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PAGANI AUTOMOBILI S.P.A.: MOTORING BECOMES ELECTRIC[[1]](#endnote-1)

Adrian Pierce and Professor Robert D. Austin wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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Everyone is developing something in this direction.

That is not something you can just pretend not to see.

Horacio Pagani, founder and chief executive officer, Pagani Automobili S.p.A.[[2]](#endnote-2)

In May 2018, Pagani Automobili S.p.A. (Pagani Automobili) put the speculations of industry observers to rest with an announcement that it would build an electric vehicle (EV). “The management is already organising the company to have a division specifically for electric cars,” confirmed Horacio Pagani, the company’s founder and chief executive officer (CEO). “By the end of 2018,” he said, “the idea is to have a section where electric cars can be developed and tested. There is electric car research already ongoing.”[[3]](#endnote-3)

In one of the world’s largest industries, Pagani Automobili was an oddity. Unlike the mass-production auto giants, the company produced only 35 to 40 vehicles a year, each priced at around US$2.4 million. Unlike many supercar start-ups, which emerged frequently only to die out soon after, Pagani Automobili was profitable and stable, and had been in business for almost 20 years.[[4]](#endnote-4) A key to its survival had been always doing things its own way: “We are a small, family-owned group,” explained Pagani. “We do not belong to a big corporation or a large automotive group where you lose your freedom. We are able to do things in a swift way.” It would have been possible, Pagani had once suggested, for the company to add a more practical line of vehicles, increase volume, and thereby increase its profits to €500 million[[5]](#endnote-5) a year, but it had not done so because, as Pagani himself put it, “I don’t give a damn about that kind of thing.”[[6]](#endnote-6)

It was perhaps not too surprising, then, that the company took a unique approach to EV technology. Pagani had no plans to stop producing internal combustion models; EVs would be produced in parallel, without increasing total volume. As it moved into EVs, the company would also continue a traditional focus on improving performance by saving weight rather than adding power: “We’re not really challenging the crazy horsepower,” Pagani said, referring to the EV industry’s obsession with the power and acceleration potential of EV technology. “It is more about lightweight vehicles with extremely good drivability. Transfer this to an electric vehicle and you can imagine what we are looking for: an extremely light weight that will probably be a benchmark for electric cars in the future.” Concerns about weight had also led Pagani to rule out building a hybrid vehicle. He explained, “I imagine a car that is fully electric. I love the design and the style of the [Porsche] 918 [hybrid], but it will only allow you to drive around 25 km [kilometres] in full-electric mode. When the battery runs out, you are still carrying the batteries around with your combustion engine. That’s about 300 kg [kilograms] of weight—useless weight.”[[7]](#endnote-7)

However, the decision to build an EV also raised many questions. It would be crucial to ensure that an electric Pagani could deliver the emotional appeal the brand’s customers had come to expect. This bar was set very high, as Pagani explained: “A car has to make you dream. It has to light you up. If a car can light you up every time you see it, it has done its job.”[[8]](#endnote-8) Achieving emotional appeal involved many specific challenges. For example, one classic aspect of the sensation of driving a Pagani was the metallic “clunk” of the manual gear changes. But there was no need for a manual gearbox on an EV. Could one be included anyway, to preserve that element of the driving experience? “That was the first question [I posed] when I went to the design and engineering team,” Pagani admitted. “Everybody replied that you don’t need that on an electrical car, but I don’t have an answer [to my question] right now.”

Could the team at Pagani Automobili build an electric vehicle that customers would experience as a true Pagani Automobili? Was this even possible? Did EV technology really belong in Pagani Automobili cars?

A Brief History of Pagani Automobili[[9]](#endnote-9)

Pagani had been fascinated by automobiles for as long as he could remember. As a boy, living in a small town in Argentina in the late 1950s, he spent countless hours in the shops of local woodworkers, building models of cars he had read about in magazines. Around the same time, he fell in love with an idea attributed to Leonardo Da Vinci, that truly special things were created at the intersection of art and science, where both beauty and function were important. This idea, along with Pagani’s love of cars, set him on a path that would eventually lead him to create beautiful, highly functional automobiles.

The wooden models evolved, over time, into a small, fully operational vehicle, which Pagani built while still in high school. In 1974, when he was 18, Pagani set off to study industrial design at university; but he found the academic life too far removed from actual car making and soon dropped out. Eager to get back to making things, he opened a small factory in 1977, which won contracts to design various industrial items, such as benches, for local businesses. In 1979, he landed his first automotive job when Groupe Renault (Renault) engaged him to work on the design of a new race car for its Argentinian racing team.

