

The Policy and Economic Factors Behind the Digitization of Motorsport

Yuqiao Zhao

*The Second High School Attached to Beijing Normal University, Beijing, China
zhaoyuqiao78@gmail.com*

Abstract. As the global consensus on addressing climate change deepens, traditional fuel-powered racing faces enormous pressure from political incorrectness and public opinion. How do global carbon neutrality regulations and the FIA's new competition rules force traditional automakers and race operators to transition toward electrification through constraint mechanisms? Under the dual influence of the ESG evaluation system and racing budget caps, this study adopts a case study approach to explore the following questions: How does the electrification transition in racing affect teams' commercial sponsorship structure and R&D return on investment? What are the pathways of the "spillover effect" from electric racing technology to mass-produced road cars? Why do electric racing series face commercialization bottlenecks even though they are fully compliant with policy and environmental requirements? This paper finds that policy and economic interests are the fundamental drivers of racing electrification. Policy regulation has broken the rules of traditional fuel-powered racing, reduced R&D costs for road cars, and created real economic returns for automakers. ESG capital has become the decisive factor for electric racing. The era of traditional tobacco and petrochemical sponsorship is over, and tech giants and green funds that comply with ESG norms have successfully taken over the commercial landscape of electric racing through large sponsorships.

Keywords: Racing electrification, Carbon neutrality regulation, ESG investment standards, Regulatory economics, Technology spillover effects

1. Introduction

The electrification of the global automobile industry is now widely recognized as an irreversible trend, and it is being driven from multiple directions. Motorsport is no exception. Many racing series entered the electric era quite early, such as TT Zero, founded in 2011, and Formula E, founded in 2014. In 2026, Formula 1, the most influential racing series, will also change its powertrain to 50 percent electric and 50 percent fuel [1]. This decision is significant enough to reshape the structure and technology of F1, and it has already triggered some incidents and considerable controversy. Why take such a risk to change a long-established fuel-powered racing series? Using a case study approach, this paper mainly examines the policy and economic factors behind the electrification of motorsport, and further seeks solutions to make racing safer and better to make the transition smoother.

2. External pressure and administrative regulation

As the global consensus on addressing climate change deepens, traditional fuel-powered racing faces enormous pressure from political incorrectness and public opinion. It is not only the automotive industry that has rapidly become greener in recent years; countries and industries across the board have begun to pay attention to global environmental issues. Among the most serious is global warming caused by greenhouse gases, especially carbon dioxide emissions. Pollution and exhaust emissions from factories and many other industries have been strictly controlled. The public is constantly aware of environmental protection, and many environmental organizations have emerged during this period to guide people toward protecting the environment. Automobile exhaust accounts for a large share of CO₂ emissions. As renewable energy technologies gradually mature and hydrogen-powered and electric vehicles develop, the world is shifting toward electric vehicles. In this environment, if FIA-sanctioned events continued to insist on fuel-powered engines, they would inevitably face public opinion and broad social pressure. For example, during the 2022 F1 British Grand Prix, several members of the radical environmental group Just Stop Oil broke through safety barriers, rushed onto the high-speed track, and sat down on the racing surface in protest. The incident instantly spread through global media, forcibly linking "motorsport" with "destroying the earth" and creating devastating public relations pressure for the FIA, F1 management, and sponsors. According to a global motorsport fan survey by Nielsen Sports and Motorsport Network, more than 72% of young viewers aged 18-24 believe that "sports events must have a strong sense of environmental responsibility," and this group's brand favorability toward traditional fuel-powered vehicles has declined significantly over the past five years [2]. In reality, however, the direct carbon emissions produced by all cars burning gasoline during a race account for only 0.7% of the total emissions of the event, while the remaining 99.3% comes from international logistics and transport (45%), business travel by personnel (27.7%), and factory and R&D operations (19.3%) [3]. Therefore, even though motorsport itself does not have a very large direct impact, public opinion has exerted great pressure on F1.

