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WRC 2022 regulation changes

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1 Introduction

1.1 Justification

The world rally championship (WRC) has faced many mixed reviews since the decision to take the sport in a new direction with the introduction of hybrid technology and changes to regulations. The purpose of this report is to look at that the key changes introduced at the start of the 2022 season.

1.2 Aims

This report aims to look at the affects each of the new features introduced since 2022.

1.3 Objective

The objectives of the report are to look at the environmental impacts, performance impact on the cars, the new safety measures being implicated.

2 Background

Over the last couple of years, the WRC has faced some troubles with the regards to the sustainability and outlook of the sport, with only 3 main manufactures currently competing, after Citroen's withdrawal in 2019. For the 2022 season the WRC introduced some of the biggest changes ever seen in the history of the sport. The main changes for 2022 was the introduction of hybrid technology, a new sustainable fuel as well as an all-new safety cell for the cars.

2.1 2022 WRC cars overview

The 2022 cars use the 1.6 turbocharged in line 4 engine as used in the previous generation of cars but with a return to the stick operated sequential gearbox, the centre differential has also been removed and the aerodynamics have been dialled down. (Toyota GR YARIS Rally1 Ready For The WRC Hybrid Revolution | Journal Online, no 2022) They also have a new compact hybrid system, which consists of a 3.9 kWh battery. To save weight and space the battery and electric motor are housed together and are mounted transversely in the centre of the car ensuring the extra weight doesn't upset the balance of the car. The motor is connected to the cars rear differential via a separate prop shaft which allows the teams to retain the 4 wheel drive system.((48) WRC HYBRID  EXPLAINED | Puma  Hybrid Rally1 Powertrain  Explained | #MSPORTERS - YouTube, 2022) To keep the development costs to a minimum and ensure that all the cars have the same power output all

competitors must use the same hybrid units developed by compact dynamics. In addition, all the manufacturers must use 100% synthetic fuel to power their cars.

3 Discussion

3.1 Environmental impact

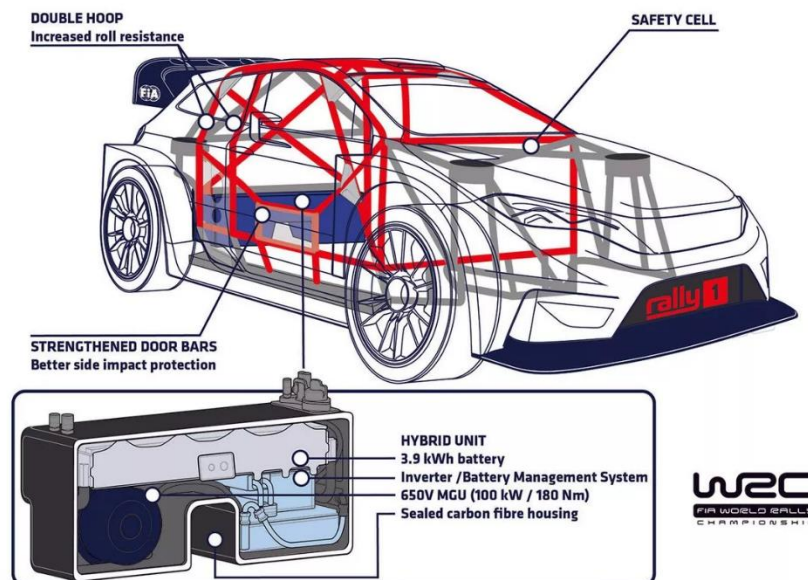
One benefit of the new hybrid system is the ability to use it in all Electric mode, which allows the cars to travel up to 20km on battery power alone. when in ev mode the maximum output of the battery is limited to 50% to increase the battery life. (WRC, 2021) To maximise the Environmental impact of this feature the competitors must only run on electric power when driving in and around the service park.(Howard tom, 2023). As well as in the Hev zones outside the service park. Although these zones have been criticised by many as they are currently very limited in mileage, as demonstrated on the 2022 rally monte Carlo where the Hev zone was calculated to be only around 0.3% of the total rally route(Toma Sebastian, 2022). Although the batteries can travel much further. The WRC has also stated that the battery will be recharged using only green electric power.(WRC, 2021). While the internal combustion engine will run on a 100 per cent sustainable fuel. Which is a first for any of the FIA (Fédération Internationale de l'Automobile) world championships. (Toyota GR YARIS Rally1 Ready for The WRC Hybrid Revolution | Journal Online, 2022). The new fuel is manufactured by P1 fuel and is created by mixing biofuel made from plants and e-Fuel which is created using synthesized hydrogen and carbon dioxide. (Hyundai motorsport team, 2023) . As outlined in the FIA net- zero plan the service park is also run on only green energy. Although not all the countries on the WRC calendar has the technology to provide green energy, the WRC has overcome this by using generator run only of bio- diesel and are hoping to take this a step further in the future by using hydrogen cell generators with the aim to send any surplus energy back into the local grid.

