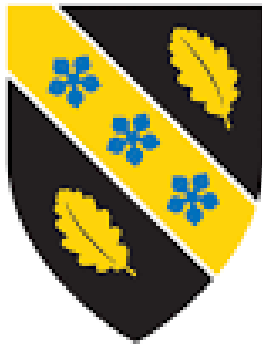


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Prifysgol Cymru

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The Future of Motorsport

Academic Skills (*ACHA4005*)

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1. Introduction

Electric vehicles have become increasingly popular. Tesla and other big car manufacturers like Audi, Porsche and Volkswagen are now producing vehicles that don't use the typical internal combustion engine (ICE). It is important to understand concepts for future systems because the world of Motorsport never stands still and is always looking to improve, become faster and find more efficient ways of working. This investigation will look at what is the best source of power for high performance racing cars. It will also look at the attitude of the main governing body's towards this innovative technology because they determine the regulations and what technology is used on the vehicles. Motorsport has led the way by introducing groundbreaking innovations. Understanding this technology is important because it gives an advantage over competitors. The report will explain how the technology works and what are the advantages and disadvantages of both. It will also look at the alternatives to both petrol and electric.

2. Background

Nikolaus Otto invented the four-stroke cycle Internal Combustion engine in 1876. This invention is still the same concept used in modern engines today. “His concept of compressing the fuel mixture before ignition, a critical advancement in engine efficiency and power, remains a core principle in today’s gasoline engines (James Hardy, 2024).” This groundbreaking concept has been developed to give the maximum performance with the lowest wear possible. High-performance engines can rev to over 10,000rpm giving vast amounts of torque and acceleration. Vehicles have been able to run in extreme conditions. They have also been able to run for extended periods of time without overheating or breaking down showing the versatility of his design. Most race cars use v6 or v8 engines showing the versatility of Otto’s design. Old F1 cars used v12, v10 and v8 engines before they now run on the hybrid v6 turbo. All these engines use the principles set out in Nikolaus Otto’s concept.

In 1893 Rudolf Diesel adapted the four-stroke cycle to run on diesel instead of petrol. This gave different advantages to Otto’s design while keeping most of the concept the same. Diesel engines are more efficient and produce more torque at lower revs compared to petrol engines. While petrol engines require a spark plug to ignite the fuel and air mixture, diesel engines use spontaneous combustion to ignite the fuel, injecting it straight into the combustion chamber at correct time. “Diesel’s engine also boasted higher thermal efficiency compared to petrol engines of the time. This higher efficiency translated to better fuel economy and made diesel engines particularly suitable for long-haul transportation and heavy-duty applications. (James Hardy, 2024).” Although diesel engines are not commonly used in motorsport, when the engineers get the formula right, they can produce some quick cars. The advantages for long haul operation were shown in the Le Mans winning Audi R18 which used a turbo charged diesel. To win the 24hrs of Le Mans the vehicle must run at near maximum performance for around 5000km over a 24-hour period. This shows that diesel engines have been developed and improved just like petrol engines.

In 1954 Felix Wankel developed the rotary or wankel engine. His concept uses a rotor instead of a piston. The rotor is located inside a stator housing. The special shape of the rotor and stator housing create chambers that allow the fuel and air mixture to be drawn in, compressed, ignited and forced out all at the same time. A spark plug ignites the fuel like in a petrol engine. Wankel engine’s still uses the 4 strokes set out in Otto’s concept however it has fewer moving parts which produced less torsional vibrations and therefore gives a smoother operation. Less repairs are needed because of the less moving parts. Although less repairs are needed the oil seals and rotor can wear out. When this happens, it is more expensive and time consuming to fix. In motorsport wankel engines have been the heart of some very successfully cars. The Mazda 787B that competed and won the 1991 Le Mans used the wankel engines. The Mazda RX7 Group B rally car used a twin-rotor engine.

EVs are not a new phenomenon. Back in the 1888s an EV called the Flocken Elektrowagen was invented by Andreas Flocken. This was only 3 years after the first automobile was invented. These became more popular than the design using otto’s concept. EVs were easier to operate and didn’t require cold starts. The ease for operation meant they outperformed their competitors. They produce maximum torque at 0 RPM giving them incredible acceleration. They

can also provide smooth uptake of power. Some EVs are lighter than petrol or diesel vehicles. They are more efficient meaning less energy is wasted. EVs can also perform better in some extreme conditions such as at high altitude. On a conventional vehicle at high altitudes the engine will begin to suffocate. EVs on the other hand have no engine and can operate easily at high altitudes. EVs also have a lower centre of gravity. With the developments to the internal combustion engine, it became more efficient. Petrol and diesel cars could travel further than EVs. They could also travel faster than EVs. This led to the technology being left behind.