In addition to environmental pressure, the external coercive force imposed by government macro-regulations is also an important factor. Several major global automobile markets, including the European Union, the United Kingdom, China, and some U.S. states, have successively enacted "internal combustion engine vehicle bans." If motorsport continued to use purely fuel-powered engines, racing technology would become completely disconnected from the civilian automobile market. In 2023, the European Union passed legislation requiring that from 2035, all new vehicles sold within the EU must achieve zero carbon emissions (100% zero emissions), fully banning the sale of new purely fuel-powered and ordinary hybrid vehicles. These timetables (2030-2035) require automakers to complete their electrification R&D deployment during the 2020s, and because racing technology cycles usually lead mass-produced vehicles by three to five years [4], the FIA must revise its technical access rules in advance. As the highest governing body of global motorsport, the FIA must translate countries' "dual carbon goals" into competition technical access rules to prevent motorsport from being marginalized.

3. Capital restructuring and technology monetization

In addition to external factors and government policies, economic factors have played a decisive role in the transformation of racing. ESG standards consist of E—environmental, S—social, and G—governance. The CSRD is a mandatory law introduced by the European Union. It requires large and medium-sized enterprises operating in the EU to compulsorily disclose ESG data in accordance with

unified standards, so as to prevent companies from pretending to be environmentally friendly. Together, these two mechanisms ensure strict control over automakers. To force companies to provide real ESG data, the EU's CSRD mainly relies on Scope 1, Scope 2 and Scope 3 emissions to ensure the authenticity of corporate environmental performance [5]. Scope 1 covers emissions from facilities that a company directly owns or fully controls. For example, if a chimney or exhaust pipe is located on your plant site, the gases burned and emitted from it are Scope 1. Scope 2 refers to indirect emissions from purchased energy, meaning the emissions produced by the power plants or heating stations that generate the energy a company buys for its own use. Although the carbon is not directly burned in your office or factory, it is attributed to you because you consume that energy. Scope 3 is divided into upstream and downstream emissions. Upstream emissions are the indirect emissions generated by the front end of the supply chain—suppliers and their own upstream suppliers—when a company purchases materials, services, and related activities to maintain daily operations, produce goods, or provide services. Examples include carbon emissions from the extraction and processing of raw materials such as steel, chips, and cotton. Downstream emissions are the indirect emissions generated in the second half of the product life cycle after a company's products or services are sold, during distribution, use, and final disposal, such as emissions produced when products are dismantled, recycled, landfilled, or incinerated after reaching the end of their service life. These strict requirements make it difficult for companies to cut corners or engage in greenwashing.

The Sustainable Finance Disclosure Regulation (SFDR) is a regulation introduced by the European Union in 2021 to regulate financial markets. It divides financial products into three categories: grey funds, light green funds, and dark green funds, corresponding to sustainability capacity from weak to strong [6]. In grey funds, ESG factors are basically not considered in investment decisions, or only the most basic risk assessment is conducted, with no commitment to any green objectives. In light green funds, products promote environmental or social characteristics, but greenness is not their only objective; such funds exclude comprehensive equity funds with high-polluting enterprises. In dark green funds, sustainable investment is the core objective, and clear quantitative indicators must be established. In addition, institutions and financial institutions must publicly disclose on their official websites how they assess sustainability risks when making investment decisions. For products, they must disclose in detail the actual green content of the product in pre-contractual documents and periodic reports. SFDR forces financial institutions to use these data to show investors who buy funds exactly how green they are. Under these circumstances, dark green funds must invest 100% in enterprises that meet sustainable objectives, which causes a large amount of dedicated capital to be able to buy only stocks and bonds of companies in sectors such as photovoltaics, wind power, energy storage, and the circular economy. Moreover, enterprises with excellent ESG performance can not only raise equity capital more easily through IPOs or additional share issuances, but can also issue green bonds or sustainability-linked loans at lower interest rates. Because enterprises with good ESG performance are more likely to be included in the holdings of various ESG funds, their stocks have higher liquidity and lower volatility, and the market is willing to give them a higher price-to-earnings premium. Conversely, if a company discloses extremely high carbon emissions in its CSRD report and has no emission reduction plan, asset management companies will forcibly exclude or reduce holdings of that company's stock in order to maintain the light green or dark green label of their funds, or to reduce PAI (Principal Adverse Impact) indicators. Under pressure to disclose the carbon footprint of their portfolios, banks and bond funds will raise loan interest rates for high-polluting enterprises, or even directly refuse to provide financing to projects without a clear carbon transition roadmap. If a company does not pay