Pagani had never before even seen a race car like the one Renault asked him to create, so he went back to first principles. By first studying how racing tires interacted with the road and then slowly working his way up through the car’s other systems, he created a highly original design.[[10]](#endnote-10) When the car debuted at the Argentinian Formula 2 national championship, it received international praise.[[11]](#endnote-11) One journalist wrote that he had never in his long career seen anything as well finished and as well presented as Pagani’s race car.

Pagani’s success with the Renault car earned him a job at Automobili Lamborghini S.p.A. (Lamborghini) in Modena, Italy. He began as a low-level factory employee in 1983, but his work ethic and vision quickly earned him greater responsibilities as a designer. As a senior designer, Pagani worked on some of the most iconic Lamborghini models in history. He developed a particular interest in the performance advantages of using composite materials (made by combining two or more constituent materials). Composites were significantly stronger and lighter than the materials that had been used in car manufacturing up to that point. But they were also very costly. Pagani struggled to convince Lamborghini to incorporate composites into production vehicles.[[12]](#endnote-12) Ferrari N.V. (Ferrari), at that time a direct competitor of Lamborghini, had not invested in composite material technology, so why, Lamborghini’s managers reasoned, should they?[[13]](#endnote-13) Frustrated by this, Pagani parted ways with Lamborghini in 1991 to start a company of his own, Modena Design, where he could focus his efforts on the development of a car constructed from composite materials.

From the early days, Pagani operated Modena Design primarily as a services firm, offering consulting services to other companies. But all the while, his ultimate objective was to develop a new kind of car. His expertise in composites made him useful to companies in the automobile and aerospace industries, and there he learned from client experiences, especially in aerospace. Alongside the consulting he did, Pagani developed prototypes of what would eventually become his company’s first released model.

After seven years of bootstrapped development, the Pagani Zonda was unveiled during the 1998 Geneva International Motor Show. The long development time was partly a result of the way Pagani had financed the project, but it was also a reflection of Pagani’s perfectionist tendencies. He wanted his first production car to be functionally perfect and beautiful beyond belief. He aimed to make the Zonda so emotionally captivating that an individual might choose to buy it without even ever driving it, despite its million-dollar price tag. Pagani routinely described the Zonda in sensual terms; the Zonda, he suggested, was irresistibly seductive.

Customers appeared to agree. Upon the Zonda’s release, Pagani received more orders than he would ever be able to fill.[[14]](#endnote-14) The company’s production capabilities were in their infancy, and its facilities were more a development shop than a factory. Unsure how many cars he would be able to deliver to customers, Pagani acted with an abundance of caution: The first production run of the Zonda, he decided, would consist of five or six orders.[[15]](#endnote-15)

Demand for Pagani’s creations would always exceed supply. He released new versions of the Zonda every few years (see Exhibit 1), and customized each unit sold. Some vehicles were built for racing, others for everyday driving. Newly released models always sold out quickly.[[16]](#endnote-16)

After producing the Zonda for 13 years, Pagani introduced a new model, the Huayra (pronounced “wai-rah”), in 2011 (see Exhibits 2 and 3). Pagani continued to produce the Zonda, but the company focused more of its efforts on the Huayra. In 2018, Pagani Automobili estimated that its Modena facility of over 62,000 square feet (5,800 square metres),[[17]](#endnote-17) which was slightly bigger than the size of an American football field, would produce and deliver 40 cars[[18]](#endnote-18) to customers all over the world.

EV Technology—an introduction[[19]](#endnote-19)

EVs were often segmented into two distinct categories: hybrid and all-electric vehicles.

Hybrid vehicles were powered by both electricity, which drove an electric motor, and fossil fuels, which drove an internal combustion engine. An onboard computer regulated an optimal blend of electric and gasoline power in different driving situations. Hybrids could be either hybrid electric vehicles, which used electrical energy alongside internal combustion for power to the wheels and recharged electric batteries through regenerative braking;[[20]](#endnote-20) or they could be plug-in hybrid electric vehicles, which worked like hybrid EVs but could supplement power by plugging into an external power source.

All-electric vehicles (also referred to as battery-electric vehicles) operated solely on electric power and did not contain an internal combustion engine. Electric energy to recharge batteries was generated through regenerative braking and by plugging the vehicle into an external power source.

