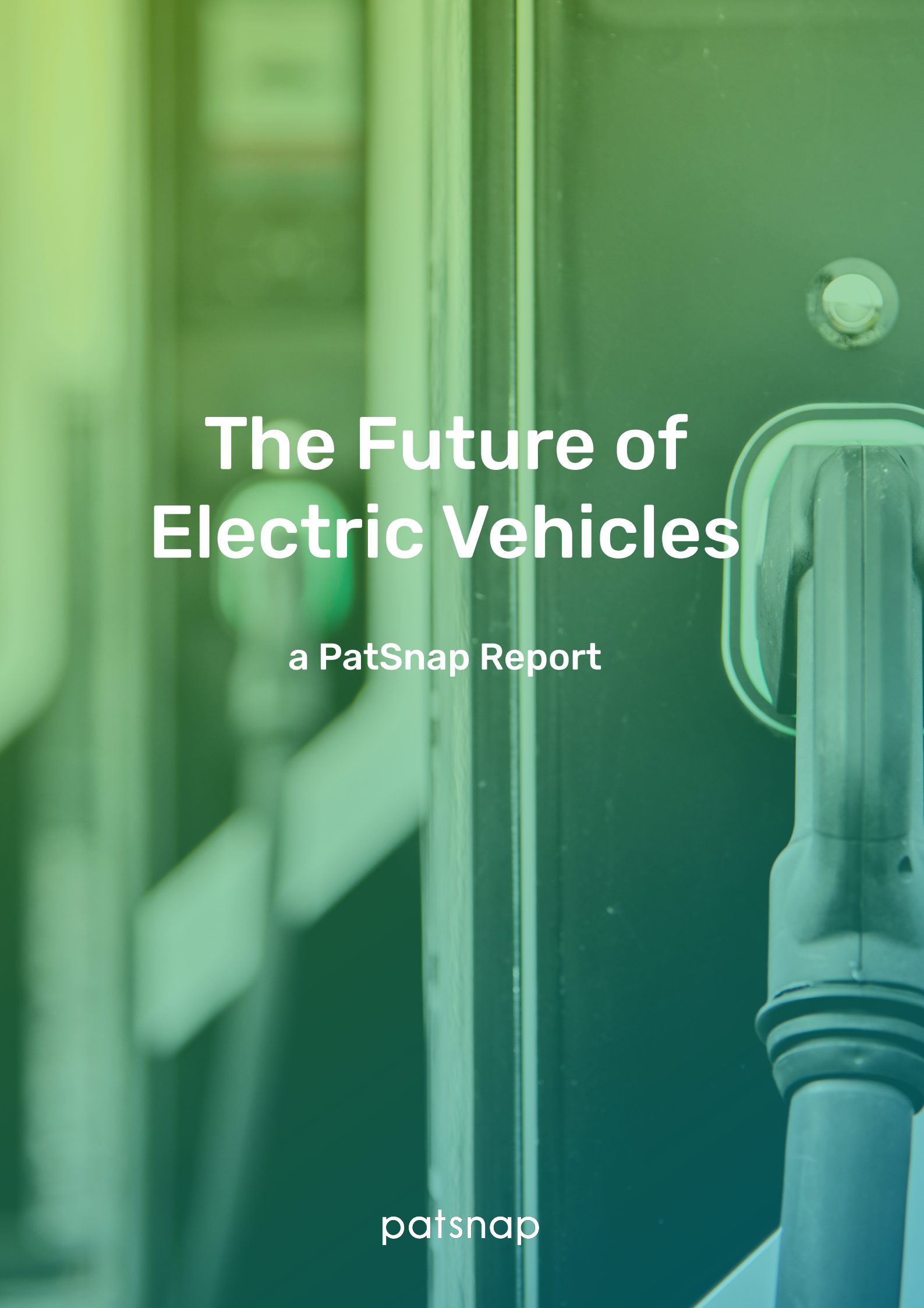


The Future of Electric Vehicles

a PatSnap Report

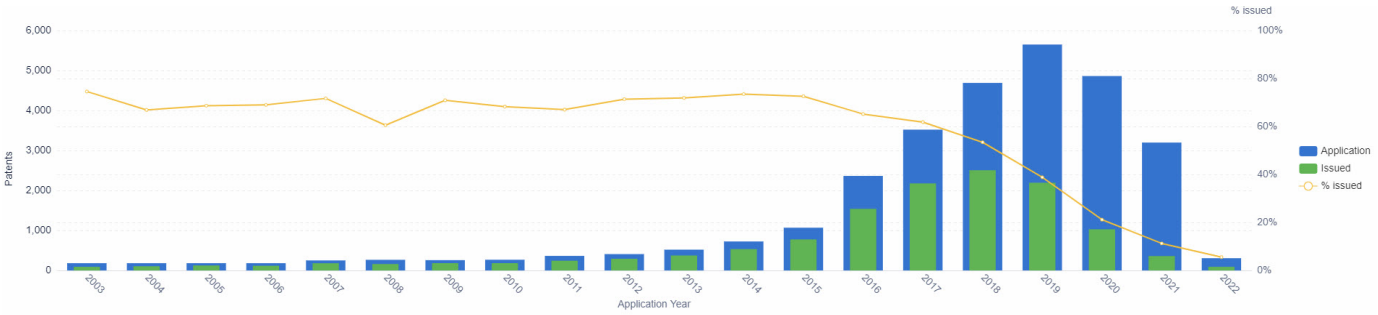
patsnap

Electric Vehicles, Autonomous Vehicles, and The Tale of Tesla

Rising oil prices, climate change, and dramatic battery price declines are contributing to the accelerated growth of the Electronic Vehicle (EV) market. The current global market size is valued at $163.01 billion USD and is projected to grow by a whopping 21.7% by 2030 – adding $700 billion USD to the global economy. This rapid growth speaks to changing consumer preferences related to economic and environmental challenges.

