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Impact of 2026 FIA technical regulations on Formula 1 power units, aerodynamics and energy management

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The year 2026 will bring significant changes to the regulations that will affect the technological challenges in Formula 1. The predicted impact on vehicle design and performance changes compared to the current season was evaluated. Special attention was paid to increasing the share of ecology, which affects the importance of electric power in vehicles, and is also reflected in the introduction of sustainable fuels, redesigned power units, active aerodynamic systems, and reduced body weight. These changes are analyzed for their impact on aerodynamic efficiency, vehicle dynamics, and energy management strategies. Based on technical data, information, and predictions, changes can be determined to adapt the cars to evolving restrictions in areas such as energy recovery, electric power usage, and aerodynamic balance. The analysis shows the growing role of precise design and integrated system optimization in achieving competitive results. The article highlights how the updated regulations strengthen the direction Formula 1 is heading in: greater efficiency, sustainability, and technological advancement.

Key words: *Formula 1, hybrid power units, sustainable fuels, combustion engines, energy recovery system*

1. Introduction

Formula 1 has been constantly evolving since its very first season, adapting to new technological, sporting, and environmental demands. Changes introduced to the power units have always been at the core of this evolution, effectively setting the direction for the sport's development over the decades [10]. Over the years, power units have transformed dramatically, from large, high-revving naturally aspirated engines to today's highly integrated hybrid constructions – Fig. 1.

The FIA has gradually implemented increasingly strict regulations concerning not only engine power, but also displacement and overall configuration [36]. These adjustments were driven by safety considerations and growing environmental priorities, which, in recent years, have become among the most influential factors shaping the future of motorsport. Figure 1 presents a comparison of power output and engine displacement used in Formula 1 over the past decades. A clear downward trend in engine capacity is visible, accompanied by a gradual increase or stabilization in maximum power. Early engine designs featured larger displacement but delivered relatively lower power [33]. Over time, as turbocharging technologies and later hybrid systems developed, power output increased despite reduced displacement.

The cyclical fluctuations observed in the chart reflect regulatory changes introduced by the FIA, which imposed limits on both power and engine configuration. The highest power levels were achieved during the turbo era of the 1980s, while current hybrid units, despite having the smallest displacement in F1 history, offer high efficiency and comparable performance thanks to the integration of energy recovery systems. Engineers continuously work on advanced technologies that influence the speed, reliability, and overall sophistication of Formula 1 cars. Innovations are tested and developed under extreme conditions, enabling them to reach technological maturity rapidly. Many solutions originally created for Formula 1 later find their application in road vehicles.

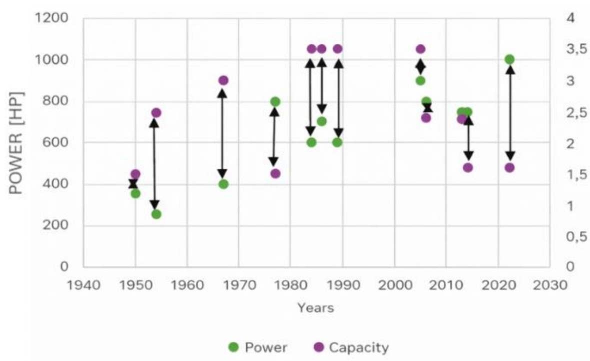


Fig. 1. A depiction of the power of racing cars over the years [32]

Moreover, F1 has a significant impact on the development of artificial intelligence and data analysis methods (Fig. 2) [30].

Fig. 2. Telemetry list [39]

The enormous amount of information collected by the cars during race weekends enables the refinement of telemetry systems and analytical tools [30]. This enables real-time monitoring of tyre condition, battery energy levels, braking forces, and other parameters essential to vehicle performance.

This article discusses the key changes that will be introduced in the 2026 season and compares them with the solutions used in current car designs [8]. The technical regulations presently in force were implemented in 2022 [9], and since then, Formula 1 cars have been continuously refined to improve both performance and reliability.