3.2 Performance impact

One of the biggest changes since the introduction of the hybrid system is the increase in performance. The cars use the same turbocharged 1.6 litre 4-cylinder engine which produce 380 horsepower, but with the introduction of the hybrid system in 2022 the competitors are able to utilise an extra 100 kW from the electric motor, which briefly brings the total output of the car to over 500 horsepower.

(Hybrid system for the WRC | Schaeffler Group, 2022). Making them the most powerful cars since the 1980s group B era. Unlike the button operated hybrid boost used in F1 the WRC system is operated via the pedal only, meaning the amount of electric power is dependent on how much throttle is applied by the driver. At the start of a stage the cars will switch into stage start mode. This gives the driver the full 1000 KJ available from the battery. This boost is available for around 10 seconds after the cars have left the start or until the driver lets off the throttle or applies the brakes. Once the boost has been used the driver must perform a valid regen. This is done using the regenerative braking system where energy is harvested under braking or by letting off the throttle. If the driver fails to regen enough energy, they will not have the benefit of additional boost. Additionally, the maximum amount of energy recovery is limited to 30Kw no matter how much braking force is applied. Once the driver has performed a valid regen they will have an extra 100kw when they apply the accelerator.(WRC, 2021) The way in which the 100kw is deployed is decided by one of three maps homologated by the FIA and is dependant of the length and surface type of the special stage.(Bertram Simon, 2022) This ensures that the power boost is deployed in the safest way possible whilst also ensuring that all the competitors have equal performance.

Figure 1 image of rally 1 safety cell and hybrid unit



(FIA. (2020) WRC car detail. Available at: <https://www.motorsport.com/wrc/news/hyundai-toyota-m-sport-hybrid/6004350/> (Accessed: 19/11/23)

3.3 new safety features

3.3.1 safety cell

One main area of improvement in the new 2022 regulations was safety. This is all thanks to the introduction of the rally one safety cell, unlike previous generation of WRC cars which used a more traditional roll cage. The safety cell is a space frame design which also makes up part of the chassis on the 2022 cars, whilst retaining as much of the production cars original body panel in efforts to keep costs down. (Hyundai motorsport team, 2023). The results from the crash testing show a 51% improvement on side on impacts, 70 % impact increase in a frontal impact, 38% improvement in a rear impact. As part of the test, they also simulated a barrel roll with the results showing a 115% increase in energy absorption over a traditional roll cage. (WRC, 2021)

3.3.2 Hybrid system safety measures

The hybrid unit is one particular area the WRC has focused on when coming to safety. With the unit being able to withstand impacts of 70g in both acceleration and deceleration through all 6 axis of motion. This is thanks to the unit being located in the base of the roll cage at the centre of the car whilst also being encased in a strong carbon fibre shell. With the battery being able to produce 750 volts additional safety measures had to be put in place to ensure the safety of the mechanics and drivers when working on the car as well as spectators as often they help out when recovering vehicles if a vehicle leaves the road mid stage. To combat this all cars are insulated with a sock capable of blocking up to 1000 volts. As well as introducing a new traffic light system on the side of the car indicating the status of the battery. Green being safe and red or unilluminated being dangerous. (Hyundai motorsport team, 2023)

Figure 2 image showing the battery status indicator.



(WRC.(2022) E-Safety . Available at: <https://sectorallyfinland.fi/en/e-safety/> (Accessed: 19/11/23)

4 Conclusion

To conclude I believe that the changes brought forward in 2022 have had a positive impact on the sport. Firstly, by taking the existing cars and making them more environmentally friendly ensures the sport keeps all the exciting aspects that the fans love while ensuring the sport has a sustainable future whilst also adding a new exciting dynamic. I also believe that the advancements in both hybrid and fuel technology will be beneficial to other forms of motor sport as well as the wider automotive industry.

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