Subsequently, EV production and exports are set to rise from 8,151 units in 2022 to 39,208 units in 2030. Key factors driving this increase include government incentives for production, maintenance, and availability of localized charging stations.

Although the United States is currently the largest market for EVs, patent data suggests by 2030 the Asia Pacific market will lead. This is because of Asia's focus on pollution control, government laws, and capital investment from large automaker organizations.

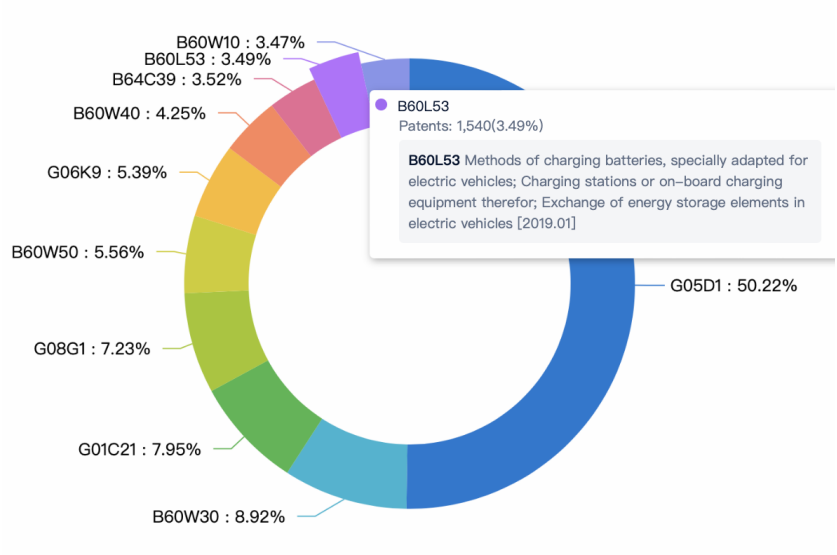


Application and Grant Trends, EV Market, PatSnap Insights

Patent trends in the EV market are promising, indicating strong market interest in its development. In 2020, more than 18,000 patents were filed in the EV space, with an average grant rate of 50% throughout the past five years .