Overall, the historical evolution of power units and racing technology in Formula 1 clearly reflects the three engineering pillars highlighted in this article's title. **Speed** is increasingly shaped not only by engine performance but also by advances in aerodynamics, which determine how effectively the available power is translated into lap time. **Heat** relates to the ongoing energy transition in Formula 1, where fuels (soon fully synthetic) play a central role in meeting environmental targets. This direction is directly aligned with one of the sport's key long-term objectives: achieving **net-zero emissions** while maintaining the performance standards expected of the series. Finally, **Precision** captures the complexity of modern power units and hybrid systems, supported by advanced telemetry and data analytics that allow engineers to fine-tune every detail of the car's operation.

The following sections develop each of these themes, showing how they collectively define the engineering core of contemporary Formula 1.

2. Speed

2.1. Structural evolution of Formula 1 cars

One of the main objectives of the new regulations was to address a long-standing issue in Formula 1: the difficulty of following another car at close range. This problem significantly limited overtaking opportunities and often prevented drivers from mounting a proper attack. The root cause lay in the 2021 car design, where downforce was distributed evenly between the front, the floor, and the rear of the car approximately 33% each – Fig. 4.

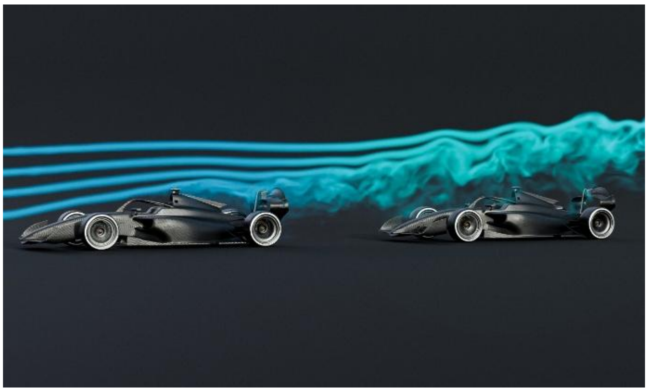


Fig. 3. Air flow representation [1]

With such a distribution, airflow disturbed by the leading car resulted in a substantial loss of front-end grip for the following driver. It is estimated that in turbulent air a car could lose up to 46% of its aerodynamic downforce [31]. This led to understeer, which, in turn, contributed to tyre overheating and accelerated tyre degradation – Fig. 3.

The turbulent wake generated by the rear of the leading car also reduced the effectiveness of the trailing car's front wing [6], further compromising stability and the ability to follow closely.

Since 2022, the role of the wings has been reduced, with greater emphasis placed on managing airflow beneath the car's floor. A simpler and more controlled aerodynamic structure was introduced, and the downforce distribution was adjusted accordingly: 25% at the front, 50% generated by the floor, and 25% at the rear – Fig. 4 [29].

The use of ground effect significantly reduced downforce loss in turbulent air, from approximately 46% in 2021 to around 10% in current designs.

Aerodynamics has always been a key factor in determining a Formula 1 car's performance. As technical regulations evolved, the approach to managing airflow around the vehicle changed repeatedly, from aggressive designs that generated extreme downforce to more regulated yet highly refined concepts used today. Each regulatory shift affected the balance between top speed, cornering stability, and the overall efficiency of using the available power.

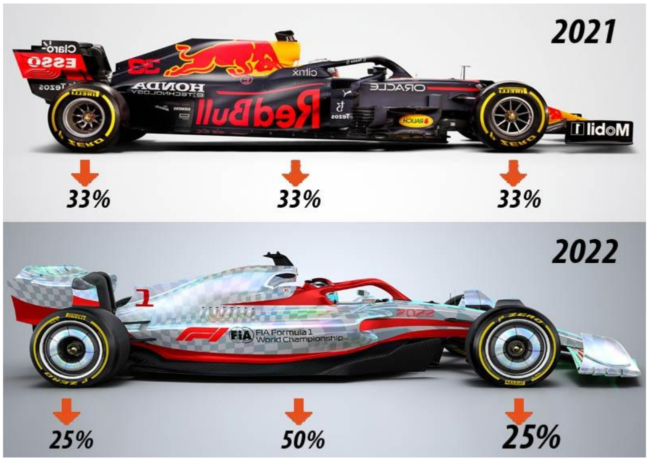


Fig. 4. Presentation of the pressure force distribution [42]