In 2017, sales of hybrid vehicles and all-electric vehicles totalled 4 per cent and 1 per cent, respectively, of total global vehicle sales.[[21]](#endnote-21) By comparison, gasoline and diesel cars totalled 76 per cent and 19 per cent, respectively, of total global car sales.[[22]](#endnote-22)

Owners of hybrid or all-electric vehicles enjoyed a range of benefits. Due to a reduced dependence on fossil fuels, hybrids and all-electric vehicles were considered an environmentally friendly choice; owners could take satisfaction from the knowledge that they had lowered their personal contribution to pollution and climate change. EVs could also deliver advantages in driving performance, especially acceleration, because increases in electric power were delivered instantaneously to the wheels.[[23]](#endnote-23) On classic zero-to-sixty-miles-per-hour benchmarks or in short distance races, certain electric cars could out-accelerate much more expensive internal combustion engine sports cars.[[24]](#endnote-24)

But there were also downsides to EVs. Manufacturing costs for EVs were high, which generally translated into a higher total cost of ownership for consumers, despite savings in fuel/power and maintenance costs (the total cost of ownership could vary greatly depending on factors such as local fuel prices, EV subsidies, and the specific model being compared).[[25]](#endnote-25) Available battery technology had a limited range between recharges, and recharging could result in significant travel delays. Some batteries lost energy storage capacity over time, which could necessitate expensive repairs or replacement after a few years. Additionally, due to the weight of the battery, electrically powered cars were often substantially heavier than an equivalent, traditional car; this was especially important for sports cars, as higher power-to-weight ratios were directly related to performance.[[26]](#endnote-26)

Expanding Popularity

The years leading up to 2018 saw rapid increases in the adoption of EV technology; global sales of hybrids and all-electric vehicles experienced an average annual growth rate of 55.3 per cent from 2012 to 2017.[[27]](#endnote-27) Projections estimated that by 2040, global sales of new EVs would reach 55 per cent of total global vehicle sales, effectively surpassing sales of new gasoline and diesel vehicles.[[28]](#endnote-28) Many major car manufactures started to invest heavily in the development of hybrid and all-electric vehicles in an attempt to capture this growth from first movers with a strong foothold on the market, such as the U.S.-based automotive company, Tesla Inc. (Tesla).[[29]](#endnote-29)

Many countries provided incentives for drivers to go electric. Norway, for example, offered tax advantages, free parking in public locations, and free charging for EVs; the country’s plans called for banning internal combustion engine vehicles by 2025. The Netherlands, Germany, and the United Kingdom also announced plans to outright ban the sale of new petrol and diesel cars by 2030, 2032, and 2040 respectively (Scotland planned to do so in 2032). In the United States, the state of California set a similar goal for 2040. China announced its intention to set a date “in the near future” by which time fossil fuel vehicles would be banned (see Exhibit 4).

Where Art Meets Science—The Pagani way of making Cars

When you drive it, it brings you to your senses. . . . It’s a car, but not as a car was usually considered.

It was “a synthesis of ideas, a concentrate of technology contained in an elegant and sinuous shape.”[[30]](#endnote-30)

Pagani Automobili website

Since the release of the company’s first production vehicle in 1998, Pagani had been guided by his own particular philosophy, which called for building cars the “Leonardo Way: At the intersection of art and science.” This philosophy strongly influenced many decisions about organization and processes—about how work was done at Pagani Automobili.

For example, Pagani Automobili managers emphasized the importance of small team size. According to Francesco Zappacosta, the company’s managing director, “At Pagani, the design team is a hybrid between designers and engineers, so the same team starts from a blank sheet of paper then designs the whole car.”[[31]](#endnote-31) This was an advantage over mainstream sports-car manufacturers that chose to span the development of new cars across many employees and numerous company departments and divisions. Pagani explained why such an approach would not work at Pagani Automobili: “The car has to look like a solid piece, sculpted from a single language and single vision, all integrated.”[[32]](#endnote-32)

Another aspect of the Pagani Automobili philosophy called for completing work during development by hand, without the use of machinery, as much as possible.[[33]](#endnote-33) Roberto Malmusi, Pagani Automobili’s composites manager, explained: “There is no work done mechanically with a machine or a robot. This is not only an indication of quality but also of philosophy. Our customer must feel with their own hands, with their own senses, sight, touch, what we offer, what we do with the car. And this can only be done by hand, without the use of machines.”[[34]](#endnote-34) Making by hand was central to the creative process of designing a car, as Pagani explained: “This is art. It is an expression of the hands, a kind of manual intellectualism which goes from the head to the hands. You’ve got about a hundred people here who work with their hands, designing parts, even those that come from external suppliers.”[[35]](#endnote-35)

Inspiration for the design of components of Pagani Automobili cars came from a wide range of sources: classic Italian boats, state-of-the-art watches, even fighter planes.[[36]](#endnote-36) Ultimately, however, Pagani aimed for each model to communicate a forceful, singular message to the customer. For the Huayra, for example, Pagani aimed to capture “the forces of wind” within a high-performance sports car. He explained, “We wanted to give shape to the wind. An energy, subtle, elegant, yet strong and persistent.”[[37]](#endnote-37) This integrating idea extended even to the name—Huayra was the Andean god of wind.[[38]](#endnote-38) Throughout the car’s development, Pagani obsessed about capturing the feeling of an airplane taking off into the wind, in terms of both the physical sensation and the car’s sound. The team behind the Huayra even tuned the engine and other performance components to better simulate the intense rush and sound of a fighter plane taking off into the wind.[[39]](#endnote-39)