Despite this, challenges in the EV industry such as the high cost of batteries and sporadic charging stations limited mass growth. For example, it costs around $14,000 to replace a Tesla S model 3 battery. Although the batteries are designed to last for 21 to 35 years, or up to 500,000 miles, this isn't always by province. Cheaper battery prices and affordable at-home chargers are making EV vehicles more accessible to consumers. Despite the importance of EV battery life to consumers the case.

As such, some consumers resist making a purchase because of the risk associated with this expensive replacement. Local governments in North America, Europe, and Asia are just now beginning to incentivize EV charging stations to increase the availability of stations across territories. For example, Canada has few EV charging station rebates which can offer incentives to purchase and install an "at-home" EV charging station of up to $600 per installation, but lack standardization, research, and development in this technology area (noted by classification code B60L53 in the chart below) accounts for less than 4% of new innovation. This may pose an issue to the industry, as consumer demand increases in accordance with affordability and supply.



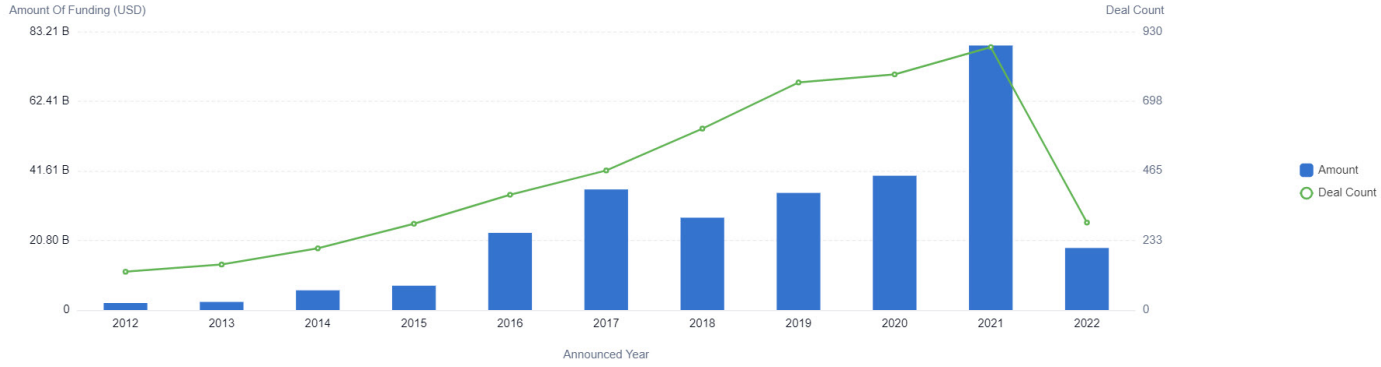
B60L53 Classification Code, EV Autonomous Driving, PatSnap Insights

Another important factor to consider while examining the rise of EV production is the supply of semiconductor chips. EVs use twice the amount of chips than traditional combustion engines vehicles. Semiconductors improve mileage and safety while empowering vehicles with smart, AI-powered technology, and these elements are critical when developing "green" vehicles. Ultimately, the more sophisticated an EV is, the more semiconductor chips it uses.

More semiconductors are being developed than ever and they are now being manufactured specifically for EVs. Unfortunately, the automotive industry was hit hard by the semiconductor shortage that started back in 2019. Automakers were unable to scale projects completely due to the lack of semiconductors available, making it extremely hard to roll out new vehicles on a wide enough scale. Between 2019 and 2020, global vehicle production fell by more than 14 million units. Even though there was some improvement in 2021, the consistent shortage of semiconductors meant automakers had lost $210 billion in revenue and decrease in production of 7.7 million vehicles. The chips that are used in vehicles are more complex than those in typical industries – the automotive industry must follow strict safety requirements with the use of specifically validated semiconductors. Therefore, this makes it difficult for companies to predict how the supply chain may be affected and the impact of that. 2022 also came with factors affecting the shortage through Russia's war on Ukraine earlier this year. Russia supplies 25-30% of palladium (a rare metal used in semiconductors) and Ukraine supply 25-35% of the world's purified neon gas. It is not only shortages on the manufacturing level, but also the raw material level, which will increase the backlog of semiconductors being used in vehicles.