Structurally, one of the greatest challenges has been maintaining the car's minimum weight, including the driver. Modern Formula 1 cars are relatively heavy; according to regulations introduced in 2022, the car with the driver but without fuel must not exceed 798 kg [5]. For comparison, in 2005, cars were almost 200 kg lighter – Fig. 5.

The increase in weight has clear causes. Heavier and more advanced braking system components were introduced, and to a lesser extent, changes to the power unit also contributed to the weight gain. Additionally, the monocoque and impact structures had to be reinforced to meet far more stringent crash-test requirements [28].

Another challenge faced by car designers was modifying the vehicle's dimensions. Although the overall width of the car remained unchanged, the front wing was narrowed from 2000 mm to 1950 mm in accordance with the new regulations, ensuring that it no longer aligned with the outer edges of the front wheels [45].

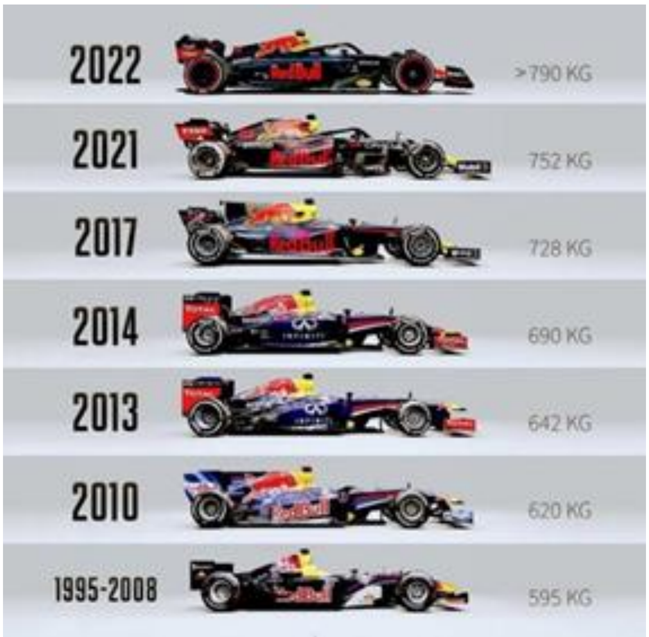


Fig. 5. Weight of F1 cars over the years [19]

Fig. 6. Comparison of F1 car lengths over the years [7]

The new homologation procedures include more severe frontal, side, and rear impact tests, with higher collision speeds and higher energy-absorption thresholds. The chassis must maintain cockpit integrity under significantly greater loads than before, which requires additional composite layers and a strengthened structural design. As a result, driver safety has improved substantially, although at the cost of additional mass.

The car's length was also revised. Since the 2022 season, the maximum wheelbase has been limited to 3600 mm – Fig. 6. Previous regulations did not specify such a restriction, resulting in cars becoming shorter by several to over a dozen centimetres compared to earlier designs.

The 13-inch tyres used until the 2021 season were replaced with 18-inch tyres, which required the design of larger wheels and adjustments to the suspension layout. The current tyre diameter is 720 mm, making it 60 mm larger than the previous specification. The wheel widths, however, have been retained: 305 mm at the front and 405 mm at the rear – Fig. 7 [22].

The shift to larger tyres also necessitated changes to both the suspension components and the braking system. The updated regulations introduced new brake disc specifications – the number of cooling holes was reduced, and although the disc diameter was increased, its overall mass also rose. This reduced heat dissipation efficiency, making the brakes more prone to overheating during a race.