attention to low-carbon transition, even if its current profits are high, investors will worry that it will face high carbon tariffs, fines, or stranded asset risks in the future, and will therefore discount it in valuation models. In general, these regulations give green enterprises an advantage in investment markets, while companies that are not green or that engage in greenwashing suffer negative impacts in terms of capital and market access. For enterprises, greenness is no longer merely a form of public welfare or social responsibility publicity, but a matter of survival concerning whether they can obtain money and at what cost.

With the current trend toward vehicle electrification, major automakers are moving toward electric vehicle manufacturing. If racing can also be electrified accordingly, then electric racing can feed extreme test results back into civilian vehicles, reducing mass-production R&D costs and battery costs. Racing pursues extreme performance, extreme efficiency, and extremely high reliability. The electric motors, batteries, electronic control systems, and thermal management systems in racing cars all need to operate under extreme conditions, such as very high temperatures and rapid acceleration and deceleration. This environment can expose all technical shortcomings in a very short period. Once a technology matures in the racing field, its achievements naturally "spill over" into civilian vehicle R&D. The experience, algorithms, and data accumulated through racing development in turn help the development of ordinary household vehicles. There are many successful cases. When Jaguar participated in Formula E, its engineers developed a highly efficient energy management and thermal control algorithm. During races, drivers use this algorithm to fine-tune battery discharge and brake recovery strategies to achieve the fastest speed with the least amount of electricity. Jaguar did not ask owners of its civilian electric vehicle, the I-PACE, to replace batteries or upgrade hardware. Instead, it directly packaged the battery thermal management algorithms and kinetic energy recovery logic iterated over several years by its FE racing team into a software upgrade package. Without the extremely demanding limit data obtained from racing as a foundation, redeveloping this optimization algorithm and testing its reliability in the laboratory would have required millions of euros in testing expenses and several years of time [7].

4. Commercial choices and competing technical routes

However, the process of automakers transitioning to electrification has not been very smooth. If they do not follow policy and ESG requirements, they will face huge carbon emission fines, be unable to enter certain markets, and may even be dumped by investors in capital markets. At the same time, electric vehicles are currently generally facing price wars and high-cost pressure, while the mature fuel vehicle industrial chain is the product that continuously contributes profits and cash flow at present. Except for a very small number of pure electric vehicle manufacturers, the pure electric businesses of most traditional automakers are loss-making in the early and even middle stages. The high gross margins and mature supply chain of fuel vehicles are the source of funds for developing new platforms, software, and battery technology. Engine plants, transmission plants, and tens of thousands of traditional component workers are all heavy assets that cannot be shut down quickly. Forced closure would cause huge asset impairment and social costs. Different companies have adopted different strategies in response. Many automakers have chosen to divest fuel assets and share R&D costs. For example, Geely and Renault established a joint venture, HORSE [8], to separately carve out and merge their respective internal combustion engine and hybrid powertrain operations. By sharing fuel powertrain plants with peers, they can expand economies of scale and reduce unit production costs, while allowing the parent companies to disengage and focus on intelligent and electric technologies. Other companies adopt mixed-line production. In plant construction and platform development, automakers avoid blindly investing heavily in single-

purpose factories for electric vehicles. Instead, they adopt flexible production, so that one production line can handle fuel vehicles, hybrid vehicles, and pure electric vehicles. When the electric vehicle market slows or policies are rolled back, production capacity can be quickly switched back to fuel or hybrid vehicles, greatly improving capital resilience against risk.