The Product—A Close Look at the Huayra

Inside the Huayra it looks like a Victorian’s idea of the twenty-third century.[[40]](#endnote-40)

Richard Hammond, co-host of BBC Two television program *Top Gear*

During assembly, Pagani Automobili vehicles were subjected to beyond-obsessive attention to detail. Each individual nut and bolt used in production was designed by company employees and included an engraved Pagani Automobili logo.[[41]](#endnote-41) The name badge (located on the exterior of the car at the rear) was machine-carved from a singular chunk of aluminum using a process that took 24 hours to complete. Although such a badge could be made using a much faster process (e.g., stamping), Pagani rejected the approach because machine carving produced the highest quality result.[[42]](#endnote-42) Wheels for the car were also machine-carved, in a process that took five full days.[[43]](#endnote-43) Dashboard instruments were designed and created by world-famous watchmakers and jewellers; each cost €5,000 to create, approximately 100 times the cost of an instrument dial for mainstream production vehicles.[[44]](#endnote-44) Pagani explained why all this was necessary: “There is a supreme focus on the feeling and emotion that the car brings the driver. This is what fuels the meticulous design of the interior of the car. While the exterior is obviously important and beautiful, it’s really the details and craftsmanship that contributes to the emotion of driving it.”[[45]](#endnote-45) The resulting aesthetics impressed reviewers, such as Peter Cheney of *The Globe and Mail*, who commented, “It [the Huayra] is a beautiful, densely compacted collection of extraordinary components and swooping, extraterrestrial shapes, rendered in carbon fibre, titanium and milled aluminum. Every knob, switch and panel is sheer art, with the shimmering beauty of a jewelled watch movement. This is the Sistine Chapel with headlights and turbochargers.”[[46]](#endnote-46)

The Huayra was also engineered to perform. With 789 horsepower and weighing in at just over 1,200 kg, it featured, according to Cheney, “the kind of power-to-weight ratio you normally find in machines like the F-18 fighter jet.”[[47]](#endnote-47) (By comparison, a Chevrolet Corvette had about 650 horsepower and a curb weight of about 1,500 kg.) As a result, the Huayra’s acceleration was described by Cheney as “hallucinatory”—getting from zero to 100 km per hour took 2.8 seconds and the rated top speed was about 380 km per hour.

Even in the realm of performance, however, Pagani took aesthetics into account. The Huayra featured a manual stick-shift gear changer, unusual in a modern, 2018 sports car. Pagani felt that the stick shift was an important part of sports car culture, and that it was thus essential to the driving experience to include it. The stick shift in the Huayra contained 67 exposed moving parts, all designed to work together to deliver the nostalgic mechanical clunk upon changing gears that was once common in iconic sports cars. The Huayra also included an automatic gear changer, so a driver had the option of using whichever he or she preferred.[[48]](#endnote-48)

Customization was another core component of the Pagani Automobili customer experience and development process. While Pagani aimed to sell his vision of the perfect sports car in every model that left the factory, every client that placed an order would have many opportunities to tune the car to their specific preferences and tastes. Pagani explained, “We all feel like a family. That is why every client becomes part of the family. Every client has the possibility to express themselves and their ideas; it’s not that we design only thinking of our ideas as the final result, there is an enormous exchange of ideas and opinions and every car in the end is effectively an outfit fitted by size.”[[49]](#endnote-49)

Forty-eight variations of the Zonda and 17 variations of the Huayra had been produced from 1998 to 2018 (see Exhibit 5). Customized modifications could take a year and a half[[50]](#endnote-50) to ensure perfect performance and compatibility with all other aspects of the vehicle. One notable special edition Huayra was the result of a collaboration between Pagani Automobili and world-famous, luxury fashion brand Hermès. The two brands worked together to create a special-edition model for a car collector with an affinity for high-end fashion. Another notable limited edition was a Pagani Zonda made especially for world-famous race car driver Lewis Hamilton. As per Hamilton’s request, the Pagani Zonda 760 LH (the “LH” stood for Lewis Hamilton) was the first of the 760 models that featured an entirely manual transmission, simply because Hamilton thought it would be more fun to drive that way.[[51]](#endnote-51) “When you are selling cars before you have made them,” Pagani said, “your sense of responsibility toward your clients increases dramatically.”[[52]](#endnote-52)

EV technology At Pagani’s Competitors

There were three main segments in the high-performance sports car industry: mainstream sports car manufacturers (e.g., Ferrari, Lamborghini, McLaren Automotive Ltd. [McLaren], Tesla); specialty sports car manufacturers (e.g., Bugatti Automobiles S.A.S. [Bugatti], Koenigsegg Automotive AB [Koenigsegg]); and a variety of new, all-electric sports car manufacturers. (This is not an exhaustive list; we have excluded some high-volume producers. See Exhibit 4 for a summary table of technical specifications for the competitors described below.)