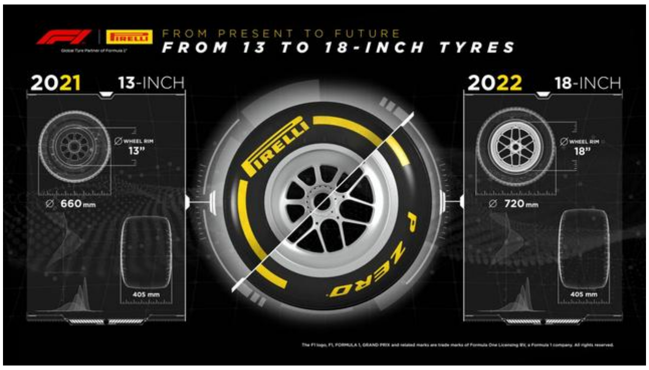


Fig. 7. Comparison of 13-inch and 18-inch tires [23]

The changes made to the tyres directly influence the evolution of the car's handling characteristics. They make the car more challenging to control at the limit and require the driver to adapt their driving style, particularly in braking behaviour and tyre temperature management [41].

The wheel covers introduced in 2022, designed to enclose the rims – Fig. 8, also serve an important aerodynamic purpose. They reduce airflow turbulence generated by the rotating wheels, which reduces the disturbed wake behind the car and improves the ability to follow another vehicle closely.

Fig. 8. The McLaren team uses hubcaps to promote their sponsor [25]

The structural changes introduced in recent years show that Formula 1 is gradually moving toward closer racing, greater safety, and more predictable on-track behaviour. The return of ground effect, simplified aerodynamics, and the planned introduction of active aero all reshape how downforce is generated. At the same time, new requirements for weight, dimensions, and tyres affect how the car responds to loads and how it handles in corners. In practice, it is a continuous search for the right balance between performance and stability - an evolution of the car's architecture driven by the needs of modern Formula 1.

2.2. Changes in aerodynamics

Aerodynamics has undergone a similarly dynamic transformation. Since the 1970s, Formula 1 has oscillated between periods of extreme downforce generation, often followed by regulatory clampdowns introduced for safety reasons. Ground-effect cars, high-downforce sculpted bodywork, blown diffusers, and later, energy-efficient aero regulations all illustrate how the aerodynamic philosophy of F1 has repeatedly shifted in response to performance, safety, and regulatory constraints. The current technical regulations focus primarily on changes implemented in the central section of the car, where the number of aerodynamic components has been significantly reduced. This redesign enabled the reintroduction of ground effect into Formula 1 in 2022 [24]. The underbody concept is based on controlled external airflow, allowing air to move both beneath and above the vehicle and directly influencing the car's aerodynamic characteristics.

At the rear, a large diffuser has been installed, whose main function is to expand the airflow exiting the floor. This solution maximizes ground effect and enables the car to generate stable, predictable downforce.

In 2026, Formula 1 will introduce active aerodynamics [2], intended to support energy management, an essential requirement due to the characteristics of the new power units. Both the front and rear wings will feature movable elements, enabling higher cornering speeds and improved straight-line performance. The rear wing will consist of three segments – Fig. 9. At the same time, the *beam wing, the lower aero profile located beneath the main rear wing*, will be removed, and the side elements will be simplified.

Fig. 9. 2024 vs 2026 rear wing comparison [20]

The front wing, consisting of two movable flaps, will be narrowed by 100 mm. The wheel covers will also be removed and replaced with new side-section elements designed to reduce the turbulence generated by the front wheels. The car's floor will be partially flat, and the diffuser will be reduced in size and simplified [8], in order to limit ground effect and decrease the need for extremely low ride heights and very stiff suspension setups – Fig. 10.

Fig. 10. Projected car design [16]

The changes introduced in 2026 will affect the aerodynamic characteristics of the cars. Downforce is expected to decrease by around 30%, while aerodynamic drag will be reduced by 50%.