3. Discussion

In more recent years most, series use a hybrid power system. F1 uses a “1.6-litre, V6 turbocharged hybrid internal combustion engine – already the most efficient engine in the world. (Lawrence Barretto, 2024)”. IndyCar uses a similar engine. Hybrid gives the advantages of EVs while keeping the superiority of the Internal combustion Engine. “NASCAR isn’t the place you’d expect to find a new electric vehicle make its debut. (Chris Morris, 2024).” NASCAR race on oval circuits and require the cars to refuel 3 or 4 times a race. Fully EV cars do not yet have the range to complete a full race. However, NASCAR have created a prototype EV car. This was pushed by manufacturers but since the fall of Tesla stock and overall EVs becoming more expensive they now seem to have little interest in this avenue. NASCAR have also stated, ““There’s no plans right now to have a series that’s electric,” Probst said. “But I will also say I learned a long time ago you never say ‘never’ or ‘always,’ so that’s a good life lesson.”(Zach Sturniolo, 2024).” As things stand at the moment, EVs desirable for most series but that doesn’t mean that governing body’s like NASCAR and the FIA won’t continue to develop this technology. NASCAR have also said that if they used Electric it would be as a hybrid rather than a full EV.

Full EVs are suited better to short hill climbs and drag racing. EVs can use a lot of its power all in one go. They also have an acceleration that is unparalleled. As mentioned in the research EVs can have maximum torque at 0 RPM. While traveling uphill using an internal combustion engine a lower gear is selected to increase torque however this also decreases the maximum speed. The McMurtry that won Goodwood is a good example that EVs are better suited to hill climbs. In 2022 the electric powered car broke the record in a blistering 39.08 seconds.



Figure 1 - McMurtry Spéirling sets OUTRIGHT HILLCLIMB RECORD at Goodwood Festival of Speed (McMurtry Automotive, 2022)

Diesels and petrol-powered vehicles are still superior when it comes to long distance endurance racing. However, the Le Mans 24-hours all use vehicles that have hybrid power. The acceleration from the electric and the top speed of internal combustion improves the overall performance. Hybrid systems can use kinetic energy recovery systems or KERS for short. This turns the motor into a generator and allows the high voltage battery to be recharged while braking on corner entry. The energy is ready to deploy on corner exit, increasing acceleration.

Internal combustion engines could run on a sort of synthetic fuel that operates the same as petrol or diesel. This would allow the same technology to be used while adhering to the environmental guidelines. F1 is looking into synthetic fuels for 2026. The push for synthetic fuels decreases the popularity of electric vehicles. Many of the vehicles used in motorsport are powered by the internal combustion engine or use hybrid power. Creating synthetic fuels doesn't necessarily improve performance but it allows the performance of current petrol and diesel vehicles to be maintained. The diesel engine was adapted from the petrol engine; maybe the current internal combustion engines could be adapted to better suit synthetic fuels. This could result in a low carbon footprint and be environmentally friendly while still giving the roar of the engine that fans love in motorsport. Rotary engines use the same concept of the four-stroke cycle in a different design. Perhaps synthetic fuels will lead to an innovation that creates a similar development. Synthetic fuels will also be able to work in partnership using the hybrid system.

4. Conclusions

In conclusion I think that EVs have a place in motorsport. The acceleration and torque produced are too big of an advantage to overlook. However, I do not think that electric is entirely the way forward. They do not have the range or capacity to race full speed for 4 or 5 hours. In endurance racing it is very difficult to be competitive using electric vehicles. Hybrid power provides an alternative to pure EVs and internal combustion. It takes the best from each and creates something incredibly quick. Oval Circuits like the ones NASCAR races on may benefit from hybrid technology because they can keep the advantages without the disadvantages. They could charge up the battery between stages or on cautions. The acceleration would improve starts and restarts giving you a better chance in the race. You could also use the hybrid system to save fuel and open different strategies.

Synthetic fuels look like a good way of keeping environmental emissions to a minimum while still producing the same power as petrol and diesel. If governments and governing body's don't allow the continuation of petrol and diesel, synthetic fuels might save the internal combustion engine. The only reason I can find for not using petrol and diesel is because of the limited advantages of electric and the restrictions placed because of the environment.

5. References

- Chris Morris, 2024. NASCAR rolls out its first electric car | Fortune [WWW Document]. URL <https://fortune.com/2024/07/08/nascar-unveils-electric-car/> (accessed 11.12.24).
- James Hardy, 2024. Fueling Innovation: Discovering Who Invented the Internal Combustion Engine | History Cooperative [WWW Document]. URL <https://historycooperative.org/who-invented-the-internal-combustion-engine/> (accessed 11.14.24).
- Lawrence Barretto, 2024. 2026 F1 power unit regulations explained: More electrical power, more overtaking aids and more sustainable – get the inside scoop on the 2026 power unit regulations | Formula 1® [WWW Document]. URL <https://www.formula1.com/en/latest/article/explained-2026-power-unit-regulations-fia.68izKQ2tn1voQPWvgLVMXN> (accessed 11.15.24).
- McMurtry Automotive, 2022. McMurtry Spéirling sets OUTRIGHT HILLCLIMB RECORD at Goodwood Festival of Speed - McMurtry Automotive [WWW Document]. URL <https://mcmurtry.com/mcmurtry-speirling-sets-outright-hillclimb-record-at-goodwood-festival-of-speed/> (accessed 11.15.24).
- Zach Sturniolo, 2024. Inside NASCAR's first foray into electrification | NASCAR [WWW Document]. URL <https://www.nascar.com/news-media/2024/07/10/inside-nascar-first-foray-electrification-ev-vehicle/> (accessed 11.12.24).