Ferrari

Based in Maranello, Italy, where it was founded in 1927, Ferrari was known all over the world as a manufacturer of high-performance sports cars.[[53]](#endnote-53) In 2017, its 3,380 employees produced and delivered 8,398 cars to customers in over 60 countries.[[54]](#endnote-54) Ferrari’s lineup consisted of six core models,[[55]](#endnote-55) which ranged in baseline price from approximately US$200,000 to US$1,400,000.[[56]](#endnote-56) As of 2018, only one (the LaFerrari—Ferrari’s highest performing and most expensive sports car) of the six Ferrari models featured any form of EV technology. The LaFerrari used regenerative braking technology for boosting overall performance.[[57]](#endnote-57) Ferrari planned to begin implementing similar hybrid technology across its other models for the explicit purpose of boosting performance, beginning in 2019.[[58]](#endnote-58) When asked during the 2016 Geneva International Motor Show whether Ferrari’s future might feature an all-electric vehicle, Sergio Marchionne, Ferrari chairman and CEO, was unequivocal: “There will never be an electric Ferrari because engine noise is such an important part of the Ferrari driving experience. Near-silent electric powertrains just won’t cut it in a car wearing the Prancing Horse badge.”[[59]](#endnote-59) Nevertheless, by January of 2018, Ferrari had unveiled plans to build an all-electric Ferrari model.[[60]](#endnote-60) Marchionne revised his message, saying, “If there is an electric supercar to be built, then Ferrari will be the first.”[[61]](#endnote-61)

Lamborghini

Lamborghini was an Italy-based manufacturer of high-performance sports cars founded in 1963 to compete with Ferrari (and others).[[62]](#endnote-62) In 2017, its approximately 1,400 employees[[63]](#endnote-63) produced an estimated 3,500 cars, which it delivered to customers around the world; production was expected to double with the opening of a new factory in 2018.[[64]](#endnote-64) Lamborghini’s lineup consisted of three core models,[[65]](#endnote-65) which ranged in baseline price from approximately US$200,000 to US$400,000.[[66]](#endnote-66) Though none of these Lamborghini models featured any form of EV technology, the company had announced plans to begin implementing hybrid technology into all of its models beginning in the early 2020s.[[67]](#endnote-67) It qualified the announcement, however, by also saying that it would adopt EV technology only if it did not compromise the car in any way.[[68]](#endnote-68) Maurizio Reggiani, research and development lead at Lamborghini, referring to Lamborghini’s iconic combustion engine, explained: “The value of our brand is based on our top end product. It must be really the pure interpretation of a supersport car. We are sure that one of [the] things you must offer on a supersport car is a V12 naturally aspirated engine.”[[69]](#endnote-69) In November 2017, Lamborghini revealed that it was working on an all-electric concept car in a research partnership with the Massachusetts Institute of Technology.[[70]](#endnote-70)

McLaren

McLaren, a British manufacturer of high-performance sports cars, was founded in 1966 in Surrey, England.[[71]](#endnote-71) In 2018, McLaren sold nine models that ranged in baseline price from approximately US$200,000 to US$1,100,000.[[72]](#endnote-72) Three models, all of which belonged to McLaren’s high-priced “extreme series,” featured hybrid technology.[[73]](#endnote-73) In 2016, the company announced, as part of a new six-year business plan, an objective of introducing hybrid technology into 50 per cent of the cars it produced.[[74]](#endnote-74) Mike Flewitt, CEO of McLaren, addressed the possibility of an all-electric McLaren during the 2016 Geneva International Motor Show:

For us, the vehicle, when it comes to pure EV, has to be as exciting to drive as a P1 or a 675LT. So what we need to work on is how we deliver an EV that is that exciting, that [is] engaging, that [is] compelling. We need to work on the things that make it exciting. We get a lot of excitement today from noise, from the physical sensation, the vibration, and so on that comes from our conventional powertrain. How do we replace it so it is equally as fun?[[75]](#endnote-75)

In December 2017, McLaren suggested that an all-electric vehicle was under development but faced many challenges due to the limitations of battery technology.[[76]](#endnote-76)