The 2026 regulations simplify key aerodynamic elements, reduce ground effect, and introduce active aero to better manage the car's performance.

2.3. Comparison of car dimensions: 2022 vs. 2026

The new technical regulations introduce changes not only to the power unit but also to the car's bodywork. The cars' dimensions will be reduced to improve agility. The maximum wheelbase will decrease from 360 cm to 340 cm, and the overall width will be reduced by 10 cm to 190 cm. Additionally, the floor width will be limited to 150 mm – Fig. 11.

These dimensional changes aim to achieve a new minimum weight of 768 kg, 30 kg lower than the current value. Calculations indicate that the car with the driver will weigh 722 kg, while the tyres will account for the remaining 46 kg. The wheels will also be narrowed while retaining their 18-inch diameter; their width will be reduced by 25 mm at the front and 30 mm at the rear [46].

Fig. 11. Comparison of the dimensions of the 2022 and 2026 cars [43]

3. Heat – sustainable fuels

One of the key factors shaping the thermal behaviour of the power unit is the type of fuel it uses. The shift toward sustainable fuels directly affects combustion characteristics, heat generation, energy efficiency, and overall engine performance. For this reason, alternative fuels naturally fall under the *Heat* category, which defines how future Formula 1 engines will manage and convert thermal energy.

Sustainable fuels are still an emerging technology, but one with significant potential for development [17]. The new regulations give engine manufacturers considerable freedom, while simultaneously requiring them to use sustainable fuels that meet specific parameters. At present, there are two main production pathways: synthetic fuels and second-generation biofuels.

A key characteristic of sustainable fuel is its environmentally neutral lifecycle, from production to combustion. In contrast, today's fuels are derived from crude oil, and their extraction, refining, and burning all generate substantial emissions [34]. Since 2023, teams have been using fuel containing 55% bio-component content, but starting in the 2027 season, only fully synthetic, 100% sustainable fuel will be permitted – Fig. 12. Biofuels are fuels produced from biological materials such as crops, microorganisms, wood, and various types of waste. First-generation biofuels were the earliest category developed and relied mainly on food-based feedstocks such as corn, jatropha, or used cooking oils. Their use raised significant concerns, as diverting food crops for fuel production created ethical issues, affected livestock feed availability, and contributed to global food supply challenges. Second-generation biofuels, on the other hand, are produced from non-food biomass and biological waste. Formula 1 selected this type of biofuel because its production relies on materials that do not compete with food supply, including waste from the food industry, residual oils, straw, and wood. This approach is far more sustainable, making second-generation biofuels the preferred foundation for fuel development in F1 [11].

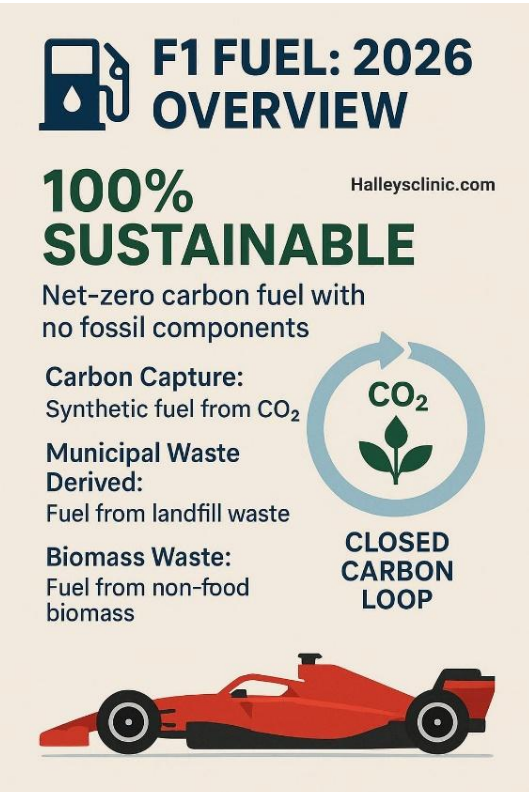


Fig. 12. Sustainable fuel in Formula 1 [14]

Synthetic fuels, also referred to as e-fuels or electrofuels, are produced by chemical processes that combine carbon dioxide captured from the atmosphere with hydrogen produced by water electrolysis [38]. The production of e-fuels requires significant electrical energy, which is why renewable energy sources are used to ensure the overall process remains environmentally neutral [4].