Due to this growing chip shortage, automotive companies are ordering ~10-20% more chips than are needed to ensure inventory and safeguard protection. Original Equipment Manufacturers (OEMs) are estimated to place orders of chips for around 120 million new cars, even when the sales forecast is around 83 million. Alongside the increased ordering of chips, legislature is being put in place to allow automakers to be closer to supplies. Having shorter logistics routes will allow for faster responses but also lower supply chain costs. With the knowledge the shortage will continue to affect the automotive industry for the next three to five years, having this protective strategy will ensure the impact will not be as hard hitting in future years (read our Semiconductor Deep Tech Report for more on this).

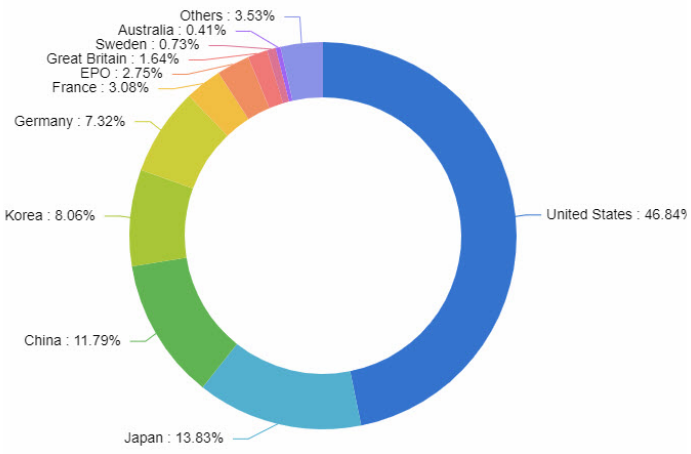
The graph below highlights investment trends in the EV industry. As you can see, the market is ripe with funding — 2021 alone drew in $81 billion USD in funding, raised across 800 deals. As we write this (in mid-2022), the market is sitting at $15.26 USD billion in funding and is expected to reach more than $100 billion USD by year's end. Heavy investments in the development of autonomous driving, customization, and sustainable practices are likely to lead.



Investment Trends, EVs, PatSnap Discovery

The IP view of the EV market is vast and diverse. There are many nuances to vehicles themselves including technology, physical attributes, manufacturing, and safety features. Each of these aspects are patented by the companies or manufacturers. In particular, innovation related to automation and self-driving vehicles is high.

Here's a look at the geographic distribution:



Geographic Distribution, EV Autonomous Driving, PatSnap Insights

Within the IP landscape, the United States has dominance with 46.78% of the patents coming out of it. However, there are new contenders within the autonomous vehicle space – Japan, China and Korea are gaining traction and finding their space within the industry. The exciting developments happening within Japan align with the change in the political view around autonomous vehicles. The government in Japan is close to adapting a bill which will legalize driverless cars and delivery robots. If successful, by March 2023 there are plans to offer unmanned self-driving vehicles to support elderly people in low populated rural areas. This movement from the government may explain the growth of patents coming out of Japan; companies are protecting their inventions before the door for driverless vehicles is opened wide. China, however, are following close behind Japan and have increased their rate of innovation significantly around the autonomous vehicle space. There has been a lot of support to promote pilot Robotaxi services from Baidu and AutoX, however these autonomous vehicles without in-car safety regulations mean the cars cannot pass safety regulations. These incentives are likely to continue to increase over the years, allowing for additional autonomous vehicle start-ups to enter the space and to be backed by the Chinese government. The chairman and CEO of UISEE (a Chinese self-driving start-up) stated that "Companies that originally only focused on the Robotaxi market are now exploring other autonomous driving sub-scenarios". It is expected that China will close the gap between itself, Japan, and the United States through its experience in new-energy vehicles (NEV) and advantages in digitalization – China is one to watch within this industry.