Koenigsegg

Koenigsegg, founded in 1994 in Sweden, had 135 employees[[77]](#endnote-77) in 2017 and tended to produce only one model at a time, typically in very limited numbers.[[78]](#endnote-78) The company’s founder and CEO, Christian Von Koenigsegg, had earned a reputation as a “serial innovator” in automotive technology and often included innovations in new Koenigsegg models. For example, the Regera, unveiled in 2015 for a production run of 80 units,[[79]](#endnote-79) used EV technology to create the first ever production car without a transmission.[[80]](#endnote-80) As Koenigsegg explained during the 2016 New York International Auto Show, “This is the only combustion-engine sports car I know that doesn’t have a transmission. The engine is also directly connected to the rear axle. That was possible because of the electrification.”[[81]](#endnote-81)

Bugatti

Bugatti was a French manufacturer of high-performance sports cars known for again and again breaking the record for fastest production car in the world.[[82]](#endnote-82) The company produced one model, the Chiron, and sold approximately 40 cars per year[[83]](#endnote-83) with a baseline price of US$2,990,000.[[84]](#endnote-84) As of 2018, the Bugatti Chiron did not feature any EV technology. However, the company had confirmed that the Chiron’s successor would be some form of a hybrid.[[85]](#endnote-85)

Other Electric Sports Cars

Rimac Automobili (Rimac) was a Croatia-based electric sports car manufacturer founded in 2009. In 2013, Rimac unveiled the Concept One, which it billed as the fastest all-electric car in the world.[[86]](#endnote-86) Only eight of these cars were produced, and each sold for US$980,000.[[87]](#endnote-87) In 2018, Rimac confirmed it was developing a successor to the Concept One, which would also be an all-electric vehicle.[[88]](#endnote-88)

Nio, a Chinese-based electric sports car manufacturing start-up, was founded in 2014.[[89]](#endnote-89) Nio produced one model, the EP9, an all-electric car similar in performance and features to Rimac’s Concept One.[[90]](#endnote-90) Only six EP9s were ever produced; they were sold to the company’s investors for US$1,200,000 each.[[91]](#endnote-91)

As of 2018, many all-electric sports car concept cars had been released. Few, however, were in actual production and legal for road use.[[92]](#endnote-92)

Conclusion

The world was changing fast for Pagani Automobili, and EVs were not the only emerging issue the company needed to consider. Both Ferrari[[93]](#endnote-93) and Lamborghini[[94]](#endnote-94) had disclosed in recent interviews that they were not interested in autonomous-vehicle technology. It would be natural enough for Pagani Automobili, another brand that similarly emphasized the experience of driving, to follow suit. But should it? There was a lot of “buzz” around this topic, generated by auto brands such as Tesla, not to mention tech companies like Google. Should Pagani Automobili also take an official stance on this matter? Would there, one day, be a self-driving Pagani Automobili as well as an electric one?

Exhibit 1: Debut of Core Pagani Models

|  |  |
| --- | --- |
| **Year** | **Model** |
| 1999 | Zonda C12 |
| 2000 | Zonda S |
| 2001 | Zonda S 7.3 |
| 2003 | Zonda Roadster |
| 2005 | Zonda F |
| 2006 | Zonda Roadster F |
| 2006 | Zonda F Clubsport |
| 2009 | Zonda Cinque |
| 2009 | Zonda R |
| 2010 | Zonda Roadster Cinque |
| 2010 | Zonda Tricolore |
| 2011 | Huayra |
| 2013 | Zonda Revolución |
| 2014 | Huayra Dinastia |
| 2016 | Huayra BC |
| 2016 | Huayra Pacchetto Tempesta |
| 2017 | Zonda HP Barchetta |
| 2017 | Huayra Roadster |

Source: Created by the case authors using data from “The 65 Pagani Cars,” Pagani History, accessed December 12, 2018, www.paganihistory.com/cars.

Exhibit 2: Pagani Huayra Roadster

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Source: Pfaff Automobiles, used with permission.

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Source: Pfaff Automobiles, used with permission.

Exhibit 3: Schedule of Countries Planning to Ban Fossil Fuel Vehicles

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Geography | Ban Announced | Ban Commences | Type of Combustion Engine Banned | Selectivity |
| China | 2017 | In “the near future” | Petrol and diesel | New vehicle sales |
| Scotland | 2017 | 2032 | Petrol and diesel | New vehicle sales |
| United Kingdom (excluding Scotland) | 2017 | 2040 | Petrol and diesel | New vehicle sales |
| France | 2017 | 2040 | Petrol and diesel | New vehicle sales |
| Norway | 2016 | 2025 | Petrol and diesel\* | New vehicle sales |
| Netherlands | 2017 | 2030 | Petrol and diesel | New vehicle sales |
| Germany | 2016 | 2030 | Petrol and diesel | New vehicle sales |
| California,  United States | 2017 | 2040 | Petrol and diesel\*\* | New vehicle sales |
| Mexico City, Mexico | 2016 | 2025 | Diesel | All vehicles |
| Paris, France | 2016 | 2025 | Diesel | All vehicles |
| Madrid, Spain | 2016 | 2025 | Diesel | All vehicles |

Note: petrol = gasoline; \*Norway will be implementing policy changes, not an outright ban, by 2025; \*\*California has set a goal, not an outright ban, for 2040.