By capturing CO_2 directly from the atmosphere, the system forms a closed carbon loop: the amount of CO_2 released during combustion is offset by the CO_2 used to produce the fuel [18]. As a result, the use of e-fuels does not increase the total concentration of CO_2 in the atmosphere – Fig. 13.

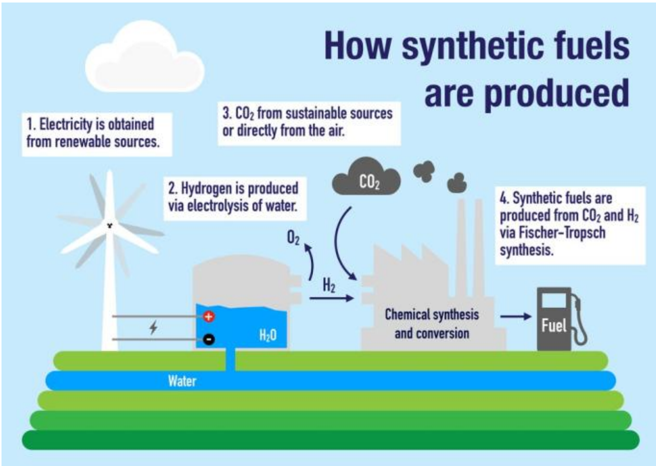


Fig. 13. Synthetic fuel production scheme [13]

Although sustainable fuels differ in their production pathways, their combustion properties share several key characteristics that influence engine behaviour. One of the most relevant parameters is energy density. Bioethanol, commonly used as a reference bio-component, has an energy density up to ~33% lower than conventional gasoline, which naturally increases fuel consumption for the same engine load [13]. Biodiesel, in contrast, remains closer to fossil diesel, with only around 8–10% lower energy content [13]. Synthetic fuels typically fall within a similar range: depending on the production method and carbon chain structure, their energy density may be comparable to advanced biofuels, although still lower than that of traditional fuels [35].

For Formula 1, this means that performance gains will not come from higher fuel energy content but rather from optimizing combustion parameters, ignition timing, and thermal management for the new fuel chemistry. The move to 100% sustainable fuels, therefore, shifts the engineering focus toward efficiency and precision in the combustion system rather than relying solely on the fuel's intrinsic energy potential.

4. Precision: engine

The power unit belongs in the *Precision* section because its performance depends on exact control of combustion, energy recovery, and thermal management. The precision required to synchronize the internal combustion engine with the electrical systems, along with the constant data-driven adjustments made during operation, make the power unit one of the most complex and finely tuned components of the entire car.

The influence of sustainability and environmental goals has been evident in Formula 1 since 2014, when hybrid power units were introduced [37]. Starting in 2026, the FIA is taking another major step forward. Electrical energy will be required to account for 50% of the power unit's output – Fig. 14, meaning that electric and mechanical energy will be used in equal proportion [35].