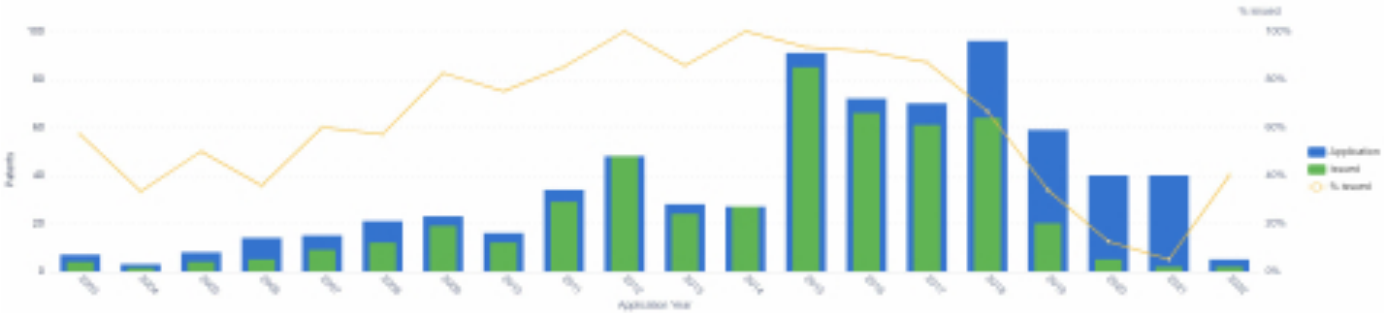
If we look at some valuations of some patents coming out of each jurisdiction, it shows the importance of the technology that are being developed:

Company	Patent Name	Patent Number	Valuation
Honda Motors Co Ltd	Electric vehicle driving support system	US20130268152A1	$1,140,000
Hyundai Motors Co Ltd	Apparatus and method for controlling lane change with consideration of priority	CN107433946B	$1,250,000
Toyota Jidosha KK	Autonomous driving vehicle system	JP2016132352A	$4,980,000

Not only are China and Japan settling their place in the automotive market through the number of granted patents, but they are also securing high valued technologies. These high valued patents will shape the development of the autonomous vehicle industry in ways which will favour the respective companies.

The Tale of Tesla

Tesla is a company that never seems to go more than a few days without media coverage, largely due to the company's famous and highly opinionated CEO, Elon Musk. From 2021, Tesla has reached a net worth of $1 trillion – meaning it is the 6th most valuable company in the world.



Although Tesla is present in the patenting ecosphere, the volume of its technology filings pale in comparison to other industry leaders, such as Toyota. This is intentional, as Musk stated in 2014 that he isn't a fan of the concept. This begs the question: if not patents, where is the evidence of the innovation driving Tesla's success?

Two words: trade secrets.

Trade secrets are a form of intellectual property. They differ from patents as they can be utilized while remaining confidential and remain under ownership of the proprietor for as long as they can be kept a secret. Many corporations put protections in place to protect disclosure of such trade secrets such as utilizing non-disclosure agreements. Unfortunately, once the cat's out of the bag, there's no putting it back. With patents, for the price of publishing your invention, you're afforded legal protection that will allow you to sue any competitors copying your solution. Generally, with trade secrets, the economic benefit is because it is not publicly known.

Telsa relies on trade secrets as a key innovation tactic. We know this because in the summer of 2020, Telsa sued Rivian Automotive, alleging the company "stole trade secrets by actively recruiting former Tesla employees and instructing them to provide specific sensitive and confidential information".

Tesla likes to exercise complete hegemony over its processes — from material processing, manufacturing, component assembly, vehicle optimization, sales, and distribution, and after-sales — which puts the company in a position to identify, codify, and catalog intellectual assets (e.g., software). Therefore, maintaining trade secrets gives Tesla a competitive advantage.