Source: Created by the case authors using data from Alex Gray, “Countries Are Announcing Plans to Phase Out Petrol and Diesel Cars. Is Yours on the List?,” World Economic Forum, September 26, 2017, accessed December 12, 2018, www.weforum.org/agenda/2017/09/countries-are-announcing-plans-to-phase-out-petrol-and-diesel-cars-is-yours-on-the-list/; Shehab Kahn, “Germany Pushes to Ban Petrol-Fuelled Cars within Next 20 Years,” *The Independent*, October 10, 2016, accessed December 12, 2018, www.independent.co.uk/news/world/europe/germany-petrol-car-ban-no-combustion-diesel-vehicles-2030-a7354281.html; Ryan Beene and John Lippert, “California Considers Following China With Combustion-Engine Car Ban,” Bloomberg, September 26, 2017, accessed December 12, 2018, www.bloomberg.com/news/articles/2017-09-26/california-mulls-following-china-with-combustion-engine-car-ban; Fiona Harvey, “Four of the World’s Biggest Cities to Ban Diesel Cars from their Centres,” *The Guardian*, December 2, 2016, accessed December 12, 2018, www.theguardian.com/environment/2016/dec/02/four-of-worlds-biggest-cities-to-ban-diesel-cars-from-their-centres.

Exhibit 4: All Pagani Models (Including Special EditionS and Prototypes)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **All Zonda Models (48 in total):** |  |  |  | **All Huayra Models (17 in total):** | | |
| **Model** | **Debut** | **Production Type** |  | **Model** | **Debut** | **Production Type** |
| Zonda La Nonna | 1998 | Special edition |  | Huayra | 2011 | Core |
| Zonda C12 | 1999 | Core |  | Huayra Dinastia | 2014 | Core |
| Zonda S | 2000 | Core |  | Huayra La Monza Lisa | 2014 | Special edition |
| Zonda S 7.3 | 2001 | Core |  | Huayra 730S Edition | 2015 | Special edition |
| Zonda Roadster | 2003 | Core |  | Huayra The King 1 of 1 of 1 | 2015 | Special edition |
| Zonda GR | 2003 | Special edition |  | Huayra Gemini Uno | 2015 | Special edition |
| Zonda Monza | 2004 | Special edition |  | Huayra Scozia | 2015 | Special edition |
| Zonda F | 2005 | Core |  | Huayra BC | 2016 | Core |
| Zonda Roadster F | 2006 | Core |  | Huayra Pearl | 2016 | Special edition |
| Zonda F Clubsport | 2006 | Core |  | Huayra Futura | 2016 | Special edition |
| Zonda Cinque | 2009 | Core |  | Huayra Pacchetto Tempesta | 2016 | Core |
| Zonda Roadster F Final Edition | 2009 | Special edition |  | Huayra Hermès Edition | 2016 | Special edition |
| Zonda PS | 2009 | Special edition |  | Huayra Cento | 2017 | Special edition |
| Zonda R | 2009 | Core |  | Huayra BC Macchina Volante | 2017 | Special edition |
| Zonda Uno | 2010 | Special edition |  | Huayra Roadster | 2017 | Core |
| Zonda Nero | 2010 | Special edition |  | Huayra Lampo | 2017 | Special edition |
| Zonda Roadster Cinque | 2010 | Core |  | Huayra L'Ultimo | 2018 | Special edition |
| Zonda Tricolore | 2010 | Core |  |  |  |  |
| Zonda 750 | 2010 | Prototype |  |  |  |  |
| Zonda Absolute | 2010 | Special edition |  |  |  |  |
| Zonda GJ | 2010 | Special edition |  |  |  |  |
| Zonda HH | 2010 | Special edition |  |  |  |  |
| Zonda RAK | 2010 | Prototype |  |  |  |  |
| Zonda R Evolution | 2012 | Special edition |  |  |  |  |
| Zonda 760RS | 2012 | Special edition |  |  |  |  |
| Zonda 760 LH | 2012 | Special edition |  |  |  |  |
| Zonda 764 Passione | 2012 | Special edition |  |  |  |  |
| Zonda Revolución | 2013 | Core |  |  |  |  |
| Zonda PS MKII | 2013 | Special edition |  |  |  |  |
| Zonda Fantasma | 2013 | Special edition |  |  |  |  |
| Zonda X | 2014 | Special edition |  |  |  |  |
| Zonda LM | 2014 | Special edition |  |  |  |  |
| Zonda JC | 2014 | Special edition |  |  |  |  |
| Zonda 760 | 2014 | Special edition |  |  |  |  |
| Zonda ZoZo | 2015 | Special edition |  |  |  |  |
| Zonda 760 AG Roadster | 2015 | Special edition |  |  |  |  |
| Zonda LM Roadster | 2015 | Special edition |  |  |  |  |
| Zonda Kiryu | 2015 | Special edition |  |  |  |  |
| Zonda 760 VR | 2015 | Special edition |  |  |  |  |
| Zonda MD | 2016 | Special edition |  |  |  |  |
| Zonda by Mileson | 2016 | Special edition |  |  |  |  |
| Zonda Zeus | 2016 | Special edition |  |  |  |  |
| Zonda Oliver Evolution | 2016 | Special edition |  |  |  |  |
| Zonda Viola | 2016 | Special edition |  |  |  |  |
| Zonda HP Barchetta | 2017 | Core |  |  |  |  |
| Zonda Riviera | 2017 | Special edition |  |  |  |  |
| Zonda Fantasma Evo | 2017 | Special edition |  |  |  |  |
| Zonda Aether | 2018 | Special edition |  |  |  |  |