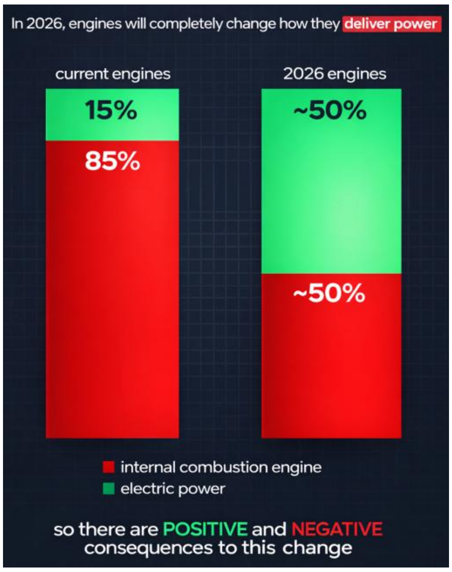
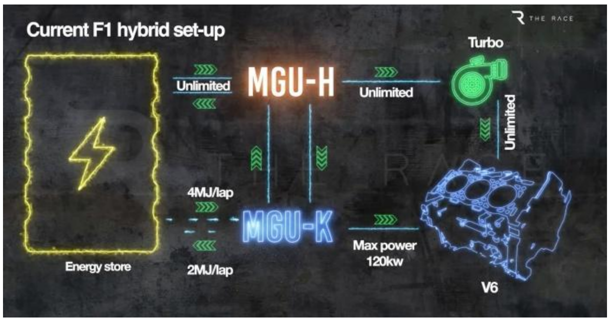


Fig. 14. The share of electricity in Formula 1 [40]

a)



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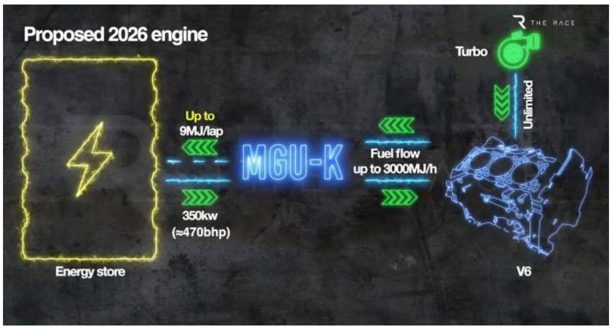

Fig. 15. Comparison of current and 2026 hybrid power unit configurations: a current F1 hybrid system layout, including the MGU-H, a) 120 kW MGU-K and unrestricted turbo operation; b) proposed 2026 power unit layout, without the MGU-H, featuring an increased 350 kW MGU-K and updated limits on energy deployment and fuel flow [21]

The 2026 Formula 1 car will debut with a newly designed power unit, in which the output of the internal combustion engine and the electric motor will be almost evenly balanced. This shift eliminates the MGU-H system and significantly increases the MGU-K's power to 350 kW, or roughly 469 HP – Fig. 15 [12].

The removal of the MGU-H is the most significant change introduced in the new power units. The way the engine generates power will change substantially, although the total output is expected to remain slightly above 1000 HP. The role of electrical energy will increase dramatically. The MGU-K is set to deliver around three times the power of 2025, from 120 kW to 350 kW [44], while the internal combustion engine will run on fully sustainable fuel. Its output will gradually decrease in proportion to the growing contribution of electrical energy [47].

However, the new power unit will be considerably heavier. The MGU-K will increase in mass from 7 kg to 20 kg, while the battery will grow from approximately 20–25 kg to a minimum of 35 kg. Despite removing the MGU-H, which saves about 4 kg, changes to other components increase the total engine weight from 151 kg to 185 kg.

Table 1. Comparison of the weight of the drive units [8, 9]

Parameter	Current engine	From 2026
Engine	~100 kg*	130 kg*
MGU-K	7 kg	20 kg**
MGU-H	4 kg	–
Battery	20–25 kg	35 kg
Total minimum weight	151 kg	185 kg
* together with the turbocharger		
** 16 kg MGU-K and 4 kg mechanical transmitter		

The updated regulations introduce two primary power unit operating modes: the standard mode mode *x* and the override mode mode *y* – Fig. 16 [3].