In motorsport, Formula E and Formula 1 represent two completely different route choices: pure electric and strong hybrid. When automakers choose which series to participate in, they essentially weigh three dimensions: compliance, spectator appeal, and technology transfer. Formula E is the world's first international single-seater racing series to receive net-zero carbon certification. Because it has no engine noise or exhaust emissions, FE races can be held directly on the streets of major city centers such as New York, London, and Tokyo [9]. Traditional Formula 1, by contrast, relies on high-revving fuel engines and has long been labeled as high-carbon-emitting. To meet global sustainability policies, F1 has adopted extremely efficient V6 turbo-hybrid engines and has committed to using 100% sustainable synthetic fuel from 2026 onward, so as to achieve carbon neutrality compliance while retaining internal combustion engine technology [10]. For F1, although its R&D budgets are extremely expensive, its enormous global exposure can bring immeasurable brand premiums to automakers, such as Red Bull, Ferrari, and Mercedes. Automakers fully committed to pure electric technology tend to choose FE. They can quickly establish a green and low-carbon image at relatively low cost, while rapidly transferring track-validated electronic control algorithms to civilian pure electric models. Automakers that retain hybrid technology tend to choose F1. Through F1, they can demonstrate their top-level capabilities in strong hybrid and sustainable fuel technologies, satisfying ESG carbon reduction pressure while continuing to provide brand endorsement for their high-margin fuel and hybrid product lines. However, the technical and strategic changes brought by hybrid power to racing will be a difficult challenge. In the 2026 F1 rules, the increased role of electric motors and energy recovery means that performance generally depends less on driver ability and more on car performance and team strategy, which has triggered extensive public discussion and led many people to criticize the FIA's reforms.

First, global carbon neutrality targets and government policies constitute powerful external constraints. In order to maintain the social legitimacy of the sport, the FIA has had to revise its technical rules, which constitute the mandatory starting point of the electrification transition in racing. Second, the rules of the game in capital markets have changed. Under ESG investment standards, multinational corporations and financial institutions are more inclined to sponsor green and low-carbon events. To survive and obtain high-value sponsorship funds, teams must follow this trend and carry out an electrification transformation to maintain commercial sustainability. Finally, as an extreme testing platform, the three-electric systems and kinetic energy recovery algorithms validated in racing can directly feed back into the R&D of civilian electric vehicles. This not only shortens the R&D cycle for mass-produced vehicles, but also improves automakers' market competitiveness by reducing battery costs. By comparison, at the current stage, the hybrid route better balances commercial spectator appeal and policy compliance than the pure electric route. In the future, the FIA should pay more attention to improving the coordination between fuel and electric power and refining the rules, rather than forcibly merging the two types of racing series.

5. Conclusion

The electrification and hybrid transition of motorsport is the inevitable result of the combined effects of external policy constraints, the restructuring of capital logic, and industrial technology spillover. Global carbon neutrality targets and the stringent environmental policies of various countries constitute an irreversible external boundary. To maintain the social legitimacy and contemporary

relevance of the sport, the Fédération Internationale de l'Automobile (FIA) has been forced to trigger a deep reshaping of technical rules. This not only constitutes the mandatory starting point for the transition of motorsport to new energy, but also defines the future development tone of the racing industry. The underlying rules of the game in capital markets have profoundly changed. Guided by Environmental, Social, and Governance (ESG) evaluation standards, multinational corporations and financial institutions are more inclined to direct sponsorship budgets toward low-carbon and green events. To ensure their own survival and compete for scarce high-value sponsorship resources, teams must carry out electrification upgrades in line with this trend, so as to maintain the long-term healthy operation of the commercial ecosystem. As an extreme technological testing platform, the "three-electric" systems and high-efficiency kinetic energy recovery algorithms validated under extreme conditions in racing can directly feed back into the R&D of civilian electric vehicles. This "track-to-street" technological spillover not only significantly shortens the development cycle of mass-produced models, but also reduces battery and system costs through large-scale technology application, thereby enhancing the comprehensive market competitiveness of automakers. Overall, when juxtaposed with the inherent constraints of the pure electric paradigm at the current stage, including range limitations and the absence of engine auditory characteristics that define traditional motorsport, the hybrid route establishes a more feasible equilibrium. This balance successfully reconciles the preservation of racing's commercial spectator allure with the satisfaction of evolving policy compliance mandates.

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