Source: Created by the case authors using data from “The 65 Pagani Cars,” Pagani History, accessed December 12, 2018, www.paganihistory.com/cars.

Exhibit 5: Summary of Competitor Data by Engine Type

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Pure Combustion Engine Vehicles** | | | | | | |
| **Manufacturer** | **Model** | **Acceleration**  **(0–60 mph)** | **Top Speed**  **(mph)** | **Horsepower** | **Production Run** | **Base**  **Price (US$)** |
| Pagani | Huayra Roadster (2018) | 3.0 seconds | 210 | 750 | 100 | $1,600,000 |
| Ferrari | 488 GTB  (2016) | 3.0 seconds | 205 | 659 | Indefinite | $230,000 |
| Lamborghini | Huracán LP 610-4  (2015-2016) | 3.0 seconds | 211 | 610 | Indefinite | $241,945 |
| Lamborghini | Aventador LP700-4  (2012) | 2.9 seconds | 217 | 700 | Indefinite | $387,000 |
| Bugatti | Chiron Sport  (2018) | 2.5 seconds | 261 | 1,479 | 500 | $3,260,000 |
| Koenigsegg | Agera RS  (2015) | 2.5 seconds | 250 | 1,160 | 25 | $1,500,000 |
| **Hybrid Vehicles** | | | | | | |
| **Manufacturer** | **Model** | **Acceleration**  **(0–60 mph)** | **Top Speed**  **(mph)** | **Horsepower** | **Production Run** | **Base**  **Price (US$)** |
| Ferrari | LaFerrari  (2014) | 3.0 seconds | 217 | 963 | 499 | $1,400,000 |
| Koenigsegg | Regera  (2017) | 2.8 seconds | 250 | 1,500 | 80 | $2,000,000 |
| McLaren | P1  (2014) | 2.7 seconds | 217 | 903 | 375 | $1,150,000 |
| Porsche | 918 Spyder  (2015) | 2.2 seconds | 214 | 887 | 918 | $847,975 |
| **All-Electric Vehicles** | | | | | | |
| **Manufacturer** | **Model** | **Acceleration**  **(0–60 mph)** | **Top Speed**  **(mph)** | **Horsepower** | **Production Run** | **Base**  **Price (US$)** |
| Tesla | Roadster  (2020) | 1.9 seconds  (estimated) | 250  (esti-mated) | Not yet known | Indefinite | $200,000  (estimated) |
| Tesla | Model S P90D  (2016) | 2.8 seconds | 155 | 522 | Indefinite | $69,200 |
| Rimac | Concept One  (2011) | 2.8 seconds | 189 | 1,088 | 8 | 980,000 |
| Nio | EP9  (2019) | 2.7 seconds | 195 | 1,341 | 6 | $1,200,000 |

Note: mph = miles per hour

Source: Created by the case authors using data from “About Us,” TopSpeed, accessed December 12, 2018, www.topspeed.com/company/about-us-ar10684.html; “Tesla Model S,” TopSpeed, accessed December 12, 2018, www.caranddriver.com/tesla/model-s; Rachel Burgess, “Rimac’s Second Electric Hypercar: 120kWh Battery and ‘Full Autonomy,’” Autocar, March 1, 2018, accessed December 12, 2018, www.autocar.co.uk/car-news/motor-shows-geneva-motor-show/rimacs-second-electric-hypercar-120kwh-battery-and-full; Georg Kacher, “Nio EP9 (2017) Review,” Car, November 6, 2017, accessed December 12, 2018, www.carmagazine.co.uk/car-reviews/nio/nio-ep9-2017-review/.

**ENDNOTES**

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