That said, the extent to which Tesla relies on trade secrets versus patents as an intellectual property strategy is hard to pin down, but one thing is certain — the company doesn't put all its eggs in one basket. Instead, like a true disruptor, Tesla is innovative in all areas of its business, not just with its technology.

As such, looking at the patent data without this context is shortsighted. As the above narrative showcases, even though Tesla is not a top patent filer in this space, it's disrupting the entire sector. All things considered; we can't help but wonder: is the current patent system an inadequate technology paradigm for market frontrunners like Tesla because it can't keep up with their required innovation velocity?

Tesla's hegemony over its processes creates an insular system that allows for the knowledge and intellectual property around each stage to be easy to manage. Notably, these strengths that make Tesla the innovative powerhouse it is today are largely incompatible with the patent ecosystem. Why? Even though a manufacturing process can be protected through utility patents, the requirement for infringement is such that the offender must be practicing all the claimed steps in the process. This means that a savvy competitor only has to change one step along the way of the process in order to avoid infringement.

So, in a hypothetical example, let's say Tesla publishes a twelve-step manufacturing process for an electric motor to power the wheels. By publishing a patent, the world is able to see this process from start to finish. Now, if I'm a competitor of Tesla that's looking to solve a similar problem with my electric motor manufacturing, I can focus all of my energy and R&D resources on redesigning one step of the same process rather than designing twelve from scratch. This means that for Tesla, from a business standpoint, it might be more optimal to keep that process secret, rather than publishing it for the world to see with the protections that a patent affords.

Tesla's Battery Innovation

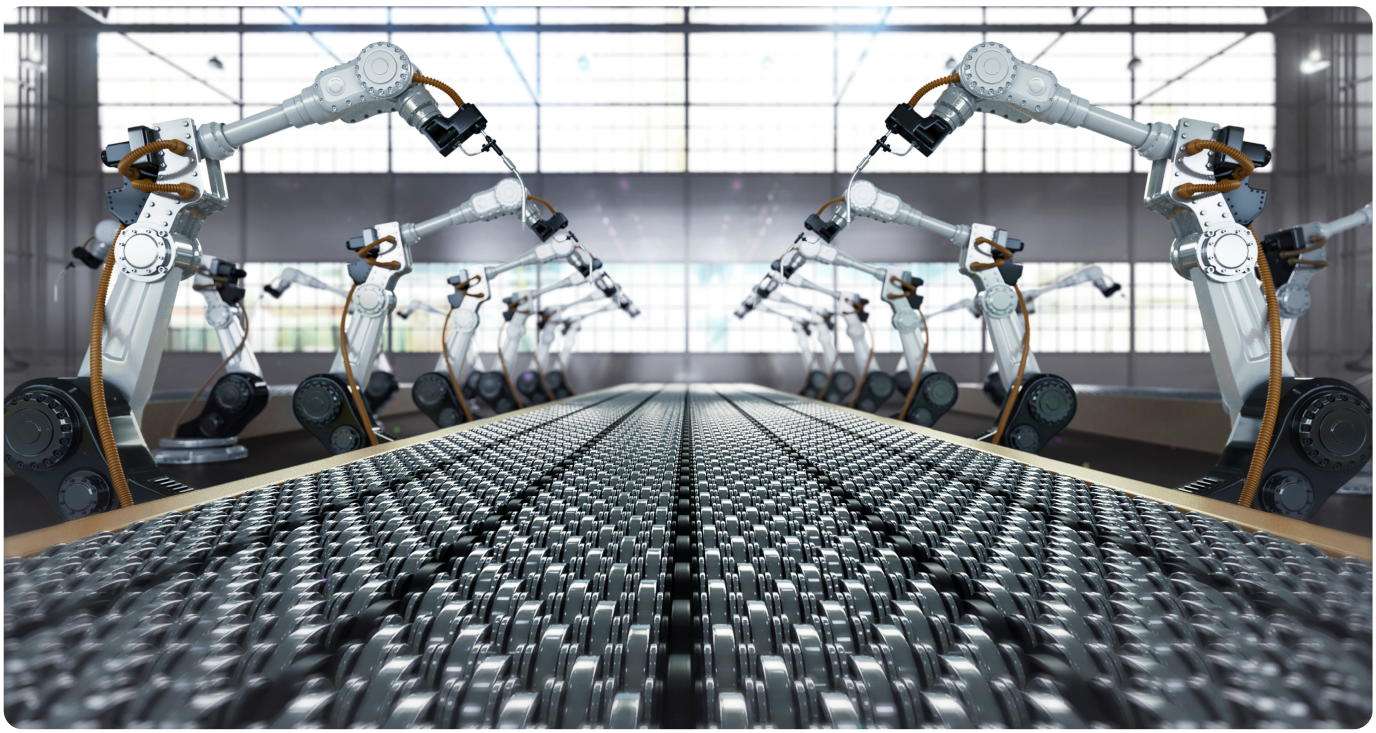
Not only is Telsa innovative in its technology, it's also forward-thinking in its business practices. The company is well aware that mass adoption of its vehicles won't happen until battery prices drop enough to make EV cars cheaper than internal combustion engines. The most significant factor in determining the battery price relates to how much cobalt is used.