Fig. 16. Differences between the new engine modes [26]

In standard mode, the car may deliver the full electric output of 350 kW (476 HP) up to a speed of 290 km/h. Beyond this point, the permitted electrical energy gradually decreases, reaching 105 kW as long as the speed does not exceed 339 km/h [27]. From 340 km/h, the electric power is capped at 105 kW, and once the car surpasses 345 km/h, electrical deployment becomes unavailable. Based on the FIA's published values, the maximum speeds are expected to remain similar to those achieved today.

The override mode operates similarly but at higher speeds. Full electric power will be available up to 337 km/h, after which it will be progressively reduced until the car reaches 355 km/h. Above this threshold, electrical energy may no longer be deployed.

The 2026 power unit marks one of the biggest structural shifts in modern Formula 1. With the removal of the MGU-H, a tripled MGU-K output, and an equal 50–50 split between electric and mechanical energy, the new system relies far more on precise energy management than raw engine power. Although the total output will remain just above 1000 hp, the way this performance is generated becomes much more complex, demanding exact control of deployment, recovery, and thermal behaviour. The increased weight of key components and the introduction of two operating modes further underline how dependent future power units will be on accuracy and data-driven optimisation making precision the defining element of the 2026 engine architecture.

5. Summary

In 2022, major aerodynamic regulations were introduced to improve on-track racing and reduce the negative impact of dirty air generated by the cars. The key updates included:

- the return of ground effect – most of the downforce is generated by the floor rather than complex upper-body aero
- simplified front and rear wings – to reduce turbulence and make following another car easier
- 18-inch tyres – offering greater durability and improving race strategy.

The V6 Turbo Hybrid engines used from 2014 to 2025 produce around 1000 HP, with approximately 850 HP from the internal combustion engine and 150 HP from the MGU-K. The total weight of the power unit increased to 151 kg due to the addition of advanced electrical components and batteries.

Key technical limitations include:

- fuel-flow limit of 100 kg/h
- fuel mass limit of 110 kg per race
- engine speed capped at 15,000 rpm
- mandatory use of E10 fuel containing 10% biocomponents.

A major technological shift will take place in 2026 – Fig. 18. The most important changes include:

- removal of the MGU-H – simplifying engine architecture and reducing costs
- increasing MGU-K output to 350 kW (469 HP) – electric power will account for 50% of the total output
- introduction of fully synthetic fuels – reducing CO_2 emissions and encouraging competition between fuel suppliers
- reducing car weight to 768 kg – through updated dimensions and new materials.

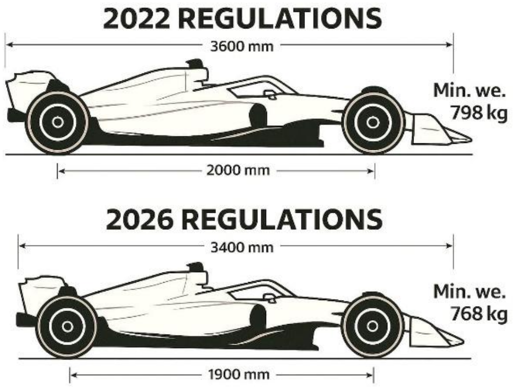

Fig. 18. Comparison of the 2022 and 2026 cars [15]

Active aerodynamics and engine operating modes: Future cars will feature active aerodynamics, with movable front and rear wings that automatically adjust based on speed and race strategy. The FIA will also introduce two operating modes for the power unit:

- standard mode X: full electric power available up to 290 km/h, gradually reduced beyond that point
- override mode Y: short bursts of increased power for overtaking, with deployment limited to speeds below 355 km/h.

Together, these updates aim to improve the racing spectacle and accelerate the transition toward more sustainable technologies. Changes Formula 1's position as a key technological testbed for future road-relevant propulsion systems, accelerating innovation in hybridisation, energy recovery and sustainable fuels.

Nomenclature

AI	artificial intelligence
E10	ethanol 10% fuel
ERS	energy recovery system
FIA	Fédération Internationale de l'Automobile
ICE	internal combustion engine
MGU-H	motor generator unit – heat
MGU-K	motor generator unit – kinetic

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