Cobalt is a rare earth metal found primarily in the Democratic Republic of Congo. Cutting out cobalt will dramatically reduce battery costs, making EV cars more affordable. Not one to be left in the dust, Tesla is working on building its Model 3 in China using lithium iron phosphate (LFP) batteries. These innovative batteries contain no cobalt and can support up to ten times as many recharges as the lithium-ion batteries used in most EVs. If successful, these batteries will reduce Tesla's reliance on Cobalt, extend battery life, and reduce costs.

Finally, in examining Tesla's success in the EV market, it's important to understand the relationship a company like Tesla has with its suppliers. Much was made of the 2020 grant of US10784530B2 after its publication, with Tesla promoting it as the solution to the 1,000,000-mile battery. The lead inventor of the patent, Jeff Dahn, a visionary in the lithium battery space, believes that high-capacity electric vehicle batteries will also go some way to relieving stress on energy grid infrastructure through vehicle-to-grid applications. Simply, as electric vehicles remain idle for most of the day, bidirectional charging can be implemented to effectively make electric vehicles 'part of the grid' whilst they are plugged in, adding temporary extra storage capacity to the grid itself. For this to be feasible, high-capacity batteries that can support many charging cycles are key. Dahn works with Tesla through an exclusive research agreement via his role at Dalhousie University. Interestingly, since its grant, ownership of this patent has been transferred from Tesla to its battery supplier, Panasonic.

This is surprising because Tesla plans to begin building its own batteries in the not-so-distant future. As such, transferring away cornerstone technology seems like a contradictory move. However, around the same time of this transfer, Tesla struck a new deal with Panasonic around battery supplying, which ends this year . Being a savvy company with revenue top of mind, it may be that Tesla saw this partnership as an offer it couldn't refuse. After all, having access to an abundant supply of discounted batteries is a win-win for Telsa. Alternatively, the two companies may enter a cross-licensing arrangement that will see them combine their battery development efforts in the near future. The verdict is still out, and chances are we'll find out sooner rather than later.

Ultimately, there are many factors including investment and technology trends, consumer demand, patents and IP trends, transfers, and licensing, working collectively to shape the future of the EV market.



Founded in 2007, PatSnap is the company behind the world's leading Connected Innovation Intelligence platform. PatSnap is used by more than 10,000 customers in over 50 countries around the world to access market, technology, and competitive intelligence as well as patent insights needed to take products from ideation to commercialization. Customers are innovators across multiple industry sectors, including agriculture and chemicals, consumer goods, food and beverage, life sciences, automotive, oil and gas, professional services, aviation and aerospace, and education.

PatSnap's team of 1000+ employees work from its global headquarters in Singapore, London, and Toronto. To learn more about how PatSnap is improving the way companies innovate, visit www.patsnap.com.

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